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ENGINEERING DESIGN STANDARD

EDS 07-4030

GRID AND PRIMARY SUBSTATION FENCING ARRANGEMENTS

Network(s):	EPN, LPN, SPN
Summary:	This standard document describes palisade and mesh fencing arrangements at grid and primary substations.

Author:	Tim Mitchell	**Date:**	27/01/2025
Approver:	Paul Williams	**Date:**	27/01/2025

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Revision Record

Version	1.1	**Review Date**	21/08/2026
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Version	1.0	**Review Date**	21/08/2025
Date	26/06/2020	**Author**	Uriel Arias
New fencing arrangements standard for grid and primary substation.			

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1 Introduction

This standard outlines the design requirements for the palisade and mesh fences used at grid and primary substations.

2 Scope

This standard applies to all EPN, LPN and SPN grid and primary substations. This standard applies to the design and installation of fencing for the following:

- The perimeter fencing at all new build substations, including cable sealing-end compounds.
- Any replacement of existing fencing.
- Any modification to existing fencing.
- Amenity fencing.

3 Glossary and Abbreviations

Term	Definition
Amenity Fence	Fencing provided to meet covenants or planning authorities' requirements
ESQC	Electricity Safety, Quality and Continuity Regulations
GRP	Glass Reinforced Plastic
Main Access Gate	Gate used for vehicles access. Minimum effective width 5.5m.
Personnel Gate	Gate for the pedestrian access of authorised personnel. 1500mm minimum effective width for primary access gate and 700mm width for wicket and escape gates around the compound.
Security Rating	For the purpose of this document, all substations have a standard security rating unless otherwise recommended by UK Power Networks Security Adviser.
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).

4 Mandatory Requirements

The mandatory requirements outlined in EDS 07-4000 are applicable for the design and construction of fencing arrangements and shall be read before progressing to the detailed design phase.

Prior to determining construction details, a site risk assessment shall be carried out to EDS 07-1109. This shall specify the security rating required for the fence arrangement.

When considering the location of the fencing arrangement, it is essential to consider the ecological impact and the sustainability of the design.

All fencing and enclosure of substations shall be in accordance with Part III Substations (Clause 11) of the ESQC Regulations.

Sites with an exposed or enclosed conductor shall be fenced as determined by UK Power Networks security report.

Gateposts, frames and fittings for vehicular and pedestrian gates shall be designed to the security category dictated by the site risk assessment.

All components shall be complementary to each other as per site security rating and risk assessment.

5 Design Functionality

5.1 Access and Escape

The clear height of all personnel gates shall be 2100mm as a minimum with a clear width of 1500mm for primary access and 700mm width for wicket and escape gates around the compound.

At least two personnel gates shall be provided to allow safe access and egress around compounds with external fence. Primary access through for personnel gates access shall be located near the main access gate and additional personnel gates where required for escape purposes, as specified in EDS 07-4000.

Subject to the UK Power Networks security advisor recommendation and site practicalities, the gate options are as follows:

a) Manually operated hinged double leaf gate.

b) Manually operated sliding/roller type gates.

c) Electrically operated sliding gate.

In the case of manually operated gates, the maximum leaf width shall be restricted to 2750mm.

Swing gates shall not be used at a sloping entrance with more than 15° slope.

All vehicular access gates shall be 1000mm wider than the connecting access road but not less than 4500mm wide. The number of vehicular access gates shall be kept to a minimum.

All vehicular access gates shall open inwards towards the substation compound. Personnel perimeter gates shall open outwards.

Removable posts and panels shall be installed where access is required for equipment in transit.

Escape distances shall be allowed in accordance to EDS 07-4000.

5.2 Type Definition

Type selection shall depend on the site conditions. Type characteristics of standard and high-risk arrangements are presented in Table 5-1 below.

