Document Number: EDS 07-3102

Version: 6.0

Date: 27/11/2025

ENGINEERING DESIGN STANDARD

EDS 07-3102

SECONDARY SUBSTATION CIVIL DESIGN

Network(s): EPN, LPN, SPN

Summary: This standard details the civil design requirements for secondary substations. It includes specific requirements for GRP enclosures, brick-built, integral and basement substations.

Author: Tim Mitchell **Date:** 27/11/2025

Approver: Paul Williams **Date:** 01/12/2025

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 version.

Applicable To:

UK Power Networks

☒	Asset Management	☐	Information Systems
☒	Capital Programme	☐	Innovation
☒	Connections	☐	Legal
☐	Customer Services	☒	Network Operations
☐	DSO	☐	Procurement
☐	Finance / Income Management	☐	Strategy & Regulation
☒	Health & Safety	☒	Technical Training

External

☒	G81 Website	☒	Contractors
☒	ICPs/IDNOs	☐	Meter Operators

THIS IS AN UNCONTROLLED DOCUMENT, THE READER MUST CONFIRM ITS VALIDITY BEFORE USE

Revision Record

Version	6.0	**Review Date**	27/11/2030
Date	27/11/2025	**Author**	Tim Mitchell

Reason for update: Major update to comply with latest standards and best practices.

What has changed:

- General formatting update to tabulate requirements.
- Section 2: Clarification on application of standard to existing sites.
- Section 4: New general requirements for approved materials, design considerations, asset life. Update to CDM regulations guidance and types of secondary substation.
- Section 5.1.3: Equipment access routes update including size of lorry loaders and restrictions on areas to unload equipment.
- Section 5.1.4: Update for generator cable access provisions.
- Section 5.2: Operational clearances update including specific requirements for substation types and Ring Main Units. Inclusion of clearance diagrams.
- Section 5.3: Clarification on positioning of Ring Main Units and Remote Terminal Units.
- Section 5.4: Foundation requirements updated to include ground preparation, use of precast concrete bases, requirements for cast insitu concrete and earthing mesh.
- Section 5.5: Update to highlight restriction on use of perforated and engineering bricks and provision of horizontal bed reinforcement for stretcher bond walls.
- Section 5.7: Updated requirements for louvre doors and fire rated doors.
- Section 5.8: Clarification on internal and external finishes to substation buildings.
- Section 5.10: Cable duct requirements update to include need for end caps and pipe bungs as well as installation of approved duct sealing system.
- Section 5.11: Removal of requirement to sand blind cable trenches where cable entries are sealed against water and gas ingress.
- Section 5.12: GRP grating requirements updated.
- Section 5.13: Ventilation requirements update including specific requirements for substation types and for louvred vents and ventilation ducts.
- Section 5.16: Clarification on SCADA systems to be used within substations.
- Section 5.18: Requirements updated for substation waterproofing.
- Section 6.1: Freestanding brick-built substation requirements updated for intake rooms and green roofs.
- Section 6.2: GRP Substation requirements update to include consideration for fire, flood, orientation and oil containment. Inclusion of specific requirements for precast concrete bases and cast insitu concrete bases.
- Section 6.3: Integral substation requirements updated for location, building fabric, noise and vibration.
- Section 6.4: Basement substation requirements updated for fire resistance, building fabric, vibration, equipment access hatch and cavity drainage.
- Section 7: Requirements within EDS 07-3103 for secondary substation fences merged into this document.
- Section 8: Refences updated.
- Appendix A: Inclusion of new drawings for distribution transformer plinths
- Appendix A: Basement standard drawing merged into single drawing EDS 07-3102_31
- Appendix B: All standard drawings updated, see drawing revision history
- Appendix C: Inclusion of standard brickwork construction details

Version	5.5	**Review Date**	31/12/2025
Date	01/09/2025	**Author**	Tim Mitchell

Reason for update: Minor update to standard drawing EDS 07-3102_13.

What has changed: Note updates and earth ring amendment to standard drawing EDS 07-3102_13.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Version	5.4	**Review Date**	31/12/2025
Date	30/07/2025	**Author**	Tim Mitchell
Reason for update: Inclusion of new standard drawing for DERMS substations. **What has changed:** • Section 5.3: Requirements for positioning of ring main units and remote terminal units included. • Appendix A: New standard drawing (EDS 07-3102_13) added for freestanding brick-built substation for metered ring main unit with DERMS equipment.			
Version	5.3	**Review Date**	26/09/2025
Date	27/01/2025	**Author**	Tim Mitchell
Reason for update: Periodic review **What has changed:** No content changes, review date extended six months to allow further review and update.			
Version	5.2	**Review Date**	05/03/2025
Date	05/03/2024	**Author**	Stephen Tucker
Reason for update: Periodic review **What has changed:** Review date extended for one year to allow further time for a full review.			
Version	5.1	**Review Date**	31/03/2024
Date	22/02/2023	**Author**	Stephen Tucker
Reason for update: Updated plinth drawing. **What has changed:** • Section 5.14: HOT site replaced with separate HV/LV earths. • Appendix A & Appendix B: LV pillar drawing EDS 07-3102.50 updated. • Appendix A & Appendix B: Firewall drawing EDS 07-3102.60 added. • Review date extended to Q1 2024 to allow further time for a full review.			
Version	5.0	**Review Date**	30/09/2023
Date	15/11/2022	**Author**	Stephen Tucker
Reason for update: New plinth drawing. **What has changed:** Appendix A & Appendix B: RTU plinth drawing EDS 07-3102.51 added.			

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Version	4.0	**Review Date**	30/09/2023
Date	22/09/2022	**Author**	Uriel Arias
Reason for update: Periodic review. **What has changed:** No content changes, review date extended one year pending further update.			
Version	3.1	**Review Date**	26/10/2022
Date	07/07/2021	**Author**	Uriel Arias
Reason for update: Transformer plinth drawing updated. **What has changed:** Appendix B: EDS 07-3102.44 drawing updated to allow for new Toshiba transformer.			
Version	3.0	**Review Date**	26/10/2022
Date	13/08/2018	**Author**	Uriel Arias
Reason for update: Use of 1500kVA transformer extended to GRP, Integral and Basement substations. Drawings changes and introductions. **What has changed:** • Section 6.1.3: LV Generator cables access requirement added. • Section 6.14: Area requirement for ventilation system revised. • Appendix A & Appendix B: Drawing registers updated. Main drawing changes detailed below. o Introduction of new 3+1 bi-fold door for use at freestanding brick-built and integral sites. o Anti-vibration pads use specified for 500kVA transformers and above. o GRP enclosure vents size increased for 1500kVA transformers. o New freestanding brick-built and integral substations for single/double metering RMUs. o New basement substation for a 1500kVA transformer.			
Version	2.0	**Review Date**	18/08/2022
Date	05/01/2018	**Author**	Uriel Arias
Reason for change: updated re business feedback **What was changed:** • Section 6.3: Use of anti-vibration pads clarified. • Section 6.14: Ventilation requirement revised to allow the use of 1.5MVA transformer. • Section 6.15: Lighting and earthing references updated. • Section 6.16: Use of perimeter earthing ring for all freestanding brick-built substations clarified. • Section 6.17: SCADA and Communications section added. • Appendix A: Drawing list revised. • Appendix B: Drawing revision history introduced.			
Version	1.0	**Review Date**	18/08/2022
Date	09/08/2017	**Author**	Uriel Arias
New document for secondary substation civil design. Document supersedes EDS 07-0102			

NOT APPROVAL

© UK Power Networks 2025 All rights reserved

Contents

1 Introduction 7
2 Scope 7
3 Glossary and Abbreviations 8
4 General Requirements 9
4.1 Design 9
4.2 Materials 9
4.3 Asset Life 9
4.4 Substation Types 10
5 Technical Requirements 11
5.1 Access 11
5.2 Operational Clearances 13
5.3 Equipment 16
5.4 Foundations 16
5.5 Masonry 19
5.6 Lintels 20
5.7 Doors and Accessories 20
5.8 Finishes 22
5.9 Cables 23
5.10 Ducts 24
5.11 Cable Trenches 25
5.12 GRP Gratings 25
5.13 Ventilation 26
5.14 Electrical Services 29
5.15 Earthing 30
5.16 SCADA and Communications 30
5.17 Signage 30
5.18 Waterproofing 31
5.19 Future Works 31
5.20 Records 31
6 Specific Substation Requirements 32
6.1 Freestanding Brick-built Substations 32
6.2 GRP Substations 33
6.3 Integral Substations 35
6.4 Basement Substations 35
6.5 Outdoor Padmount 39
6.6 Fenced and Open Walled Substations 39

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

7 Fencing for Secondary Substations 40
7.1 Risk Assessment 40
7.2 Design Considerations 40
7.3 Fencing Specification 41
8 References 45
8.1 UK Power Networks Standards 45
8.2 National and International Standards 45
Appendix A – Drawings List 47
Appendix B – Drawing Revision History 48
Appendix C – Freestanding Substation Brickwork Construction Options 49

Tables

Table 5-1 – Requirements for Equipment Access Routes 12
Table 5-2 – Foundation Requirements for Secondary Substations 17
Table 5-3 – Earthing Mesh Requirements 18
Table 5-4 – Masonry Construction Requirements 19
Table 5-5 – Louvre Door Requirements 21
Table 5-6 – Fire Rated Door Requirements 22
Table 5-7 – Steel duct requirements 25
Table 5-8 – GRP Grating Requirements 26
Table 5-9 – Ventilation Requirements for Freestanding and Integral Substations 27
Table 5-10 – Ventilation Requirements for Basement Substations 28
Table 5-11 – Louvred Vent and Door Requirements 28
Table 6-1 – Freestanding Substation Roof Requirements 32
Table 6-2 – Equipment Access Hatch Requirements 36
Table 7-1 – ESQCR Ratings for Fence Selection 40
Table 7-2 – Fence Post Specification 42
Table 7-3 – Close Boarded Fence Panel Specification 42
Table 7-4 – Timber Gate Requirements 43
Table 7-5 – Steel Mesh Gate Specification 44

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

1 Introduction

This standard details the civil engineering requirements for secondary distribution substations and customer substations metered at HV or LV and includes:

- General requirements for all substations.
- Technical requirements for all substations
- Specific requirements applicable to each substation type.
- Fencing for secondary substations.

This standard shall be read after confirming the pre-design requirements outlined in standard document EDS 07-3101.

Refer to Appendix A for a list of standard substation drawings.

Compliance

This standard is applicable from 1 March 2026. It may be applied from the date of publication, but the previous version may also be used for Connection projects quoted prior to this date.

All fire safety requirements, equipment positioning and equipment clearances shall be applied from the date of publication.

2 Scope

This standard covers the civil design and construction requirements for new 11kV and 6.6kV secondary substations for use in UK Power Networks LPN, EPN and SPN network areas.

This standard also applies to the upgrade and alteration of existing secondary substations which shall be assessed using the requirements in this standard. Non-conformances shall be submitted to UK Power Networks Asset Management for review.

This standard is intended for use by both UK Power Networks and customers.

This document does not define responsibilities of stakeholders. This should be discussed with or defined by the corresponding UK Power Networks directorate making use of the standard.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

3 Glossary and Abbreviations

Term	Definition
ACB	Air Circuit Breaker
CDM	Construction (Design and Management) Regulations
DPC	Damp Proof Course
DTp1	DTp1, also known as Type 1 aggregate, is a granular material made from crushed rock that's used as a sub-base layer for construction projects
EML	Expanded Metal Lathing. A mesh reinforcement used in brickwork construction.
ESQCR	Electricity Safety, Quality and Continuity Regulations.
Free Area	The geometric open area of a ventilation louvre, which is provided by the gap in the louvre blades.
GRP	Glass Reinforced Plastic
HV	Voltages above 1000V; generally used to describe 11kV or 6.6kV distribution systems but may include higher or other legacy voltages
LV	Voltages up to 1000V; generally used to describe 230/400V or 230/460V distribution systems
RC	Reinforced Concrete
RMU	Ring Main Unit
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
SF_6	Sulphur Hexafluoride (gas used as a dielectric and insulating material in switchgear).
Secondary Substation	Substation connected to a secondary distribution network that supplies an LV network and/or directly supplies a customer or customers at either LV or HV
Substation	Substation is used throughout this document to refer to a ‘secondary substation’
SWL	Safe Working Load
UK Power Networks	UK Power Networks (Operations) Ltd consists of three electricity distribution networks: • Eastern Power Networks plc (EPN). • London Power Network plc (LPN). • South Eastern Power Networks plc (SPN).

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

4 General Requirements

4.1 Design

Substation designs shall comply with current national and international standards and local legal requirements. Where the requirements of UK Power Networks exceed those of the Building Regulations or Local Authority, then UK Power Networks specifications shall be adopted.

Whilst it is appreciated that third party site specific considerations may influence the design, the requirements outlined in this document shall be incorporated.

The equipment layout and specification within any substation is the exclusive responsibility of UK Power Networks. As not all site-specific situations can be covered, the designs shall be checked to be sustainable, safe and secure in and around the substation environment. A written agreement shall be obtained for any deviation from the guidelines given in this document.

The design shall be capable of withstanding the electrical, mechanical, climatic and environmental influences anticipated at the site and shall consider the following:

- Purpose of the installation.
- User requirements such as power quality, reliability and availability.
- Safety of the operators and the public.
- Environmental influence.
- Maintenance and the possibility for future extension.