Table 5-1 – Fence Details According to Risk Assessment

Fence Location	Standard Risk	High Risk
Operational areas inside the substation compound (e.g. around transformer or outdoor live equipment compounds)	2400mm high palisade fence with removable panels. Kerb is not required	n/a
Open terminal compound perimeter	2400mm high palisade or 358 weldmesh fence. All-round 350mm x 350mm concrete kerb beam	3000mm (with or without spinners) or 2400mm (with spinners) high palisade or 358 weldmesh All-round 750mm x 350mm concrete kerb beam
Boundary	1800mm high timber/ weldmesh fence	1800mm high timber / palisade or recommendation from UK Power Networks security with approved crash barrier

5.2.1 Alternative fences

Any non-security perimeter fence not specified in this document is considered as an 'alternative' type of fence. These usually follow third party or project site-specific requests.

Alternative fence types shall not undermine the security rating of the substation compound. Examples of typical uses of alternative fence types are:

- Non-conductive GRP fence panel used to segregate earthed sections (single panel) or whole fencing arrangement.
- Stand-off insulators (for earthing reasons) to provide electrical discontinuity to standard fence sections.
- Timber fencing in cases where fencing is required for segregation purposes and not to secure electrical live assets, for instance to segregate customer connections schemes, satellite columns or customer buildings from livestock, demarcation of fibre chambers in farmers' fields or similar. In these cases, the use of a close-board fencing with mesh gate for front visibility is permitted.
- Specialised chain link fencing for site boundary marker. Requirements (i.e. post and wire or similar) shall be defined according to the site conditions.
- 1800mm coloured powder coated mesh fence for internal compound segregation (height restriction under busbars).
- Coloured powder coated mesh fence to enclosed ground level cables room at elevated switch houses.

The above types shall be adopted subjected to confirmation from UK Power Networks security adviser.

5.2.2 Amenity Fence

An amenity fence is a fence provided to meet covenants or planning authorities' requirements. In view of the varying requirements of planning authorities and the desirability of avoiding a clash of appearance with the surrounds no standard is defined in this document.

The amenity fence arrangement shall be specified to the minimum standard to meet the requirements imposed, having due regard to maintenance costs.

In all cases, the amenity fence shall provide minimum screening effects to discourage unauthorised interference, combined with reasonable resistance to vandalism. Graffiti proof surfaces are preferable.

5.3 Foundations Design

Site soil characteristics shall be considered when determining the concrete mix for kerbing irrespective of the security fence rating.

Foundation design calculations shall be submitted for any high-risk fence taller than 3000mm and shall consider soil conditions, wind loading and accidental loads. The factor of safety for overturning shall be 1.5 for all foundation types.

The foundation calculation method for planted foundations for security or amenity fences shall be as per Standard for Highways Volume 2 Section 2 Part 1 BD 94/17.

Supporting calculations shall be presented in accordance to the following guidance:

- The maximum destabilising moment M_{ds} shall be calculated considering the worst load case scenarios e.g. wind load or dynamic load from snow clearance or any impact load to the fence post.
- The destabilising moment shall be calculated about a fulcrum point located at $1/\sqrt{2}$ of the planting depth below ground.
- The destabilising moment M_{ds} shall then be multiplied by the factor of safety for planting foundation as mentioned above.
- The ground resistance moment M_g, shall be calculated using the following formula:

$$M_g = \frac{G \times D \times P^3}{10}$$

Where:

G: factor dependent on the ground in which the planted foundation will be installed (in kN/m^2 per m). Refer to Table 5-2 for G factors.

D: the minimum diameter (or minimum distance across flats for multi sided sections) of the post in the ground (in m).

P: planting depth (in m).

Table 5-2 – Specification of Soil Quality

Quality of Soil	G [kN/m^2/m]
Good: Compact, well-graded sand and gravel, hard clay, well-graded fine and coarse sand, decomposed granite rock and soil. Good soil shall always drain well and in locations where water will not stand for long time.	630
Average: Compact fine sand, medium clay, compact well drained sandy loam, loose coarse sand and gravels. Average soils drain sufficiently well that water does not stand on the surface.	390
Poor: Soft clay, clay loam, poorly compacted sand, clays containing large amount of silt and vegetation matter, and made-up ground. Where quality is unknown, it shall be taken as poor.	230

The planted foundation shall be acceptable if the ground resistance moment $M_g \geq 1.2 \times M_{ds}$.