The design shall comply with the CDM Regulations 2015, health and safety legislation and shall be safe to be constructed, operated and maintained. In accordance with the CDM Regulations 2015 and EDS 00-0002, a hazard elimination and management list (HEML) shall be produced for every new substation design or upgrade to an existing substation. This list shall be populated at the start and throughout the project to identify and mitigate any residual risk. Generic and site-specific hazard risk assessments shall be completed and included in the CDM documentation for the substation.

4.2 Materials

Secondary substations shall be constructed from approved materials as detailed on the relevant EDS 07-3102 drawings (listed in Appendix A) or the civil material list EAS 07-0000. Third-party developers may use equivalent products subject to prior approval by UK Power Networks.

Only approved equipment from the relevant material list can be installed in a secondary substation. Alternative products shall comply with the relevant UK Power Networks specifications and standards. Refer to EDS 08-1150 for the process for the approval of new equipment and materials.

4.3 Asset Life

Civil and building infrastructure shall be designed to meet the functional requirements of the works for a minimum design life of 40 years. Where UK Power Networks are to adopt the civil and building structures then life to first maintenance shall not be less than 20 years and the design and construction detail shall be such that ongoing maintenance is minimised.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

4.4 Substation Types

Secondary substations shall be selected in accordance with the criteria detailed in EDS 07-3101 where location, land/legal rights and risk assessment considerations are outlined.

Secondary substation types include:

- Freestanding brick-built substation, which is the preferred UK Power Networks type.
- GRP substation.
- Integral substation.
- Basement substation.
- Outdoor padmount, (micro or compact)
- Fenced or open walled substation. Restrictions for use apply, in accordance with EDS 07-3101. Refer to Section 7 for fenced substation design requirements.

Substations containing one transformer are classified as a ‘single’ substation whereas a substation containing two transformers is a ‘two-transformer’ substation. UK Power Networks substations shall contain a maximum of two transformers. If the electrical load requirements require three or more transformers, a combination of ‘single’ and ‘two- transformer’ substations shall be used.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

5 Technical Requirements

The following technical requirements apply to all substation types, unless noted otherwise. For specific requirements relating to the individual substation types, refer to Section 6.

5.1 Access

Unrestricted access to UK Power Networks substations and equipment shall be provided at all times to ensure supplies can be restored to customers in the event of a fault. For this reason, access via security staff or by prior arrangement is not acceptable.

5.1.1 Access Around Substation

Ground level substations shall be provided with external minimum clearances to all sides in accordance with EDS 07-3101 and the relevant standard drawings. This is required for access, maintenance and ventilation. The clear zones outside of the substation shall be formed of a suitable hard standing with underlying weed control membrane (e.g. Terram Weedguard or equivalent). Where impermeable hard standing is used the falls shall direct surface water run-off away from the substation and any nearby buildings.

Where new substations are to be disguised using planting schemes, the substation design shall ensure that the proximity and type of planting will not compromise future access, obstruct ventilation louvres (if not maintained) or allow planting or tree roots to interfere with foundations, cables and cable routes.

5.1.2 Personnel Access and Locking Arrangements

Access into substations shall use UK Power Networks standard key locking to the following requirements:

- Access shall be via ground level doors, that open safely from the edge of the public footpath.
- If the substation is located behind additional locked gates or doors, these shall be locked using the standard UK Power Networks master locking suite. Lock cases provided by third parties shall be capable of accepting standard UK Power Networks cylinders. Hasp and staples locks shall be capable of receiving UK Power Networks standard heavy-duty padlock.
- Where substations are within gated developments or high security compounds with controlled access via electronic key fob or other electronic locking mechanism, then a key switch override facility shall be provided by the customer and operated by the UK Power Networks master key. All electrically operated gates/doors shall be set to failsafe into the open position to permit access in the event of loss of electrical supply.
- Where access to substation doors is likely to be compromised by parking vehicles, preventive measures should be installed, ideally in the form of fixed or removable bollards or barriers. Alternatively, protection may be afforded by the creation of a locally raised kerb (220mm high) in front of the doors. Raised kerbs shall extend beyond the width of the substation.
- Access doors within buildings that have a shared access route to the substation may be fitted with a special dual cylinder mortise deadlock case, this is designed to accept two Euro Profile (or Scandinavian) cylinders fitted with a thumb-turn, one provided for UK Power Networks use and one for the customer, the operation of either cylinder shall open the lock.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

5.1.3 Access Route for Equipment

A lorry loader vehicle with a hydraulic mounted crane is normally used to deliver large items of equipment to the substation. The requirements listed in Table 5-1 shall be provided for equipment delivery. Further information on delivery vehicles can be obtained from UK Power Networks Logistics.

Table 5-1 – Requirements for Equipment Access Routes

Requirement	Details
Access for Lorry Loaders	The weight of the fully loaded vehicle can be up to 32 tonnes, with individual items of equipment of up to 5000kg. The lorry loaders are a maximum of 12.5m long, 2.6m wide and 4.7m high. The width increases to 6.2m with outriggers fully extended. The roadway providing access to the substation shall be capable of sustaining the axle weight of the lorry in transit whilst undertaking unloading activities and as such should be essentially level (gradient shall be no steeper than 1:10) and with room to deploy outriggers. The access route should not be via a 'traffic sensitive' area likely to cause difficulties if substation equipment needs to be replaced. For rural locations a permanent access road shall be provided. The requirements permanent access roads are given within EDS 07-4055.
Crane Operation	The minimum clear headroom from ground level to the top of the crane arm for off-loading and manoeuvring is 6.5m, if lifting equipment over fences or other type of obstacle, an allowance for the additional height of the obstruction shall also be considered.
Equipment Drop Zones	Equipment shall be off-loaded directly onto the corresponding plinth or as close to substation doors as possible to minimise the need for manual handling. Equipment drop zones remote from the substation location should not be more than 10m from the substation doors; any deviations shall be discussed and agreed by all parties involved in the project. The area between the equipment drop zone and the substation shall be flat and level or laid to nominal falls only.
Equipment Access Route	The route between the equipment drop zone and the substation shall be as direct as possible and shall be capable of sustaining the combined load of equipment being installed in the substation. Routes that involve the manual manoeuvring of equipment shall be avoided. Corridors on the equipment access route shall be a minimum of 2m wide generally with pinch points not less than 1.5m and provide a minimum clear height of 2.5m. If equipment needs to be rotated along the equipment access route, a 2.5m x 2.5m clear area shall be provided. Where required, the stability of the equipment access route should be confirmed as part of the design submission.
Future Access	It is important to note that the minimum clear dimensions for moving of equipment shall be maintained throughout the life of the substation and shall not be compromised by the future installation of pipework, tray-work or similar. Future equipment replacement as well as initial equipment installation shall be considered as part of the design. If a fault develops it will be necessary to exchange the equipment safely, quickly and with the minimum disruption to the site.
Restrictions	Equipment shall **not** be offloaded adjacent to slope crests or retaining walls unless this has been assessed by the designer and suitable mitigation is in place.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

5.1.4 Access for Generator Cables

All substations shall include a safe and secure generator cable access facility to allow the connection of a temporary generator during maintenance or repair activities.

The generator cable access facility shall be provided as follows:

- Brick-built and integral substations – a cable flap is provided within the approved louvre doors.
- GRP substations – a cable flap is provided in the sidewall of the approved GRP enclosure.
- Basement substations – an approved cable hatch shall be provided at a location agreed with UK Power Networks.

5.2 Operational Clearances

5.2.1 General Requirements

The substation design shall meet UK Power Networks operational requirements and the minimum dimensions, where quoted, shall be adhered to at all times.

The mandatory operation clearances are given below. In addition, it shall be possible to replace a faulty item of equipment with the other equipment in-situ.

It is mandatory that all persons switching within a substation should have a clear and direct route of escape through an outward opening door. Consideration shall be given to locating the equipment and equipment within the room relative to door positions to ensure a clear egress route.

5.2.2 Clearances Applicable to All Substations

- General access clearance around equipment should be at least 750mm for access and maintenance, unless stated otherwise.
- Minimum clearance for evacuation shall be 500mm, even when removable parts or open doors intrude into the escape routes. If relevant, the equipment doors should close in the direction of escape.
- The width of any personnel escape route between items of equipment shall not be less than 900mm.
- Clearances for RMU's within enclosed freestanding, integral or basement substations should be a minimum of 800mm to the sides and 1500mm to the rear. This is to achieve the minimum free air volume recommended by the manufacturer, which is required to vent blast fumes away from the front of the equipment. See Figure 5-1 for clearances to a standalone RMU.
- Where relevant, the distance between the front of an RMU and the front of an LV distribution board shall be a minimum of 1500mm clear.
- The maximum distance from the point of switching to the nearest escape door shall not exceed 5000mm, if this figure is exceeded or the layout of the room prevents clear and direct access to the door then an additional escape door shall be installed. Additional escape doors may also be specified at the designer's discretion if the substation is of an unusual shape.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

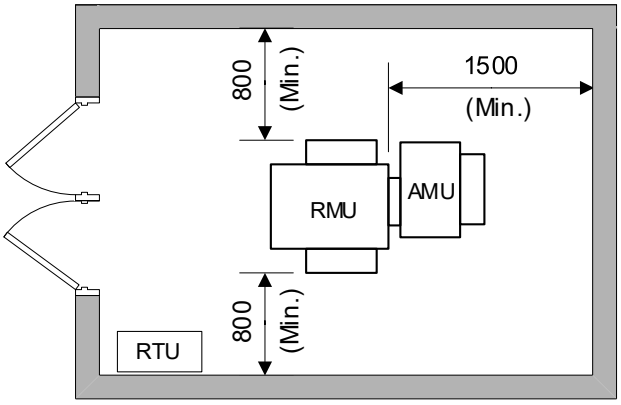


Figure 5-1 – Operational Clearances for Standalone Ring Main Units

5.2.3 GRP Substations

- Minimum clearance of 500mm along the side of high voltage switchgear (RMU) to wall of GRP enclosure[1]. If this is provided, the clearances to the rear and other side of equipment can be reduced to a minimum of 100mm. See Figure 5-2.
- When positioning equipment within GRP enclosures consideration should be given to location of RTUs, small power and lighting, vents and oil capture within the foundation.

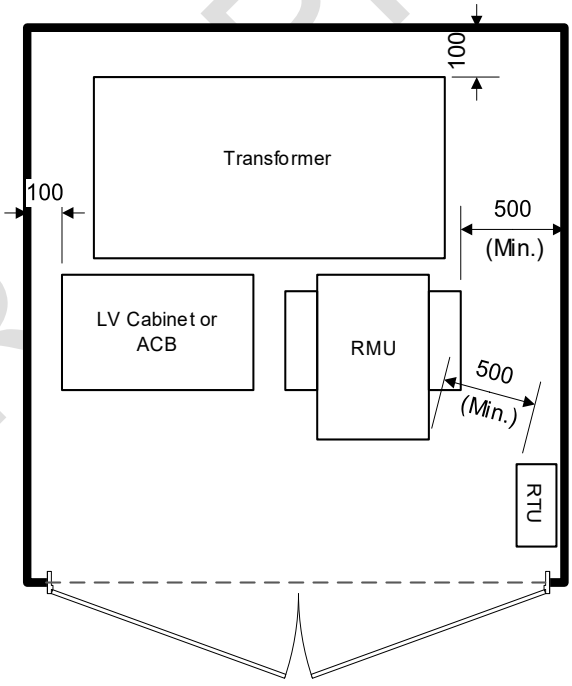


Figure 5-2 - GRP Substation Operational Clearances

[1] The clearances are reduced for GRP enclosures because there are more openings in the walls for ventilation and the roof is designed to 'lift' in the event of a fault.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

5.2.4 Freestanding and Integral Substations

- Minimum clearance of 800mm between RMU cable end box and adjacent wall. Minimum clearance of 600mm to the rear of transformers. Minimum ceiling height of 2500mm within substation room. See Figure 5-3.
- In front of a switch or LV board/cabinet where operational works are carried out, a passageway of minimum width 900mm should be maintained from the front of any opening access doors.

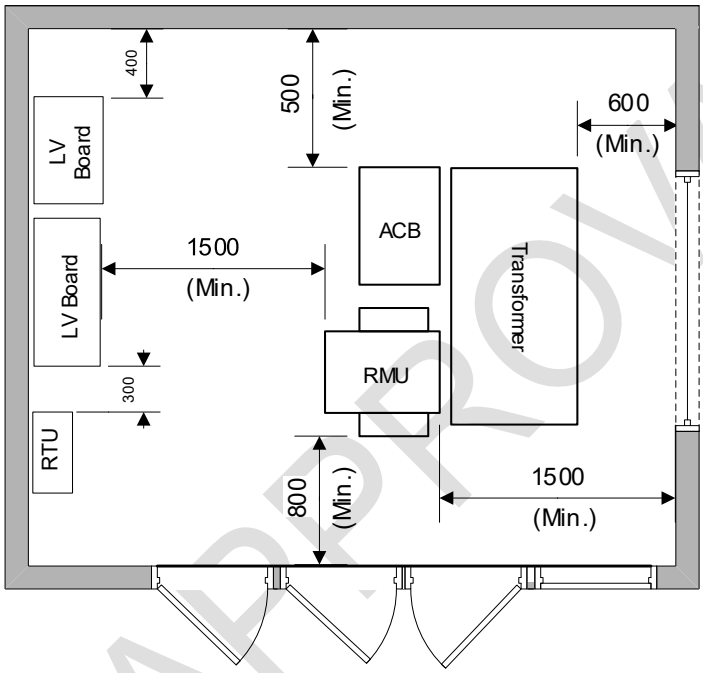


Figure 5-3 – Freestanding or Integral Substation Operational Clearances

5.2.5 Basement Substations

- Minimum clearance of 1000mm between RMU cable end box and adjacent wall. Minimum clearance of 600mm to the rear of transformers. Minimum ceiling height of 2800mm within substation room. See standard drawing EDS 07-3102_31.
- Equipment access route at ground level shall be a minimum of 2000mm wide. Personnel access stairs down to basement level shall be a minimum of 1200mm wide. Personnel stairs shall be in accordance with Building Regulations Approved Document M, Volume 2.
- Minimum clear working room around access hatches shall be 1000mm to all sides.
- Minimum 3200mm clear height from ground floor to underside of running beam.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

5.3 Equipment

5.3.1 General Requirements

The design shall meet UK Power Networks operational requirements. A standard ground-level single substation shall be designed to accommodate the following items of equipment fitted with bottom entry cable boxes:

- Transformer: typically supported on two 50mm wide x 1250mm long integral channels in contact with the floor at approximate 500mm centres.
- Transformer-mounted ring main unit (RMU), circuit-breaker or switch.
- Transformer-mounted LV cabinet or ACB (air circuit breaker).
- RTU (remote terminal unit), wall mounted for remote switching.

The substation shall accommodate all items of equipment as detailed on the electrical design. All new secondary substations shall be designed to withstand or safely relieve internal pressure due to a fault on the equipment.

Equipment shall be close-coupled rather than cable-connected wherever possible.

5.3.2 Equipment Positioning

RMUs shall be positioned such that, in the event of a fault, an operator would not be at risk from the internal arc blast from either the RMU or the cable boxes. No other substation equipment that requires operation or maintenance shall be positioned within the blast zone of the RMU. The blast zone is defined as the area to the rear and the sides of the RMU.

RTUs shall be positioned as close to the exit of the substation as possible and shall **not** be positioned to the sides or rear of the RMU.

To prevent transformer vibrations causing noise nuisance, wherever possible, substations shall be located a minimum of 10m from residential properties.

Equipment shall be positioned such that it does not block ventilation openings.

5.3.3 Equipment IP Rating

For outdoor substations, including GRP substations, all equipment shall be a minimum IP56 rated in accordance with BS EN 60529.

5.4 Foundations

5.4.1 General Requirements

The following foundation requirements apply to freestanding and GRP substations. Integral and basement substations should be designed to suit the specific needs of the site but should consider the requirements below as a minimum.

Cast insitu concrete, in accordance with Section 5.4.3, or approved precast concrete foundations, in accordance with Section 5.4.4 may be used.

Where site specific conditions dictate that foundation design shown on standard drawings is not suitable, the developers structural engineer shall produce a design to suit the site conditions. Full proposals should be provided to UK Power Networks for approval prior to construction.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

5.4.2 Ground Preparation

The existing ground shall be excavated down to the required level to allow installation of the foundations. Foundations shall be constructed on the following prepared layers (top down):

- 1200 gauge visqueen membrane (or equivalent), installed in accordance with manufacturers requirements.
- 50mm GEN1 blinding concrete.
- Minimum 150mm well compacted DTp1 material, unless noted otherwise.

Any soft spots or ground contaminants shall be removed and backfilled with DTp1 fill material (or similar approved), compacted in 150mm layers. The use of recycled aggregate, in accordance with the MCHW – Volume 1 – Specification for Highways Works Series 600, is preferred. Alternatively, a designated GEN1 concrete mix to BS 8500-2 may be used to backfill.

5.4.3 Cast Insitu Concrete Foundations

Foundations for secondary substations shall be formed of cast insitu reinforced concrete (RC), designed to suit local site conditions, with the characteristics in Table 5-2.

Table 5-2 – Foundation Requirements for Secondary Substations

Requirement	**Details**
Loading	Foundations shall sustain weight of equipment in any position (5500kg max).
Concrete Mix	RC32/40 concrete mix with maximum 20mm aggregate to BS 8500-2 shall be used unless otherwise specified by the designer. Minimum compressive strength of the concrete after 28 days shall be 40N/mm². A sulphate resistance cement combination to BS EN197-1:2011 shall be used unless otherwise specified by the designer. Concrete foundations shall be allowed to cure for a minimum of 7 days prior to landing equipment.
Steel Reinforcement	Steel reinforcing bars shall be strength grade B500B in accordance with BS 4449. Steel fabric (mesh) reinforcement shall be square mesh in accordance with BS 4483. A reinforcing bar bending schedule shall be produced to the structural engineer's design in accordance with BS 8666. Reinforcing bars shall be electrically continuous across the substation foundation reinforcement. Reinforcement design should indicate where welded or exothermic type connections are required.
Reinforcement Cover	50mm minimum cover to provide a 4-hour fire resistance. Additional cover to reinforcement shall be in accordance with BS 8500-1 for the chosen exposure class to suit local site conditions.
Blinding Concrete	Blinding concrete shall be designated concrete GEN1 in accordance with BS 8500-2.
Shuttering	All concrete cast above ground level, typically the top 150mm, shall be shuttered to provide a fair face finish.
Surface Finish	Top of all concrete works finished smooth and level within +/-2mm over 2000mm. Finished floor should be sufficiently hard to prevent chipping or crumbling.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Requirement	Details
Chamfered Edges	Sharp external edges above ground level shall have 25mm x 25mm chamfers.
Waterproofing	A proprietary bitumen based waterproof concrete sealer applied to all below ground external concrete surfaces prior to backfilling.
Joints and Seals	Where foundations are constructed immediately adjacent to other structures or foundations a 25mm expansion joint shall be installed formed of a compressible fillerboard topped with a polysulphide sealant. On fully bunded substations a hydrophilic water seal along the construction joint between kicker and concrete walls (e.g. Hydrotite CJ-0725 or similar) should be used.
Steps	Steps are not permitted within the substation.
Earth Bond Points	For GRP and freestanding substations earth bond points for reinforcement should be installed prior to casting the concrete.

5.4.4 Precast Concrete Foundations

Approved precast concrete foundations may be used for GRP substations, outdoor transformer installations or outdoor switchgear installations.

Precast bases offer improved efficiency for base installation, consistency of foundation construction and are supplied with cable ducts entries, earth bar and earth bond points pre-installed. The ground shall be suitably prepared prior to landing precast concrete base to ensure stability. All holes for dowel connections shall be made good following installation using a general-purpose non-shrink grout (e.g. Fosoc Conbextra GP or Sika 111 GP or equivalent).

For guidance on use, specification and installation of precast concrete bases refer to ECS 07-3005.

5.4.5 Earthing Mesh

For integral and basement substations, an earthing mesh shall be installed as shown on the standard drawings with the requirements listed in Table 5-3. Refer to Section 5.15 for further information on earthing.

Table 5-3 – Earthing Mesh Requirements

Requirement	Details
Earthing Design	The earthing design shall include a mesh laid within a topping screed to control the touch potential around the equipment.
Earthing Mesh	The earth mesh shall be independent from the foundation reinforcement and shall be laid across the whole substation/ switchroom footprint (excluding trenches).
Connections	Two connections from each sheet of earthing mesh shall be made directly to the marshalling bar/ring.
Steel Fabric Reinforcement	Earthing mesh shall be steel fabric reinforcement square mesh to BS 4483. A393, A252 or A142 mesh is acceptable.
Topping Screed	The topping screed shall be 50mm deep with a minimum compressive strength of 40N/mm^2 after 28 days. Float finish to +/-2mm over 2000mm.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

5.5 Masonry

5.5.1 General Requirements

The following masonry requirements apply to freestanding brick-built substations. For schemes which require aesthetic considerations, stretcher bond walls may be used in accordance with 5.5.3.

Integral and basement substations should be designed to suit the specific needs of the site but shall consider the requirements below as a minimum.

Masonry construction shall be formed of clay masonry units to BS EN 771-1 and comply with the minimum requirements in Table 5-4.

Table 5-4 – Masonry Construction Requirements

Requirement	Details
Compressive Strength	20N/mm² (minimum).
Freeze / Thaw Resistance	F1.
Active Soluble Salts Content	S1. If the walls are provided with a complete protection against water penetration (e.g. thick layer of suitable render, cladding, inner leaf of a cavity wall, internal walls) there is no requirement for active soluble salts content.
Water Absorption	23% maximum.
Joints	Neat struck joints and walls to provide a flush finish internally.
Finish	Providing that non-combustible material be used, brickwork walls may be rendered or clad externally if specifically required by the planning conditions.
Upstand	Brick walls shall be built off a reinforced concrete upstand/kicker. The upstand shall extend 150mm above ground level.
Damp Proof Course (DPC)	Brickwork shall incorporate a proprietary DPC membrane at 150mm above the external finished ground level.
Other	Bricks should be frogged and laid frogged up.
Restrictions	Brickwork shall not be projecting nor of a design that provides footholds to act as a climbing aid. Cavities between brickwork are not permitted. Perforated and engineering bricks are only permitted for use as an external skin (facing brickwork) for stretcher bond walls and shall not be used in any other circumstance. Blockwork walls are not permitted.

Common brick (e.g. Flettons) are acceptable providing that they meet the requirements of Table 5-4.

Subject to site conditions or project specification, other properties may need to be detailed in the design documentation.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

5.5.2 English Bond Walls

Brickwork shall be 215mm fully bonded brickwork to BS EN 771-1 laid English bond. Common bricks should be 'frogged' and laid with 'frogs' facing upward. Refer to Appendix C.1 for typical details.

5.5.3 Stretcher Bond Walls

Two skins of brickwork laid in 'stretcher bond' with expanded metal lath (EML) or other horizontal bed joint reinforcement every third course with no cavity. The developer shall take photographs of each EML course, UK Power Networks may request evidence of wall construction.

The inner skin shall be solid common bricks, with no perforations, and laid frog up. External facing brick to harmonise with adjacent brickwork and may be formed using perforated or engineering brick. It is important the frogs be fully filled to obtain the required level of fire resistance. Refer to Appendix C.2 for typical details.

Basement substations shall not be constructed using stretcher bond walls.

5.6 Lintels

Where required, openings in masonry walls for doors or vents shall be provided with proprietary single concrete lintel, with a minimum of 150mm end bearing unless otherwise specified by the manufacturer.

Fire rated door sets require an approved 4-hour fire rated concrete lintel of one-piece construction (Kingstone Type 29 or equivalent), with the steel reinforcement sufficiently covered to provide the required fire rating.

Steel lintels or dual concrete lintels mounted side by side shall not be used for fire rated doors.

5.7 Doors and Accessories

5.7.1 General Requirements

Only UK Power Networks approved doors with certification shall be fitted to substations, in accordance with EAS 07-0000.

Approved substation doors shall comply with the following general requirements:

- Sized to provide a clear opening suitable to accommodate the largest piece of equipment expected to pass through that door.
- Designed with leaves to swing back 180° to give good access when installing equipment only. All door leaves to have approved heavy duty door stays, unless noted otherwise, to restrict opening to 90° during normal operation.
- Designed to open outwards for emergency escape.
- Connected to the substation earthing system via an earthing lug on the doorframe, unless noted otherwise.
- Doorframe surrounds shall receive a mastic pointing externally.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

5.7.2 Louvered Doors

Louvered doors shall be installed to provide security and ventilation for substations where there is no requirement for fire resistance. Louvre door requirements are listed within Table 5-5 and Section 5.13.5.

Table 5-5 – Louvre Door Requirements

Requirement	Details
Clear Opening	As shown on relevant standard drawings.
Threshold	100mm (minimum) to 225mm (maximum) internal and external.
Locking and Escape Ironmongery	Active leaf fitted with 2-point locking system secured externally by Hasp and Staple with internal override. Operated internally by a Briton Panic Bar (padlock by UK Power Networks). The arrangement permits escape from within the substation even if the hasp and staple is secured externally with a padlock. Passive leaves shall be fitted with a 3-point locking system operated internally.
Hanging	As shown on relevant standard drawings. Typically, right hand hung.
Fixing	Steel frames fixed into brickwork openings with M10 sleeve type anchor or chemical resin fixings.
Seals	Mastic seal to the outside of the door frame surround.
Finish	Powder coated finish, standard colour Green 14-C-39. Alternatively, developer is to specify colour to match adjacent premises.
Louvre	Design to provide minimum 50% free air efficiency for the ventilation requirements given in Section 5.13. Galvanised anti-vermin mesh, 10mm², shall be provided on the internal face of the louvre.
Louvred Over Panel	Required as shown on standard drawings for substation ventilation.
Blanking Plates	Blanking plates are required for Ring Main Unit substations only, refer to relevant standard drawing for extent of blanking.
Generator Access	Built-in generator cable access hatch shall be provided, unless noted otherwise on relevant standard drawing.
Door Stays	All door leaves shall have approved heavy duty stays to lock the doors open safely at 90 degrees, unless otherwise needed due to site specific equipment access requirements (e.g. door leaf requiring 180 degrees swing).