6 Layout and Configuration

The site boundary shall fall on the outer side of the clear zone and shall be permanently and clearly defined.

A 2000mm wide clear zone external to the fencing line shall be maintained to minimise third parties compromising the statutory fence height.

A 2000mm wide clear zone is required along the fence on the inner side to facilitate access to all parts of the compound. Furthermore, it is important to keep this clearance to prevent touch potential issues and to prevent security being compromised from the inside of the compound.

Where reasonably practicable, the security fence shall be installed to allow passage from inside and outside of the site using a standard locking arrangement.

All fences shall allow a clear line of sight into the substation to deter unauthorised intruders from seeking shelter inside the substation compound.

The minimum height of a standard security fence is 2400mm, whereas a high security fence is 3000mm high.

The UK Power Networks security advisor or the customer's security risk assessment shall confirm the requirement for a high security fencing arrangement.

Boundary and compound security fencing shall be constructed to avoid providing any climbing aids.

Where reasonably practicable, right-angle internal corners shall be avoided in security fences and 135° angles shall be provided instead.

A crash barrier or similar approved shall be provided to protect security fences adjacent to any permanent car park, driveway, road, or similar.

7 Earthing

The substation fence earthing system shall be designed and constructed in accordance with EDS 06-0013 and ECS 06-0022.

8 Signs and Labels

The substation signs and labels shall be provided in accordance with EDS 09-0019.

9 Materials

9.1 Steelwork

All grade of steel for fencing systems shall be S275 as a minimum.

All fence posts and rails shall be hot dip galvanised conforming to BS EN ISO 1461 with a minimum thickness of 85 microns.

For substations located near coastal areas, or where the environment condition can be corrosive, refer to the Galvanizers Association Corrosion Map for confirmation of the galvanizing thickness required.

BS EN 1090 makes compulsory to supply fabricated structural steelwork or aluminium to site that to conform to the standard and carry the CE mark. Only firms that are CE marked with a specific ‘Execution Class’, as defined in BS EN 1090-1 shall be used. For substation projects, the execution class is ‘buildings in general’.

9.2 Palisade Fences

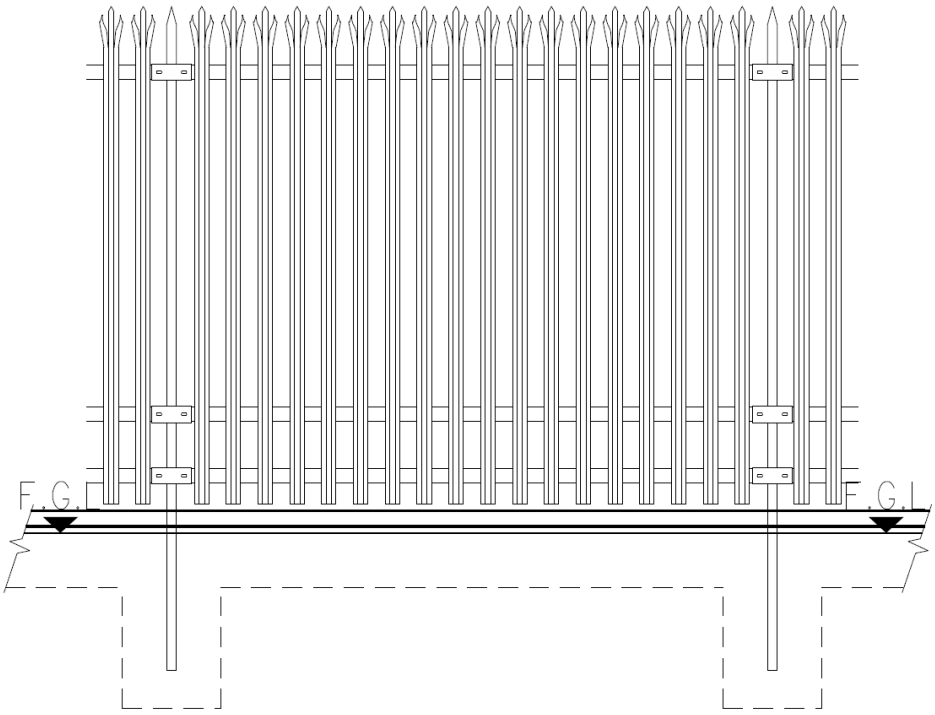

Figure 9-1 – Palisade Panel Elevation

Palisade fencing shall be in accordance with BS 1722-12. The typical arrangement of palisade fence panes shown in Figure 9-1.