5.7.3 Fire Rated Doors

Fire rated doors shall be used for basement substations, substations where doors open into a building and where specifically requested by the fire officer. In addition to the general specification, fire rated doors shall provide the requirements listed within Table 5-6.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Table 5-6 – Fire Rated Door Requirements

Requirement	Details
Fire Resistance	Minimum 4-hour fire resistance in accordance with BS 476-22 or BS EN 1634-1, when mounted in accordance with the manufacturer's instructions. Classification in accordance with BS EN 13501-2.
Clear Opening	As shown on relevant standard drawings.
Threshold	Fire rated door sets shall be mounted on a 150mm high cast in-situ RC upstand; this supports the doorframe surround angle that overlaps the brickwork and acts as a bund to contain potential oil spills.
Locking and Escape Ironmongery	3-point locking system secured externally by Hasp and Staple with internal override. Operated internally by a Surelock McGill panic bar (padlock by UK Power Networks). The arrangement permits escape from within the substation even if the hasp and staple is secured externally with a padlock.
Hanging	As shown on relevant standard drawings.
Fixing	Steel frames shall be fixed into brickwork openings with M12 sleeve type anchor bolt or chemical resin fixings, 75mm of which should be located within the supporting structure. Threshold fixings shall be countersunk and/or flush so as not to constitute a trip hazard.
Seals	4-hour intumescent mastic pointing (Lorient Intumescent Sealant or equivalent) where frame meets the supporting structure, both internally and externally in accordance with door manufacturers installation instructions.
Finish	Fire rated doors shall arrive to site primed only and are to receive one undercoat and two full gloss coats.
Door Stays	Door stays shall **not** be used on fire doors.

5.7.4 Escape Doors

Escape doors into uncontrolled areas shall exit into a lobbied area. It is essential to ensure that these are clear and useable at all times, it is imperative that operatives can escape from a hazardous area into an area of safety designated in the fire escape route of the development.

5.8 Finishes

External brick-built substations should be left in a natural brick finish but can be rendered or clad in accordance with Section 5.5.1. Decorative non-combustible cladding treatments are permitted if required by the Local Planning Authority but should be avoided if these are likely to pose any maintenance liability.

External cladding and render shall **not** impede air flow through the louvred vents or doors and shall **not** compromise the opening of the doors.

Internal walls and ceilings shall receive two coats of white emulsion paint for dust sealing.

Where internal render is required to be applied to the walls of the substation, it should allow for standard fixings for UK Power Networks equipment and ancillaries. These include wall plugs, expansion anchors and chemical resin fixings.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Internal floors shall receive two coats of red or grey concrete floor paint.

Steel doors and louvres should be powder coated. Standard colours are Grey 16 A 11 and Moss Green 14 C 39, other colours to BS 4800 can be specified if required to harmonise with adjacent colour schemes.

5.9 Cables

5.9.1 General Requirements

The installation of underground cables shall be in accordance with ECS 02-0019.

5.9.2 Cable Entries

Cable entries into substations should be direct into cable trenches. Cable ducts for cable entry are specified on the standard drawings, non-standard arrangements require agreement with UK Power Networks. Generally, UK Power Networks requires the provision of cable ducts or pipes from the substation to the back edge of the public footpath.

Once ducts have been installed, they shall be fitted with end caps to prevent water ingress prior to cable installation. After cable installation all ducts shall be sealed using an approved system to prevent water, gas, vermin ingress.

5.9.3 Cable Supports

Cable supports, where specified, shall consist of a Unistrut P1000T (41 x 41) slotted channel secured to walls at 600mm centres. If drop rods are used, then Unistrut P1001T (83 x 41) slotted channel secured to walls for lateral support shall be specified to enable cables to be cleated either below or above the Unistrut.

The weight of cables vary depending upon type, size and material used. For design purposes a weight no less than 15kg/m for each cable should be assumed.

If Unistrut cable supports are required to be fitted to the underside of blast ceilings then the Unistrut cable supports shall be provided and installed by an approved contractor at the time of the initial install.

Unistrut shall not be retrospectively fitted to the blast ceiling by non-approved installers as the additional weight of the cables and Unistrut could compromise the ceilings performance in a blast event. In these circumstances, the Unistrut should be fixed wall to wall independent of the ceiling above.

5.9.4 Service Cable Slots

Service cable slots are sized to suit the number and size of cables required. Openings shall be kept as small as possible so as not to create ‘weak spots’ within the substation fabric. All service cable slots shall sealed with a 4-hour fire rated mortar/sealant, to maintain fire compartmentation of the substation at all times.

5.9.5 Winching Eyes

Long cable runs require a cable winching eye. Where required, a suitable anchor point with a pulling ring with an internal diameter of 80mm opposite the incoming cable position shall be provided. Winching eyes can be within the cable trench or 500mm above the substation floor.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

The pulling ring shall be capable of sustaining a horizontally applied SWL of 1500kg; test certification shall be issued before usage. In all cases, as part of the design documentation, supporting calculations prior to installation shall be produced.

5.9.6 Cable Pits

Where cable pits are specified (e.g. on a narrow access road where excavation in the roadway would compromise the normal access to a building or development) they shall be provided with removable covers specified to suit the environment in which they are located.

Cables and joints shall be blinded with sand in accordance with ECS 02-0019, under UK Power Networks supervision, before being energised to protect them from mechanical damage and to prevent the possible spread of fire. Nominal 500mm layer of sand around cables with 150mm layer of pea shingle or 40mm washed aggregate to finish 50mm from the top of foundation.

5.10 Ducts

All cables shall be installed in approved ducts. The ducts shall be laid in a straight line wherever possible, laid level and/or finish flush to the external face of the boundary retaining wall being accessible from the pavement. If sites are working to reduced levels or cover during the construction phase, the ducts shall be suitably protected to prevent crushing from site traffic.

Proposed duct routes should consider nearby tree roots, structures, existing services, cable pits and drainage routes. The cable duct shall be fully accessible from both ends of the run.

All ducts terminating into the ends of concrete cable trenches shall be finished flush with the internal face of the trench and sealed externally using non-shrink cementitious grout or cast in duct couplers. Once installed all ducts should be fitted with end caps or expanding pipe bungs, at both ends, to prevent water ingress prior to cable installation.

After cable installation, all cable ducts shall be sealed internally using an approved duct-sealing system, to prevent water and gas ingress into the substation. The sealing arrangement shall be removable to enable the cables to be installed and the cables entries resealed.

5.10.1 Cable Ducts – Plastic

Unless otherwise specified by UK Power Networks the approved plastic cable ducts shall be 125mm internal diameter twin-walled high-density polyethylene ducting. Refer to EAS 02-0000.

5.10.2 Cable Ducts – Steel

Where cables pass through or under a building, a steel duct shall be provided in lieu of the standard plastic duct. To avoid potential induction currents all three phases of a circuit shall be accommodated within a single steel duct.

Steel ducts shall comply with the requirements in Table 5-7.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Table 5-7 – Steel duct requirements

Requirement	Details
Standard Compliance	Comply with BS EN 10255.
Minimum Internal Diameter	125mm. For excessively long runs or for particular applications, ducts with an internal diameter of 150mm may be specified.
Duct Design	Consist of a welded steel tube with no internal protruding seam or an equivalent seamless design. Any surface of the seam shall be smooth to the touch throughout. Ducts shall be close butted within the socket/collar. Ends of the ducts shall be de-burred and finished smooth to the touch.
Joints and Edges	All joints screwed and socketed, with the internal edges of the pipe bevelled. Pipes shall be parallel threaded to allow them to be close butted with the collar/socket.
Duty and Finish	Medium duty and supplied in either red oxide or self-colour finish.
Other	Shall be puddle-flanged where they pass through retaining walls straight into a substation. Shall be fitted with internal expanding pipe bungs at both ends after installation, to prevent water ingress prior to cable installation. After cable installation the ducts shall be permanently sealed with an approved duct sealing system (e.g. RDSS Rayflate).
Restrictions	Galvanised ducts are not acceptable as the galvanizing process can leave the ducts with an abrasive finish internally.

5.11 Cable Trenches

Ground level substations shall be designed to incorporate cable trenches, within the enclosure, for the HV and LV cables. Cable trenches shall be:

- A minimum of 1000mm deep to accommodate cable bending radii and to enable the connection onto switchgear with bottom entry cable boxes.
- A minimum of 600mm wide.
- Grated over with open mesh GRP gratings for safety at all times (Section 5.12).
- Sand blinding of cable trenches is not required where all cable entries are sealed against water and gas ingress, unless noted otherwise on the standard drawings.

5.12 GRP Gratings

GRP gratings are used to span cable trenches and shall comply with the following requirements in Table 5-8.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Table 5-8 – GRP Grating Requirements

Requirement	Details
Type	Floor gratings shall consist of approved 38mm x 38mm deep moulded fibreglass, open type with gritted surface side upwards, and coloured green. Refer to EAS 07-0000 for approved products.
Support	Gratings shall be supported by the following methods: 1. Supported on 65 x 50 x 6mm galvanised steel angles fixed into concrete or masonry walls with M12 anchor fixings at 400mm centres (Hilti HST Anchor resin fixings or equivalent). 2. Supported on 45 x 45 x 6mm galvanised steel 'kerb' angles with welded 6mm lugs. Lugs shall be fixed into the top surface of the concrete foundation using M12 anchor fixings (Hilti HST Anchor resin fixings or equivalent), prior to installing topping screed. All steel members shall be minimum grade S275JR in accordance with BS EN 10025-2 and hot dip galvanised to BS EN ISO 1461. Minimum length of M12 anchor fixings should be 100mm. Type of support arrangement required is provided on the standard drawings.
Load Rating	Approved GRP gratings are load rated for 5kN/m^2 to BS 4592-0 and Class A15 to BS EN 124.
Cable Cut-Outs	The standard gratings span in two directions which allows 'cable cut-outs' to be created for the incoming cable entry positions. It is important to maintain sufficient bearing at all times, refer to product data for information on support arrangements.
Flooring Kits	Flooring kits are available for standard substation arrangements, see EAS 07-0000.
Installation	Gratings shall be easily removable, seated level with no noticeable rocking and shall be installed prior to equipment delivery. Gratings shall be seated with minimum 40mm bearing width.
Oil Spill Channels in Bunded Substations	Grating for the oil spill channels do not require the angle supports but a 40mm x 40mm concrete recess onto which the grating sits.
Restrictions	Heavy equipment shall not directly load the GRP gratings during installation, maintenance or removal. Suitable methods of bridging the cable trenches such as steel plates and rollers shall be used to prevent damage to the gratings. Individual gratings shall be no larger than 1200mm x 1200mm.

5.13 Ventilation

5.13.1 General Requirements

Adequate ventilation shall be provided to dissipate the heat generated by the transformer and other equipment. Substations shall be designed to achieve this by using natural ventilation, where possible, generating a cross flow of air over the transformer(s) and other equipment.

Louvred vents and ventilation ductwork shall be used to achieve natural ventilation of substation rooms. Ventilation requirements for different types of substation are listed below with requirements for louvred vents and ventilation ducting listed in Section 5.13.5 and 5.13.6 respectively.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

5.13.2 GRP Substation Ventilation

For GRP substations ventilation is provided by inlet and outlet vents and soffit ventilation, which is built into the GRP enclosure. Approved GRP enclosures are given in EAS 07-0000.

5.13.3 Freestanding and Integral Substation Ventilation

For freestanding and integral substations ventilation is provided by a combination of louvred doors and suitably placed louvred wall vents, which generate cross flow of air over the electrical equipment. Ventilation requirements for freestanding and integral substations are given in Table 5-9.

Table 5-9 – Ventilation Requirements for Freestanding and Integral Substations

Substation Equipment	**Louvred Area**		
	Door Set	**Wall Vent**	**Total**
Single RMU only	0.6m^2	-	0.6m^2
1000kVA Transformer or below	5.5m^2	0.6m^2	6.1m^2
1500kVA Transformer	5.5m^2	0.9m^2	6.4m^2

Notes:

- The above values assume that a minimum of 50% air efficiency can be achieved by the louvred vents and doors, with a Class 2 discharge coefficient (Cd) in accordance with BS EN 13030. The 'free area' achieved shall therefore be 50% of the louvred area.
- Louvred door sets and wall vents shall be sized to ensure that 'total' areas stated are achieved.
- Ventilation for RMU only substations is achieved by providing a louvred door with blanking plates. Refer to the relevant standard drawing for extent of blanking.
- For substations with two RMU's or two transformers the above louvred areas shall be doubled and door/vent arrangement provided to suit.

In addition to the requirements in Table 5-9, integral substations shall comply with the following requirements:

- Integral substations shall be located at a corner of the larger building with venting on both external faces to generate cross flow ventilation.
- Where integral substations, containing transformers, cannot be located on the corner of the larger building, ventilation to the substation is reduced. In this case, the substation shall have a minimum of one wall external to the building, the room height shall be raised and ventilation ductwork shall be provided to extract warm air from substation. The ductwork shall be positioned at high level, above the transformer, and shall be directed to a louvred over-panel above the access doors. The ductwork and louvred over-panel shall be sized to ensure the 'total' areas in Table 5-9 are provided.

5.13.4 Basement Substation Ventilation

For basement substations ventilation shall be provided by inlet and outlet ventilation ducts, that are sized based on passive 'stack' principles, with louvred vents on the building façade. The system is driven by the difference in air pressure between the cool air 'inlet' and the warm air 'outlet'. For this to work efficiently a dedicated inlet and outlet ventilation duct is required.

Basement substations shall comply with the following requirements:

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

- Size of external louvred vents on the building façade and internal cross-sectional areas of ventilation ducts shall comply with the figures stated in Table 5-10.
- Cool air 'inlet' ductwork shall be trunked to low level, 500mm above substation floor level. Warm air 'outlet' ductwork shall be located at high level above the transformer.
- It is important that the outlet louvres are located as high as possible and are not sited immediately above any wall mounted LV boards, when present.
- Ventilation shafts are an extension of the substation and as such shall be constructed to the same specification as the substation walls/floors/soffits. Ventilation shafts shall be constructed from standard 215mm fully bonded brickwork or cast in-situ reinforced concrete, with sufficient cover to steelwork to achieve a 4-hour fire rating.

Table 5-10 – Ventilation Requirements for Basement Substations

Transformer Rating	Louvred Area on Façade		Ductwork Internal Areas	
	Total	Inlet / Outlet	Warm Air (Outlet)	Cool Air (Inlet)
1000kVA or below	3m^2	1.5m^2	0.75m^2	0.75m^2
1500kVA	4m^2	2m^2	1m^2	1m^2
Notes: • The above values assume that a minimum of 50% air efficiency can be achieved by the louvred vents, with a Class 2 discharge coefficient (Cd) in accordance with BS EN 13030. The 'free area' achieved shall therefore be 50% of the louvred area.				

5.13.5 Louvred Vent Requirements

Louvred vents shall be used to create ventilation openings in the walls of substations. The most common arrangement is via low level 'inlet' louvres and high level 'outlet' louvres behind or adjacent to the equipment position. Louvres shall be an approved UK Power Networks design and shall comply with the requirements in Table 5-11. The below requirements shall also apply to louvred door sets.

Table 5-11 – Louvred Vent and Door Requirements

Requirement	Details
Type and Fixings	Louvres shall be of mild steel construction, fully welded into a steel frame and secured internally by suitable anchor fixings into the substation walls (with no external fixings). The steel blades shall be individually welded into the frame for security and to prevent the blades becoming dislodged in the event of overpressure within the substation. The louvered panels shall be vertical, not sloping or raked in section.
Location	'Outlet' louvres shall be located as high as possible and are not sited immediately above any wall-mounted LV board. Vertical separation is required between inlet and outlet openings. Inlet and outlet louvres shall vent to an external safe area, preferably clear of pedestrian areas. They shall also be located to prevent entry of noxious gases (such as vehicle exhausts) and pollutants (such as smoke, soot, dust and ash). The areas outside the louvres shall not be subjected to fire risk. Louvres shall not vent into areas where heat or smoke dissipation would compromise adjoining escape routes. Louvres are not permitted to vent into bin stores, loading bay areas, undercrofts or underground car parks.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Requirement	Details
Weather Resistance	Louvre blades shall be of a profile to prevent the ingress of driving rain.
Security	Louvres shall be fitted with anti-vermin mesh and shall prevent foreign objects being inserted through the openings.
Seals	Louvre frames surrounds shall receive a mastic pointing externally.
Ventilation Turrets	In some cases, where the roof of the substation is external and exposed to open air, weatherproof ventilation turrets of the same specification as the substation walls/roof and with louvered vents installed may be used. These shall not be located directly above the main substation equipment and should be fixed securely.
Restrictions	Aluminium, timber or proprietary louvre blade systems that 'snap in' are not permitted. The position of any soft landscaping shall be considered at the design stage to ensure that the airflow through the louvres is not compromised either at inception or in the future.

5.13.6 Ventilation Ductwork Requirements

Ventilation ductwork shall be used to provide cool air to the substation, extract warm air from the substation and shall comply with the following requirements:

- Ductwork shall only be used within integral or basement substations, as outlined in Section 5.13.3 and 5.13.4 above.
- Ventilation ductwork shall be 4-hour fire rated and blast resistant using an approved steel ductwork system (Durasteel SMT or equivalent).
- Only approved licensee's shall install the ductwork; a letter of conformity is required for every installation. All ventilation ductwork proposals shall be subject to acceptance by UK Power Networks.
- Ventilation ductwork should not exceed a total length of 10m and shall contain no more than two changes in direction. Ductwork in excess of 10m may be considered only if the duct arrangement is predominantly vertical and has an increased 25% of cross-sectional area, any excess should be no longer than 5m in any circumstance.
- Ventilation ductwork shall not contain other services, give access to other portions of the building or form part of the ventilation system for the larger building.
- Ventilation ducts shall be routed directly to outside air and independently from any other ventilation system.

5.14 Electrical Services

All substations shall be fitted with lighting and power in accordance with EDS 07-1119. Where applicable, typical lighting and power requirements, compliant with EDS 07-1119, have been included in the standard substation design drawings.

Note: Substations with separate HV and LV earths have specific power and lighting requirements, refer to EDS 07-1119 for further guidance.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

5.15 Earthing

All secondary substations shall have an earthing system designed in accordance with EDS 06-0014 and constructed in accordance with ECS 06-0023.

Standard earthing arrangements are included with each substation drawing. All GRP and freestanding brick-built substations shall have a buried perimeter earth electrode, earth rods and require plinth rebar bonding. Integral and basement substations use an internal earth mesh cast into the substation floor with internal earth rods.

Substation construction shall not commence until the earthing design has been provided by the project's electrical designer. For UK Power Networks projects, this will include an earthing construction form and an earthing drawing.

On completion of the earthing system construction, the installer shall complete the appropriate part of the earthing construction form and, together with an earthing test certificate, submit to UK Power Networks for approval.

The earthing system should be installed at the same time as the excavation and foundations works are carried out, by a specialist subcontractor. The tape and rods shall be protected from damage during the remainder of the construction works, equipment installation and commissioning works.

5.16 SCADA and Communications

5.16.1 Overview

All secondary substations should be designed to accommodate a separate Type E RTU, for current use and future enhancement.

Refer to EDS 05-9111 for further details regarding communications system options.

5.16.2 SCADA Requirements for Basement Substations

All basement substations shall be installed with a 'cable connection' in accordance with EDS 05-9111. This shall include provision for a communications cable and DC power cable to be installed between the Openreach termination unit and the substation.

The cable route shall be installed within a minimum 100mm diameter duct.

5.17 Signage

It is a mandatory requirement that all substations display external signage accordance with EDS 09-0019. Refer to EAS 07-0021 for approved signs and labels.

Equipment containing SF_6 or Formel NF gas as an insulator shall be clearly identified at entrance points in accordance with EDS 09-0019.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

5.18 Waterproofing

Substation waterproofing shall be designed to BS 8102:2022, Grade 2. No seepage is acceptable. Damp areas due to internal air moisture/condensation are tolerable; measures might be required to manage water vapour/condensation. Waterproofing shall comply with the following requirements:

- A proprietary bitumen based waterproof concrete sealer shall be applied to all below ground external concrete surfaces prior to backfilling.
- Waterproof coatings applied to the internal surfaces of the substation are not acceptable. These coatings can be compromised by drilling and fixing of equipment, movement of heavy plant, overpressure from an arc fault and fire.
- Watertight sealing of all ducts with or without cables shall be carried out prior to commissioning using purpose made stop ends or bungs. The use of non-purpose made duct seals, for instance rags, newspaper, timber boards, is not acceptable.
- Cable entries using steel pipes shall be puddle flanged.
- Proprietary hygroscopic treatments may be specified depending upon the circumstances.
- Waterproof render shall be compatible with UK Power Networks fixings and fixing methods for all equipment.

5.19 Future Works

Both initial equipment installation and future equipment replacement shall be considered at the design stage. If a fault develops, it will be necessary to exchange the equipment safely, quickly and with the minimum disruption to the site or the main premises.

The future maintenance requirements together with possible additions and alterations to the installed equipment shall also be considered at the design stage.

The building fabric and accessories shall be selected to be inherently ‘low maintenance’.

5.20 Records

‘As-built’ records shall be produced and made available at the time of handing over of the site to UK Power Networks. ‘As-built’ electronic records shall be stored in the substation library or asset register and shall include:

- Marked up as-built drawings detailing all structural and dimensional details when different from the ‘For Construction’ drawings.
- Any residual risks not covered on the ‘For Construction’ drawings.
- Cable and circuits within the substation including size, depth and position of ducts, cables and pits.
- Location of earth rods and earth electrode.
- Earthing test certificates.
- Substation access position and exact position of equipment access hatch.
- Non-standard access arrangements.
- Maintenance periods, procedures, and equipment supplier information for all equipment and equipment.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

6 Specific Substation Requirements

6.1 Freestanding Brick-built Substations

6.1.1 General Requirements

This substation type shall be truly freestanding, wherever possible, and shall maintain its own structural integrity at all times. It is acceptable to attach intake rooms to the substation, as shown on the relevant standard drawings. Intake rooms shall be constructed to the same standard as the substation and shall not compromise structural integrity, fire or ventilation requirements.

The floor slab, foundations and roof slab shall be designed to the developer's structural engineer's specification to sustain all loads. A minimum clear headroom of 2500mm is required. The freestanding substation construction should not contain any structural steelwork inside the substation.

6.1.2 Roof Construction

The roof shall consist of a cast insitu reinforced concrete slab, with minimum thickness of 180mm, to provide blast and fire resistance. The reinforced concrete roof slab shall comply with the requirements in Table 6-1.

Table 6-1 – Freestanding Substation Roof Requirements

Requirement	Details
Design	Reinforcement to structural engineers detail with sufficient concrete cover to achieve a 4-hour period of fire resistance.
Concrete Mix	RC32/40 concrete mix with maximum 20mm aggregate to BS 8500-2. Minimum compressive strength of the concrete after 28 days shall be 40N/mm². A sulphate resistance cement combination to BS EN197-1:2011 shall be used unless otherwise specified by the designer.
Steel Reinforcement	Steel reinforcing bars shall be strength grade B500B in accordance with BS 4449. Steel fabric (mesh) reinforcement shall be square mesh in accordance with BS 4483. A reinforcement bar bending schedule shall be produced to the structural engineer's design in accordance with BS 8666.
Roof Slab Projection	Slab to project 150mm beyond supporting brickwork wall and to incorporate a drip detail to the eaves.
Roof Weatherproofing	Fully weatherproofed with a 20mm mastic asphalt finish in two coats to underlay of felt on a minimum 1:80 fall to the rainwater outlet. Edge of slab provided with a GRP roof edge trim. The top of the asphalt shall receive two coats of solar reflective paint.
Restrictions	The introduction of insulation or preformed void fillers that provide the falls on the slab, are not acceptable for substation roof applications. Hollow pot beams, pre-cast concrete planks and lightweight concrete placed on metal profiled decking are not permitted.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

6.1.2.1 Pitched Roof

A pitched roof is permitted above the reinforced concrete roof slab specified in Section 6.1.2.

Roof trusses or joists shall be secured to the concrete slab and all roof voids suitably ventilated. All tiles shall be double-nailed to battens.

The use of lead flashings and lead-free flashings should be considered to prevent water ingress. Fascia and soffit boards should be of low maintenance UPVC or similar approved and not timber unless expressly required by the Local Planning Authority.

Guttering and rainwater associated kit should be low maintenance UPVC or similar. Rainwater downpipes should terminate below ground level into back inlet gullies or similar drainage, discharging to local surface water sewer with permission from the local water services company or a dedicated soakaway.

6.1.2.2 Green Roof

A green roof is acceptable when specifically required by the local authority for planning approval. The green roof may be supported on the substation roof and shall comply with the following requirements:

- Extensive green roof types are acceptable, no other type of green roof shall be accepted.
- Waterproofing and sealing system shall be robust enough to last the lifetime of the substation building. Product certifications are required to confirm suitability.
- Roof drainage shall be designed to prevent stagnant water building up over the roof slab and to provide a maintenance free solution for the lifetime of the substation building.
- The customer or third party that requires the green roof shall maintain it to ensure that no damage is sustained to the substation building due to neglect or lack of maintenance. UK Power Networks accepts no responsibility for maintenance of green rooves.

Green roof designs shall be submitted for approval by UK Power Networks Asset Management.

6.2 GRP Substations

6.2.1 General Requirements

GRP substations shall be selected only where fire safety clearances can be maintained for the life of the substation, see EDS 07-3101 for required fire clearances. The selection of GRP substation type depends on the equipment to be housed, risk of flooding and risk of oil spills. GRP substations shall not be installed within other buildings.

Typically, GRP substations shall face the highway to offer immediate access and to prevent blocking of substation doors. However, where sufficient clearance to the back edge of a public footpath cannot be provided or where site constraints dictate, the substation can be rotated through 90 degrees facing parallel to the highway. The minimum clear zones in front of the substation doors shall be maintained in either orientation.

Where the substation is at risk from potential vehicle strikes, for example in car parks, then bollards and/or barriers shall be specified.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Refer to EDS 07-3101 for fire safety clearances, flood risk assessment, requirements for secondary oil containment and guidance on positioning/orientation.

For GRP substations that are subjected to flood risk, an elevated GRP substation should be used with a maximum foundation height of 1500mm above ground level. Alternatively, a flood resistant GRP is available for trial with Asset Management approval.

6.2.2 GRP Enclosures

- GRP enclosures shall be supplied and delivered by UK Power Networks unless agreed otherwise.
- GRP enclosures come with a built-in mounting frame for RTUs. Where additional equipment is required to be mounted within the GRP enclosure, fixings shall **not** be fitted through the single skin wall of the GRP. Instead 18mm plywood shall be fixed to the internal steel frame of the GRP[2] and equipment fixed to the plywood.
- Equipment shall **not** be mounted next to or behind the RMU or obstruct access of personnel, see Section 5.3.2. All equipment within GRP substations requires a minimum IP56 rating in accordance with BS EN 60536.
- The GRP shall be connected to the concrete plinth using six galvanised brackets fixed into the steel frame of the GRP housing. The brackets shall be fixed to the concrete plinth using M12 expanding shield anchors.
- Refer to EAS 07-0000 for approved GRP substation enclosures.