Pale types shall be corrugated ‘W’ profile with minimum 70mm width and 3mm thickness. Pales are to be fitted at a maximum 155mm centres, giving a maximum horizontal clear gap in any part of the palisade fence not exceeding 86mm.

Size of the fence post shall be RSJ102x44x7mm and UB127X76X13mm as a minimum for 2400mm and 3000mm high fences respectively. Three UA65x50x5 horizontal rails shall be provided as shown on Figure 9-1 – Palisade Panel Elevation.

In accordance with BS 1722-12, the top oversail is the distance from the centre of the upper rail fixing to the top of the pales and the bottom oversail is the distance from the centre of the lower rail fixing to the bottom of the pales.

The recommended oversail is 300mm at the top and 100mm at the bottom. Manufacturers may vary these oversail dimensions for practical reasons, particularly on the high-risk type; as long as security is not compromised, slight changes are permitted.

9.3 Mesh Fences

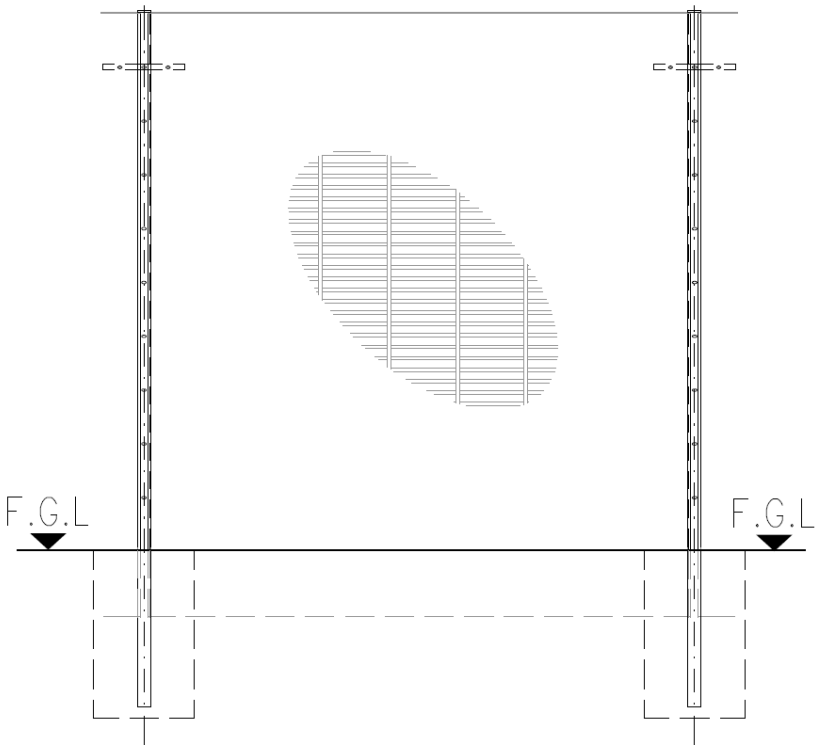

Figure 9-2 – Mesh Panel Elevation

Mesh fencing shall be in accordance with BS 1722-14. The typical arrangement of an open mesh steel panel is shown in Figure 9-2.

Panels shall, as a minimum, be pre-coated with a 95% zinc / 5% aluminium alloy (minimum thickness = 85 microns). An additional polyester powder coating may be applied as instructed by UK Power Networks dependent on specific project requirement.

Horizontal and vertical wire diameter shall be minimum 4mm.

Tamper resistant fixings shall be used.

With a standard anti burrow beam, the bottom of the mesh shall be 50mm above the top of the anti-burrow beam.