6.2.3 Concrete Foundations (Bases)

GRP substations can be installed onto cast insitu concrete bases or precast concrete bases.

6.2.3.1 Precast Concrete Bases

- Precast concrete bases offer improved efficiency for base installation, consistency of foundation construction and are supplied with cable ducts entries, earth bar and earth bond points pre-installed.
- The ground shall be suitably prepared prior to landing precast concrete bases to ensure stability. All holes for dowel connections shall be made good following installation using a general-purpose non-shrink grout (e.g. Fosoc Conbextra GP or Sika 111 GP or equivalent).
- For guidance on use, specification and installation of precast concrete bases refer to ECS 07-3005.

6.2.3.2 Cast Insitu Concrete Bases

- Cast insitu concrete bases offer flexibility on constrained sites and require a minimum curing period of 7 days prior to landing equipment.
- Concrete reinforcement layouts are provided within the standard drawings.
- Where site specific ground conditions dictate that the foundation design shown in the standard drawings is not suitable, the developer's structural engineer shall produce a design to suit the site conditions and provide full proposals to UK Power Networks for approval prior to construction.
- Preferential concrete reinforcement layouts and detailing will not be accepted by UK Power Networks unless verified by the developer's structural engineer

[2] Fixing through the single skin of the GRP can create weaknesses and lead to deterioration. The steel frame of the GRP is cast into the resin.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

- Earthing bond points for reinforcement shall be installed prior to casting the concrete.
- The top surface of the concrete floor/foundation shall be finished with a surface hardener or a suitable wearing screed for impact and abrasion resistance.

6.3 Integral Substations

6.3.1 Location

Integral substations shall be located on the corner of the larger building to provide adequate ventilation in accordance with Section 5.13.3. The substation shall also be accessible from a public footpath.

Wherever possible, integral substations shall not be located immediately adjacent to or below domestic dwellings.

6.3.2 Building Fabric

The walls and roof of the structure shall have a 4-hour fire resistance rating, REI240 in accordance with BS EN 13501-2. The structure shall maintain the 4-hour fire resistance after an overpressure event (blast) and shall typically be formed of reinforced concrete or masonry. Blockwork and plasterboard are not permitted.

A flat soffit shall be provided on new buildings except where the roof or floor design requires down-standing beams. If refurbishing a building that has existing downstand beams, the clear headroom shall be measured from the bottom of the lowest beam to the floor level.

Where steelwork is required for the larger structure, all steel members inside the substation shall be encased in concrete with sufficient depth of cover to provide a 4-hour period of fire resistance; alternatively, the steelwork can be protected with an approved 4-hour fire resisting cladding. Intumescent paint or fire sprays are not permitted.

Where thermal or noise insulation is required, it shall be installed on the outside of the substation construction and not within the substation.

6.3.3 Vibration

All transformers shall be mounted on approved anti-vibration pads to minimise structure-borne noise transmission (refer to ECS 04-0081). In addition, it is important to assess whether standing sound waves may be generated, as this can induce resonance on the larger structure. Refer to EDS 07-3101 for further information.

6.4 Basement Substations

The guidelines given in this section apply to new substations and existing sites where it is intended to modify the larger building associated with the substation and the structure, access, or ventilation system require alteration to suit the new condition.

6.4.1 Internal Chamber

A minimum clear headroom of 2800mm is required within substations at basement level as the equipment has top entry cable boxes.

Basement substations contain the items listed in Section 5.3 but with configurations where approved top entry or wall-mounted equipment may be available for use.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

6.4.2 Building Fabric

The walls and roof of the basement structure shall have a 4-hour fire resistance rating, REI240 in accordance with BS EN 13501-2. The structure shall maintain the 4-hour fire resistance after an overpressure event (blast) and shall typically be formed of reinforced concrete or masonry. Blockwork and plasterboard are not permitted.

6.4.3 Vibration

All transformers shall be mounted on approved anti-vibration pads to minimise structure-borne noise transmission (refer to ECS 04-0081). In addition, it is important to assess whether standing sound waves may be generated, as this can induce resonance on the larger structure. Refer to EDS 07-3101 for further information.

6.4.4 Personnel Access

Access to basement substations shall be, in accordance with the 'Type A Access and Egress' characteristics as defined in EDS 07-3101 and open to the air in accordance with BS 9999:2017.

Personnel access stairs from ground level to the basement shall be a minimum of 1200mm wide and shall be in accordance with Building Regulations Approved Document M, Volume 2. Stairs shall include provision of landings, handrails, nosing's and shall be finished to provide an anti-slip surface.

6.4.5 Equipment Access

Where substations are located within basements or below ground level, provision shall be made for the safe movement of equipment via the shortest route. Wherever possible equipment movement shall be made by a lorry-mounted crane parked adjacent to an appropriately sized equipment access hatch.

6.4.5.1 Equipment Access Hatch

If access is required via an opening within the ground floor slab, an equipment access hatch shall be provided and shall comply with the following requirements in Table 6-2.

Table 6-2 – Equipment Access Hatch Requirements

Requirement	Details
Hatch Size	Equipment access hatches shall provide a minimum clear opening of 2100mm x 1600mm for all transformers. The dimensions of the selected transformer shall be checked against the proposed access hatch dimensions to confirm there is adequate room.
Load Class	Access hatch cover load class shall suit all potential loading scenarios for the given site, in accordance with BS EN 124.
Working Room	A minimum of 1000mm clear working space is required around all sides of the hatch at both ground and basement levels.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Requirement	Details
Installation	The approved hatch covers shall be installed flush with the finished floor, such that when the covers are removed no additional reinstatement is necessary. For projects with a decorative floor finish on the approved hatch access cover, the floor finishes shall be laid within a removable tray above the hatch cover. This is to allow access to the hatch cover without the need to break out the floor finishes. Lifting loops for the removal of the tray shall be kept within the substation.
Location	The proposed location of the equipment access hatch shall be reviewed and accepted by UK Power Networks and shall comply with the following: • The hatch shall be located external to the substation area, near the substation doors in common areas to minimize manhandling. • Locations that involve the manhandling of large items of equipment in excess of 10m or along corridors shall be avoided. • Hatches sited in tenanted areas or areas usually occupied by persons can only be permitted where unobstructed access can be maintained and legal covenants permitting this access are in place. • It is preferable for the hatch to be located in an area clear of any overhead buildings or structures with minimum headroom in accordance with 6.4.5.2 or 6.4.5.3. • The area surrounding the access hatch shall be designed to allow for the heavy-duty delivery vehicle, which weighs 32 tonnes when fully loaded with equipment. • An adjacent on-site space shall be provided for the temporary storage of the hatch covers. • Hatches should always be located on a flat area with the surrounding area laid to falls to prevent possible ‘ponding’ local to the hatch position. Hatches can be installed within ramps providing that the fall of the ramp is less than 1:10.
Restrictions	The following restrictions apply: • Services, sprinkler pipes, conduit or similar are not permitted to pass under the equipment access hatch; the full hatch opening shall be clear at all times. • Access to the ‘equipment access hatch’ is required at all times; no permanent or demountable structures shall be positioned over the hatch or within the surrounding zone designated as working space. • The creation of ‘soft spots’ or ‘break-out’ sections of concrete slabs shall be avoided due to the disruption and time delays associated with future equipment replacement. UK Power Networks will seek solutions that remove the need to locate, break out and then reinstate areas wherever possible. • Equipment access hatches shall not be used for personnel or general day-to-day access.

FOR APPROVAL

6.4.5.2 Delivery and Installation by Lorry-Mounted Crane

The minimum clear headroom from ground level to the top of the crane arm for offloading and manoeuvring is 6.5m. If lifting equipment over fences or other types of obstacles, an allowance for the additional height of the obstruction shall be considered. If the equipment is to be lowered down a lightwell or through an equipment access hatch, the height of the drop shall be considered and an allowance included for the length of the lifting slings.

© UK Power Networks 2025 All rights reserved

6.4.5.3 Installation by Running Beams

Where access for a lorry-mounted crane is not possible and a running beam is required to lower the equipment to the basement below, the beam shall be of the running type fitted with a travelling trolley.

The running beam shall be a permanent fixture, shall extend over the whole of the hatch and shall extend past the equipment access hatch by a minimum of 2000mm to enable equipment to be attached to the lifting tackle whilst on a permanent surface. During the installation, the equipment is lifted clear of the ground and then moved into position over the open access hatch where it is slowly lowered by a hand operated chain hoist down to basement level.

Running beams shall be fitted with a permanently attached geared trolley and with welded stop ends, at both ends, to retain the trolley. The beam and the trolley are both required to be tested to a SWL of 6000kgs and certification shall be provided to UK Power Networks prior to first use. Beams shall be permanently marked with the SWL rating and shall be checked, tested and, where appropriate, re-certified prior to use by the operator in accordance with LOLER 98.

The running beam position shall be aligned with the centre of the equipment access hatch and parallel with the longest side and extend 2000mm past the hatch opening. The minimum distance from the suspension point of the trolley to the top of the equipment access hatch is 3200mm. Beams should not be installed more than 4500mm above equipment access hatches as this can introduce additional risk in terms of access to the suspension point. Services, ductwork, conduit or similar shall be kept clear of the running beam; the travelling trolley shall be able to travel freely from one end of the beam to the other, at all times.

Running beam installations shall be agreed with the relevant UK Power Networks substation design team.

6.4.6 Cable Access

High-level cable entries into basement substations shall not be above wall mounted LV board(s).

When designing a substation with high level cable entry, a minimum of 1.5m x 1.5m clear floor area shall be provided, within the substation, to create a clear space locally where a scaffold tower can be safely erected to facilitate pulling and cleating cables at height.

Steel ducts shall be specified for entry into basement substations, refer to Section 5.10.2 for steel cable ducts details.

6.4.7 Service Cable Slots

A slot for service cables shall be provided within the wall of the substation, see Section 5.9.4 for requirements. Positioning of service cable slots within basement substations depends on the equipment by the electrical design.

Where the substation is to have separate LV boards mounted a wall, the service cable slot shall be installed on the same wall at high level and to avoid other electrical equipment. Where no separate LV boards are required the cable slot shall be installed within the cable trench a minimum of 150mm above the base of the trench.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

6.4.8 Cavity Drainage

Retaining walls on basement substations shall be provided with a proprietary cavity drainage system (Delta or similar) and should be protected with the standard UK Power Networks specification brickwork. An alternative approach is to set the substation wall slightly back from the retaining wall such that any ingress or water is arrested before it enters the substation.

Access points for maintenance of cavity drains are not permitted within the substation.

6.5 Outdoor Padmount

Outdoor padmount (micro or compact) substations without an enclosure are permitted only where the requirements in EDS 07-3101 are satisfied. Outdoor padmount substations shall be installed in accordance with the relevant standard drawings.

6.6 Fenced and Open Walled Substations

The use of fenced and open walled substations is restricted, see EDS 07-3101 for applicable uses. Refer to Section 7 for fenced substation design requirements.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

7 Fencing for Secondary Substations

7.1 Risk Assessment

It is important that the type of fencing provided matches the perceived risk of the site. A site risk assessment, as described in EDS 07-3101, shall be carried out at each site to determine the safety and security hazards as relating to the location of the substation and adjacent land use prior to installation of the fence. The ESQCR rating is used to determine the type of fence and visibility requirement through the gates, refer to Table 7-1.

Table 7-1 – ESQCR Ratings for Fence Selection

ESQCR Rating	Details
Low Risk Sites	For sites deemed to be at low risk by the ESQCR rating or assessment, timber fencing and gates shall be fitted and no visibility panel installed.
Medium Risk Sites	For sites deemed to be at medium risk by the ESQCR rating or assessment, timber fencing with either a steel mesh gate or a visibility panel shall be fitted.
High Risk Sites	High-risk sites are not covered by this document. For sites deemed at high risk the boundary fence shall be steel palisade or wire security mesh construction in accordance with document EDS 07-4030 and the associated drawings. For example, in garage block areas, it will be beneficial to use a palisade fence, as the heavier steel construction is more resistant to vehicle damage. Sites can be categorised as High risk if: • The ESQCR rating in the asset register is ‘High’. • The strategic importance of the substation could lead to it being a target because of the area it supplies. This could be an industrial area, airport, sports venue or Government site. • The site is in close proximity to a vulnerable section of society such as a school or a play area. • The site is in a vandal-prone area or has come under attack in the past. • The site has suffered earthing theft.

Further information is available from UK Power Networks Company Security.

7.2 Design Considerations

7.2.1 Site Survey

A site survey and a risk assessment shall be carried out prior to installation. Each individual site shall be assessed and the method of work tailored to suit the risks and conditions of the site.

The current and future use of any adjacent land that may interfere with the security of the substation shall be considered during the design process.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

7.2.2 Fence Layout

The design of timber fencing shall provide a safe and secure environment for personnel, reducing opportunities for unlawful activity and the potential for injury to unauthorised personnel.

The fence layout shall be optimised to reduce the number of non-standard fence panels where possible.

Medium risk compounds shall be designed to ensure clear sight into the compound to deter trespass. Special care shall be taken to ensure that trees and other objects do not act as a climbing aid.

7.2.3 Fence Levels

Unless otherwise specified the top of the fence shall be 1800mm above ground level and shall be unclimbable.

For sloping sites, levels shall be calculated to ensure an even gradient is achieved where possible. Care shall be taken to ensure the effective minimum fence height is achieved on sloping sites. For steep slopes a higher standard fence may be required to maintain the minimum fence height. The top of the fence shall follow the profile of the ground along the length of installation.

7.2.4 Earthing

All fencing and gates of steel construction shall be earthed in accordance with EDS 06-0014 and ECS 06-0023.

Where fencing and gates are of timber construction, there is no requirement to provide earthing.

7.3 Fencing Specification

7.3.1 Preliminaries

The presence of underground electrical, gas or water services shall be established before the commencement of excavation, drilling or erection of the fence.

Before installation begins, the following details should be confirmed:

- Length and line of fence. Specified lengths or foundation sizes may vary to suite the local ground conditions.
- Profile of fence.
- Site preparation including site clearance and cutting or filling of ground levels.
- Any requirements for non-standard post lengths due to ground conditions.

7.3.2 Foundations

Concrete for fence foundations shall be designated concrete GEN2, or equivalent strength class with 28-day characteristic cube strength of 15N/mm^2, in accordance with BS 8500-2.

Excavation for posts shall be at least 300mm x 300mm square and 800mm deep, filled with concrete.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Local irregularities in ground level shall be graded out prior to excavating for the fence post foundations, to ensure that the fence is erected to an acceptable level and does not follow minor deviations in ground level.

All substation re-fencing works shall benefit from the installation of a concrete threshold. This threshold will span the gate opening.

7.3.3 Posts

Precast concrete posts shall be of the following specification in Table 7-2.

Table 7-2 – Fence Post Specification

Requirement	Details
Section	140mm x 115mm
Height Above Ground	1.8m minimum
Embedment Depth	750mm depth into the ground
Post Spacing	2.5m maximum
Water Resistance	The heads of the posts shall be either weathered or half rounded to prevent the ingress of water

7.3.4 Gravel Boards

Gravel boards shall be provided to prevent the timber fence being in direct contact with the damp ground.

Gravel boards shall be an approved precast concrete type with a minimum cross section of 150mm x 25mm.

When it is not possible to use gravel boards, precast kerbs can be used. Kerb bedding and backing shall be designated concrete GEN0, or C6/8 strength class, in accordance with BS 8500-2.

7.3.5 Close Board Fencing Panels

Close boarded fence panels shall be of the following specification in Table 7-3

Table 7-3 – Close Boarded Fence Panel Specification

Requirement	Details
General	All timber shall be obtained from a FSC certified source, treated with a preservative complying with BS 8417:2024 (Class 4). All fence components shall comply with BS 1722-5:2006. The preservation of the timber shall be by a vacuum pressure process to give a desired service life of 30 years.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Requirement	Details
Boards and Fixings	Constructed with vertical boards with an 18mm overlap, nailed to each rail using a 50mm x 2.65mm galvanised nails. No more than twelve boards shall be used per metre. The effect of wind and weather should be addressed when building the fence. Fence fixings shall withstand the weather and ensure the fence will be long lasting. The timber boards shall rest on top of the gravel board. These shall be nailed to the counter rail with 40mm x 2.65mm nails. The tops of the boards should be aligned. Fixings should be protected from corrosion, therefore only the use of 'hot dipped galvanised fixings are permitted. Holes for bolts shall allow the bolts to be inserted freely without any obstruction.
Main Rails	All fencing shall have three rails between each post. The approved rail types are: • Timber triangular arris rails for morticed fence; 87mm x 87mm in section. Mortices shall be 65mm x 25mm. • Timber counter rails for morticed fence; 100mm x 47mm in section. Mortices shall be 50mm x 32mm.
Capping and Counter Rails	Capping shall be 65mm x 38mm in section and shall be continuous between posts. Counter rails shall be 50mm x 25mm in section.

7.3.6 Gates

A facility shall be included on gates for 'holding open' by the addition of housing for drop bolts or 'hook and latch' arrangement. Include provision for fixing of statutory labels on the gate.

7.3.6.1 Timber Gates

Close-boarded fence compounds located in areas of ESQCR low-risk rating shall be installed with timber gates in accordance with the requirements in Table 7-4.

Table 7-4 – Timber Gate Requirements

Requirement	Details
Stiles	Timber Size: 100mm x 50mm
Top Rail	Timber Size: 152mm x 32mm
Middle and Bottom Rail	Timber Size: 200mm x 32mm
Braces	Timber Size: 152mm x 32mm
Capping	Timber Size: 65mm x 38mm
Boarding	Timber Size: 100mm x 13mm
Gate Stop	Timber Size: 50mm x 25mm
Gate Hangers	Timber Size: 100mm x 75mm Gate hangers shall be attached to the gatepost with 3No 220mm x 12mm dia. coach bolts with heads recessed into hanger and anti-theft cone nuts.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Requirement	Details
Hinges	Hinges shall be heavy duty, galvanised, ‘Hook and Ride’ type with top hinge inverted.
Drop Bolts	Gate to have drop bolt (to floor) and ‘Hasp and Staple’ (gate to post) to permit locking via operational padlock. Double gates to have drop bolt on passive leaf, with hasp on active leaf.

7.3.6.2 Steel Mesh Gates

Close-boarded fence compounds located in areas with an ESQCR medium risk rating shall be installed with expanded metal or mesh panel gates to ensure that clear sight lines into the compound are provided to discourage trespassing.

Steel gates shall be to the specification in Table 7-5.

Table 7-5 – Steel Mesh Gate Specification

Requirement	Details
Frame	The gates shall be manufactured from steel welded box section frame.
Mesh Panels	Steel mesh panels shall be 358 Security Mesh or 2089-4095 Expamet or equivalent, welded or riveted in position.
Hinges	The hinges shall have hinge pins drilled and bolts fixed through to prevent lifting the gate off its hinges
Locking	The securing bolt shall be burred over after fixing. The gate shall have drop bolt (to floor) and sliding bolt (gate to post) to permit locking via operational padlock. Double leaf gates shall have drop bolt on passive leaf, with slide bar on active leaf to prevent lifting of bolt when both gates in closed position. Sliding bolt to secure active leaf to passive leaf.
Finish	The entire construction shall be galvanised to BS EN ISO 1461 and 100 micron polyester powder coating in colour to suit UK Power Networks requirements.
Earthing	Where required steel gates shall be earthed in accordance with ECS 06-0023.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

8 References

8.1 UK Power Networks Standards

EDS 00-0002	Hazard Elimination and Management List
EAS 02-0000	Approved Equipment List – Cables and Joints
ECS 02-0019	Installation of Underground Cables - LV to 132kV
ECS 04-0081	Installation of Transformer Anti-Vibration Pads
EDS 05-9111	Operational Communications Design
EDS 06-0014	Secondary Substation Earthing Design
ECS 06-0023	Secondary Distribution Network Earthing Construction
EAS 07-0000	Approved Equipment List - Civils and Substations
EAS 07-0021	Signs and Labels for Operational Sites and Equipment
ECS 07-3005	Precast Concrete Bases
EDS 07-1119	Substation Electrical Services
EDS 07-3101	Pre-design Requirements for Secondary Substations
EDS 07-4055	Customer Switchrooms for Indoor Switchgear Panels
EDS 08-1150	Selection, Assessment and Approval of New Technology and Equipment
EDS 09-0019	Safety Sign and Identification Labelling of Equipment

8.2 National and International Standards

BS 476-22:1987	Fire tests on building materials and structures. Method for determination of the fire resistance of non-loadbearing elements of construction
BS EN 13501-2:2023	Fire classification of construction products and building elements. Part 2: Classification using data from fire resistance and or smoke control tests, excluding ventilation services
BS EN 1634-1:2014	Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware. Part 1: Fire resistance test for door and shutter assemblies and openable windows
BS 4449:2005	Steel for the reinforcement of concrete - Weldable reinforcing steel -Bar, coil and decoiled product -Specification
BS 4483:2005	Steel fabric for the reinforcement of concrete
BS 4800:2011	Schedule of paint colours for building purposes
BS 8500-1:2023	Concrete. Complementary British Standard to BS EN 206. Method of specifying and guidance for the specifier
BS 8500-2:2023	Concrete. Complementary British Standard to BS EN 206. Specification for constituent materials and concrete
BS 8666:2020	Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete.
BS EN 197-1:2011	Cement. Composition, specifications and conformity criteria for common cements.
BS EN 771-1:2011	Specification for masonry units. Clay masonry units
BS EN 10025-2:2019	Hot rolled products of structural steels. Part 2: Technical delivery conditions for non-alloy structural steels

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

BS EN 10255:2004	Non-alloy steel tubes suitable for welding and threading. Technical delivery conditions
BS EN ISO 1461:2022	Hot dip galvanised coatings on fabricated iron and steel articles. Specifications and test methods
BS EN 13030:2001	Ventilation for buildings. Terminals. Performance testing of louvres subjected to simulated rain.
BS 8102:2022	Protection of below ground structures against water ingress. Code of practice
BS EN 124:2015	Gully tops and manhole tops for vehicular and pedestrian areas.
BS 4592-0: 2006	Flooring, stair treads and handrails for industrial use. Common design requirements and recommendations for installation.
BS 1722-5:2006	Specification for close-boarded fences and wooden palisade fences
BS 1722-11:2006	Specification for prefabricated wood panel fences
BS 8417:2024	Preservation of wood. Code of practice
BS EN 60536:1992	Degrees of protection provided by enclosures (IP Code)

Construction Design and Management Regulations 2015 (CDM 2015)

Lifting Operations and Lifting Equipment Regulations (LOLER 1998)

MCHW – Volume 1 – Specification for Highways Works Series 600

The Electricity Safety, Quality and Continuity Regulations (ESQCR) 2002 as amended (2006)

Building Regulations (2010)

Building Regulations (2010) Approved Document B: Fire safety. Volume 2: Buildings other than dwellings

Building Regulations (2010) Approved Document M: Access to and use of buildings. Volume 2: Buildings other than dwellings

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Appendix A – Drawings List

Drawing Reference	Drawing Title **Note:** Most drawing references contain multiple sheets. These include civil/building details, earthing details and small power and lighting.
EDS 07-3102_01	GRP Enclosure for a Unit or Padmount Substation
EDS 07-3102_02	GRP Enclosure for a Unit or Padmount Substation with Bunded Foundation
EDS 07-3102_03	GRP Enclosure for an Elevated Unit or Padmount Substation with Bunded Foundation
EDS 07-3102_04	GRP Enclosure for a Metered Ring Main
EDS 07-3102_05	GRP Enclosure for a Ring Main
EDS 07-3102_11	Freestanding Brick-built Substation for a Metered Ring Main Unit
EDS 07-3102_12	Freestanding Brick-built Substation for Two Metered Ring Main Units
EDS 07-3102_13	Freestanding Brick-built Substation for a Metered Ring Main Unit with DERMS
EDS 07-3102_15	Freestanding Brick-Built Substation for a Single Transformer up to 1500kVA
EDS 07-3102_16	Freestanding Brick-Built Substation for a Single Transformer up to 1000kVA with ACB & LV Boards
EDS 07-3102_17	Freestanding Brick-Built Substation for Two Transformers
EDS 07-3102_20	Integral Substation for a Single Transformer up to 1500kVA
EDS 07-3102_21	Integral Substation for a Single Transformer up to 1000kVA With ACB & LV Board
EDS 07-3102_22	Integral Substation for Two Transformers
EDS 07-3012_25	Integral Substation for Metered Ring Main Unit
EDS 07-3012_26	Integral Substation for Two Metered Ring Main Units
EDS 07-3102_31	Basement Substation for a Single Transformer up to 1500kVA
EDS 07-3102_40	Standard Plinth for Micro Substation
EDS 07-3102_41	Standard Plinth for Compact Substation
EDS 07-3102_42	Timber Fence Details and Earthing Layout for Closed-Boarded Fenced Sites
EDS 07-3102_45	Standard Plinth for a Distribution Transformer up to 1000kVA
EDS 07-3102_46	Standard Plinth for a Distribution Transformer up to 1500kVA
EDS 07-3102_50	Plinth Design for Freestanding 6 & 8-Way LV Pillars
EDS 07-3102_51	Plinth Design for Remote Terminal Unit
EDS 07-3102_60	Brick Firewall for Secondary Substations

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Appendix B – Drawing Revision History

Drawing Reference	Latest Rev.	Changes in latest revision
EDS 07-3102_01	D	Notes and layout revised. Reinforcement and GRP flooring layouts added. Earthing details added.
EDS 07-3102_02	D	Notes and layout revised. Reinforcement and GRP flooring layouts added. Earthing details added. Duct arrangement updated.
EDS 07-3102_03	D	Notes and layout revised. Reinforcement and GRP flooring layouts added. Earthing details added. Duct arrangement updated.
EDS 07-3102_04	D	Notes and layout revised. Reinforcement and GRP flooring layouts added. Earthing details added.
EDS 07-3102_05	D	Notes and layout revised. Reinforcement and GRP flooring layouts added. Earthing details added.
EDS 07-3102_11	B	Notes and layout revised. Building dimensions and clearances to equipment updated. GRP flooring layouts added. Earthing details added.
EDS 07-3102_12	B	Notes and layout revised. Building dimensions and clearances to equipment updated. Earthing details added.
EDS 07-3102_13	C	Notes updated.
EDS 07-3102_15	D	Notes and layout revised. Building dimensions and clearances to equipment updated. GRP flooring layouts added. Earthing details added.
EDS 07-3102_16	D	Notes and layout revised. Building dimensions and clearances to equipment updated. GRP flooring layouts added. Earthing details added.
EDS 07-3102_17	D	Notes and layout revised. Building dimensions and clearances to equipment updated. Earthing details added.
EDS 07-3102_20	D	Notes and layout revised. Building dimensions and clearances to equipment updated. Earthing details added.
EDS 07-3102_21	D	Notes and layout revised. Building dimensions and clearances to equipment updated. Earthing details added.
EDS 07-3102_22	D	Notes and layout revised. Building dimensions and clearances to equipment updated. Earthing details added.
EDS 07-3102_25	B	Notes and layout revised. Building dimensions and clearances to equipment updated. Earthing details added.
EDS 07-3102_26	B	Notes and layout revised. Building dimensions and clearances to equipment updated. Earthing details added.
~~EDS 07-3102_30~~	C	Withdrawn. Combined into single drawing EDS 07-3102_31.
EDS 07-3102_31	B	Notes and layout revised. Ground floor plan and additional cross section added. Door, access hatch, ventilation requirements tabulated. Clearances to equipment updated. Earthing details added.
EDS 07-3102_40	D	Notes and layout revised. Earthing details added.
EDS 07-3102_41	D	Notes and layout revised. Earthing details added.
EDS 07-3102_42	D	Notes and layout revised. Updated clearances to boundary and equipment added. Civil elements combined into single drawing. Earthing details added.
~~EDS 07-3102~~_44	E	Withdrawn
EDS 07-3102_45	A	New drawing
EDS 07-3102_46	A	New drawing
EDS 07-3102_50	D	Notes and layout updated.
EDS 07-3102_51	B	Notes and layout updated.
EDS 07-3102_60	B	Notes and layout updated.