If an anti-burrow beam is not included in the design, mesh panels shall extend a minimum of 300mm into the ground surrounded by lean mix to deter burrowing.

9.4 Reinforced Concrete

Structural concrete for fence foundations shall be designed to the latest version of BS EN 206, BS 8500:1 and BS 8500:2, considering chemical and sulphate class.

All reinforced concrete work shall comply with the following specification:

- Foundations and reinforcement details to suit local site conditions and to the structural engineering design.
- Ground contaminants to be removed; local soft spots to be excavated and brought up to formation level with a designated GEN1 mix to BS 8500-2.
- Pour structural concrete on 50mm GEN1 mix concrete blinding, on 1200 gauge polyethylene slip membrane, on DTp1 type material compacted to designer's specification.
- Sulphate resistant cement combination to BS EN197-1.
- RC32/40 concrete mix with 20mm aggregate to BS 8500-2.
- 40N/mm² minimum compressive strength of the concrete after 28 days.
- Concrete cover to rebar 40mm nominal. 50mm to bottom face in contact with blinding. 75mm where in direct contact to soil.
- 25mm chamfers to all sharp external edges above ground level.
- Fair face finish to exposed concrete.
- Finished smooth and level within +/-4mm over 5000mm.
- Ribbed bar reinforcing to BS 4449, strength grade B500B. Steel fabric reinforcement square mesh to BS 4483.
- Welded or exothermic type connections to be indicated on the reinforcement drawings.
- Reinforcing bars to allow for earthing continuity. The reinforcement design shall specify the bars and type of bonding needed to achieve continuity throughout the bund.
- If precast foundations are used, concrete C16/20 conforming to BS 8500 part 1 and part 2 to be used as backfilling material as a minimum.
- Fibre reinforced concrete is allowed for standard risk construction type with expansion joints every 6000mm maximum.

9.5 Backfill

Backfilling material of excavated gap for planted foundations and kerbs shall be equivalent or better-quality material.

All backfilling material shall be placed in 150mm thick layers and shall be compacted to designer's specification.

10 References

10.1 UK Power Networks Standards

EDS 06-0013	Grid and Primary Substation Earthing Design
ECS 06-0022	Substation Earthing Design and Construction
EDS 07-1109	Security Requirements for UK Power Networks Operational Sites
EDS 07-4000	Grid and Primary Substation Civil Design
EDS 09-0019	Safety Sign and Identification Labelling of Equipment

10.2 National and International Standards

BS 1722-12	Fences. Steel palisade fences. Manufacturing and installation. Specification
BS 1722-14	Specification for open mesh steel panel
BS 8500:1	Complementary British Standard to BS EN 206. Method of specifying and guidance for the specifier
BS 8500:2	BS 8500-2:2006+A1:2012. Concrete. Complementary British Standard to BS EN 206-1. Specification for constituent materials and concrete
BS EN 206	Concrete. Specification, performance, production and conformity
BS EN 1090-1	Execution of steel structures and aluminium structures
BS EN ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
BD 94/17	Standard for Highways
ESQC	The Electricity Safety, Quality and Continuity Regulations (ESQC) 2002 as amended (2006)

11 Dependent Documents

The documents below are dependent on the content of this document and may be affected by any changes.

EDS 07-4000	Grid and Primary Substation Civil Design
EDS 07-4050	Grid and Primary Switch House Buildings
EDS 07-4070	Grid and Primary Transformer Bunds and Enclosures

Appendix A – Drawings List

Drawing	Title	Revision
EDS 07-4030.01	Palisade Fence	
	Sheet 1: General Arrangement	A
	Sheet 2: Foundation and Post Details	A
	Sheet 3: Builders Details	A
	Sheet 4: Personnel Gates	A
	Sheet 5: Vehicular Gate	A
	Sheet 6: Enhanced Security Details	A
EDS 07-4030.02	Mesh Fence	
	Sheet 1: General Arrangement	A
	Sheet 2: Foundation and Post Details	A
	Sheet 3: Builders Details	A
	Sheet 4: Personnel Gates	A
	Sheet 5: Vehicular Gate	A
	Sheet 6: Enhanced Security Details	A