FOR APPROVAL

© UK Power Networks 2025 All rights reserved

Appendix C – Freestanding Substation Brickwork Construction Options

C.1 English Bond Wall Details

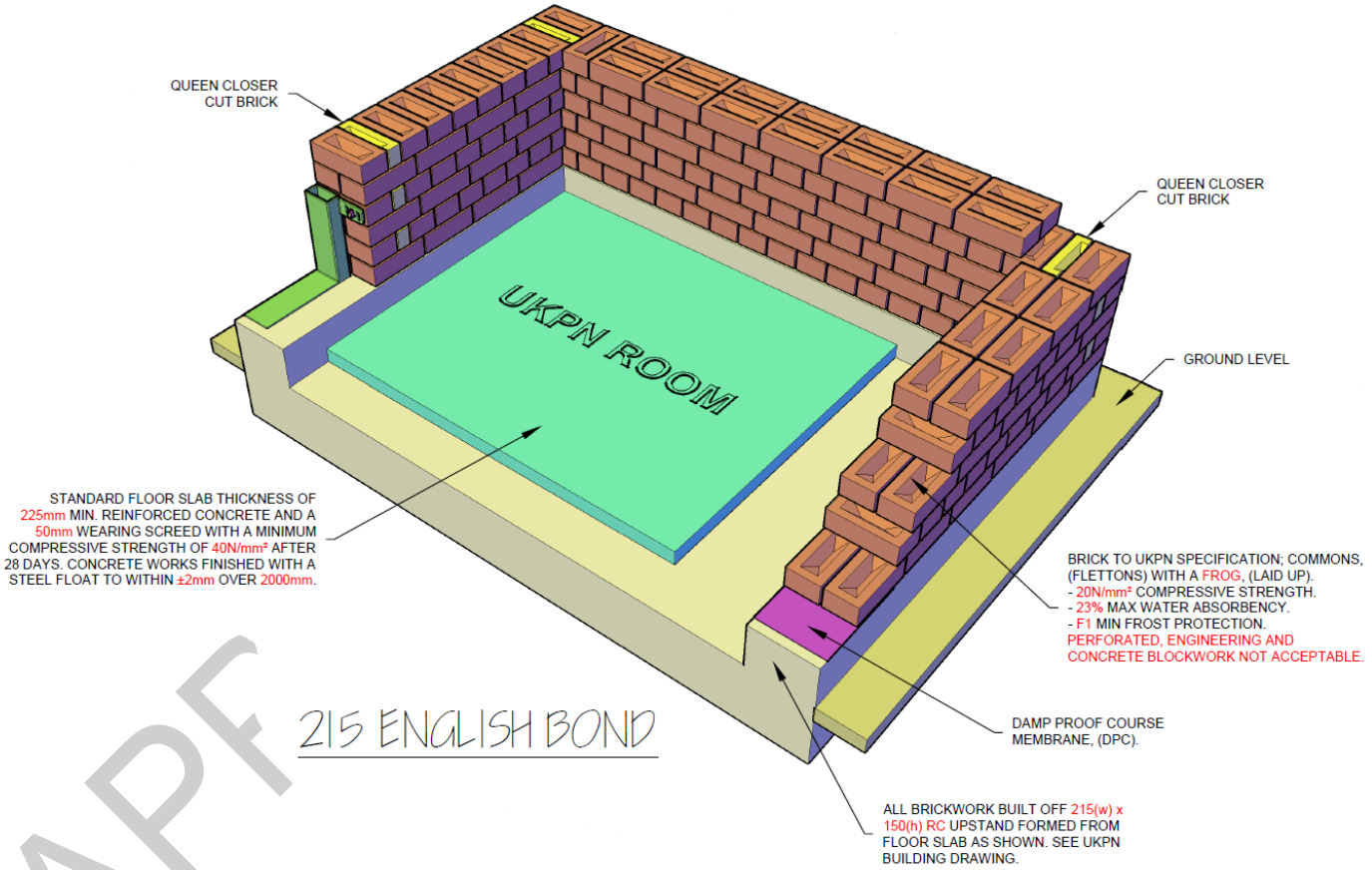


Figure C-1 – 215mm English Bond Wall Details

FOR APF

© UK Power Networks 2025 All rights reserved

C.2 Stretcher Bond Wall Details

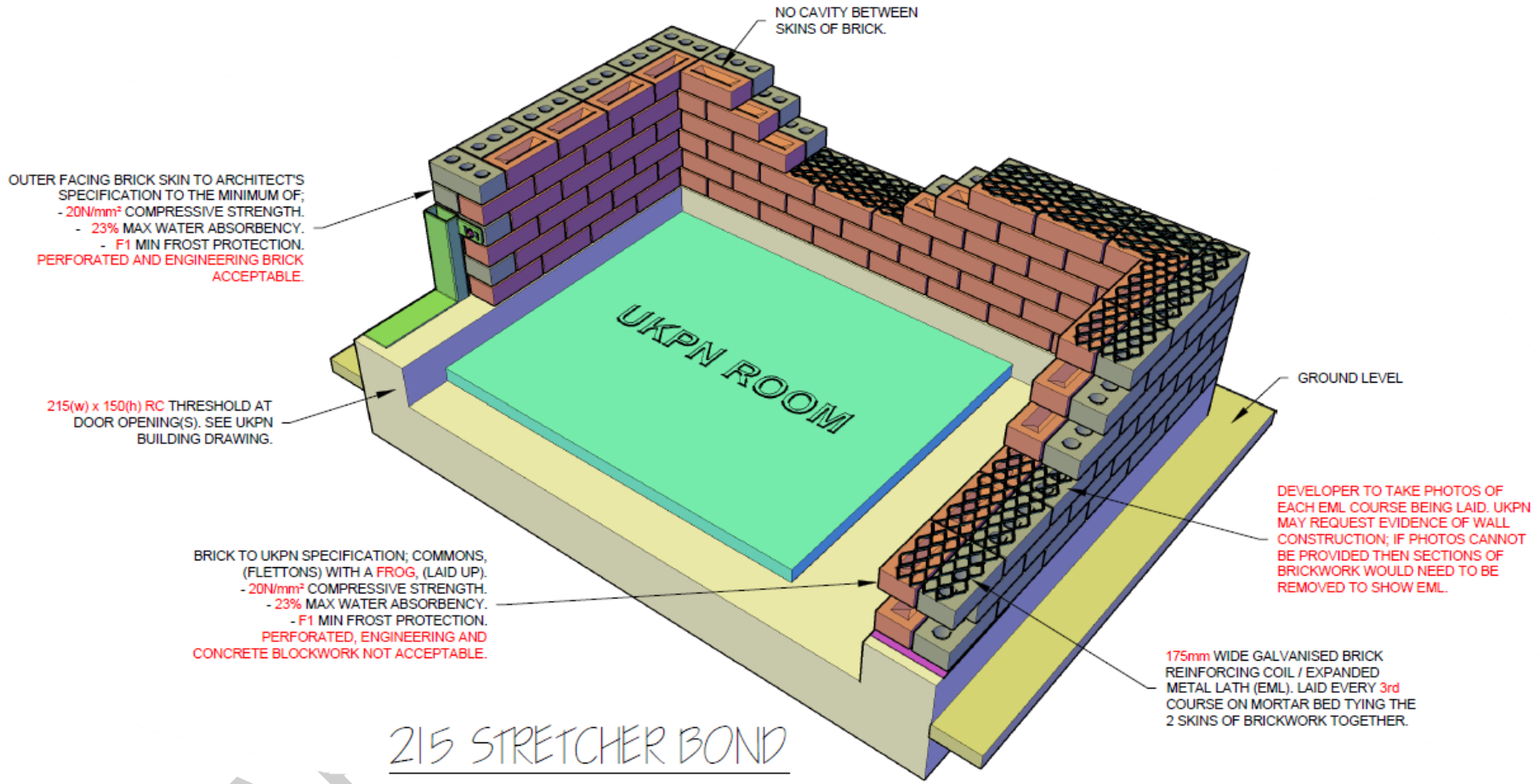


Figure C-2 – 215mm Stretcher Bond Wall Details

© UK Power Networks 2025 All rights reserved

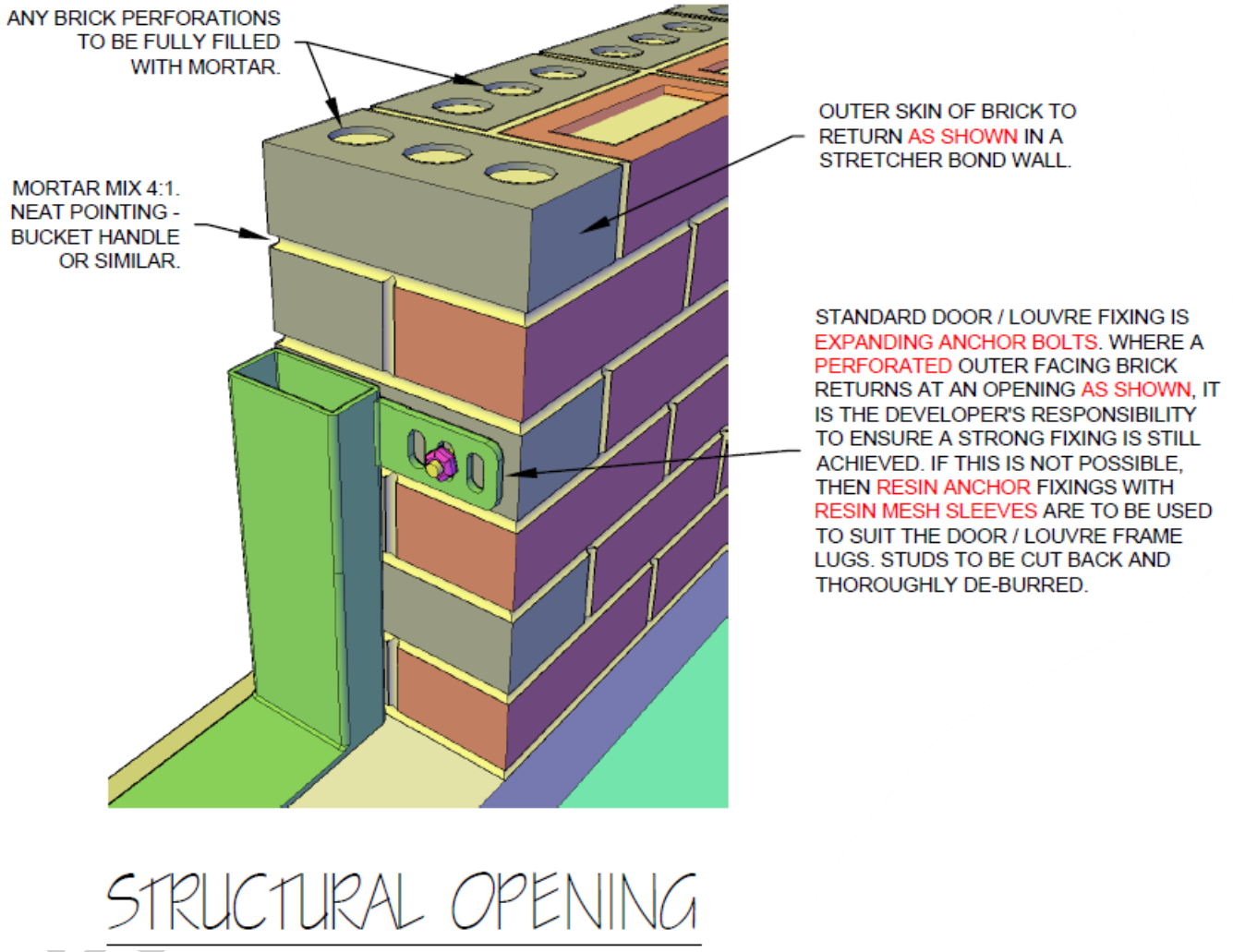


Figure C-3 – Structural Openings in Stretcher Bond Walls

© UK Power Networks 2025 All rights reserved