

## **PERIMETER SECURITY FENCING FOR SUBSTATIONS AND OTHER OPERATIONAL COMPOUNDS**

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### **PURPOSE AND SCOPE**

All perimeter security fencing shall comply with "The Electricity Safety, Quality and Continuity Regulations 2002" as a minimum standard. These minimum standards, relevant British Standards and/or Eurocodes should be used as a reference when the item is not covered or superseded by this technical specification.

The function of perimeter security fences is to provide a deterrent, physical barrier and potential alarm against intruders. The perimeter fence shall be robust to give long delay times for access/egress for person's intent on unauthorised access.

This technical specification is applicable to the design and construction of perimeter security fencing for the following:

- The perimeter of all new build (green or brown field) substations and other *operational compounds*, e.g. cable sealing end compound.
- Any existing site where the perimeter security fencing is to be replaced in its entirety
- Any partial modification, extension or repair to the perimeter of an existing (non Critical National Infrastructure) site

Site boundary or demarcation fences are not covered by this technical specification. However, High Voltage (HV) segregation fences are covered.

The purpose of this technical specification is to provide National Grid's minimum security requirements for perimeter security fencing. The specification details the required functions of the perimeter security and *operational compound* fences with respect to three categories of substation security risk as stated below:

- Category 3- Reduced
- Category 2- Standard
- Category 1- Enhanced

It also gives the minimum acceptable standards for important features of the fence and attachments.

The location and/or strategic importance of certain sites will necessitate additional security features. The identities of such Critical National Infrastructure (CNI) sites are not available in the public domain and their individual requirements will be identified on a site by site basis as necessary and incorporated into the project specification accordingly. National Grid Group Security shall be engaged during the project development stage in order to facilitate this assessment process and confirm whether a site is CNI rated.

CNI specifications are not included in this technical specification. In the event of a site being designated as CNI, reference shall be made to NG security for the specification.

*Text contained in boxes, such as this, provides an informative commentary. It does not form part of the formal requirements of the document, but aims to explain the rationale and 'spirit' of the requirements.*

## PART 1 – PROCEDURAL

### 1 FENCE SYSTEM

**1.1** Fence systems shall fall into categories 3-1. The choice of installation method for fence systems shall as far as reasonably practicable be made following the hierarchy as below:

**1.1.1 Category 3 – Reduced** – As per 'Standard' but without electric fence.

**1.1.2 Category 2 – Standard** – A physical mesh or palisade barrier to 2.4 m height with electric pulse fence.

**1.1.3 Category 1 – Enhanced** – As per standard with enhanced features as stated in 3.3.

**1.2** The requirements for each category detailed in sections 3.1 to 3.3 are to be used in conjunction with the general requirements detailed in section 2.1 below.

**1.3** External substation perimeter security (fencing and gates) shall, as a minimum, be a Category 2 'Standard' fence system.

**1.4** Unless otherwise specified by National Grid the perimeters of operational compounds or similar designated areas that are discretely independent of substation sites shall have, as a minimum, a Category 3, 'Reduced' fence system. Additionally, if necessary the feasibility of providing a full Category 2 'Standard' fence system shall be considered with the options presented to National Grid for consideration and possible inclusion in the project scope.

### 2 GENERAL REQUIREMENTS

**2.1** The general requirements detailed below shall apply to all perimeter security fencing as appropriate.

**2.2** Unless otherwise indicated in this technical specification all palisade fencing shall be in accordance with BS 1722-12:2006 – 'Fences. Specification for steel palisade fences'.

**2.3** Unless otherwise indicated in this technical specification all mesh fencing shall be in accordance with BS 1722-14:2006 – 'Specification for open mesh steel panel'.

- 2.4** The minimum foundation sizes detailed in BS 1722-12:2006 – 'Fences. Specification for steel palisade fences' and BS 1722-14- 'Fences. Specification for open mesh steel panel,' shall not be used without supporting calculations demonstrating their suitability for the specific ground and exposure conditions. The factor of safety against overturning shall be;

- 2.0 for *planted base* type foundations (See 'Informative' box below)
- 1.5 for *gravity base* foundations

*INFORMATIVE: The factors of safety against overturning for gravity base foundations is less than that for planted base foundations because the latter are reliant on soil pressures whereas the former are governed by self weight which can be determined more accurately.*

NB: Further guidance on designing planted post foundations can be found in Appendix A.

- 2.5** The maximum wind load that causes a fence post to fail should be factored and used to calculate the foundation loading.
- 2.6** In addition to the loading requirements defined in BS 1722-12:2006 – 'Fences. Specification for steel palisade fences' and BS 1722-14 – 'Fences. Specification for open mesh steel panel', 'straining' fence posts and their foundations shall be designed to resist 25% of the maximum load effects due to the electric pulse fence wires according to the manufacturers' recommendations. Corner posts should be designed for 100% of the load combination.

N.B. Electric pulse fences are further detailed in section 3 of this technical specification.

- 2.7** Where necessary, icing conditions shall be designed in accordance with the guidance provided in BS EN 1991-1-4 – 'General actions- Wind actions'.
- 2.8** Fence post foundations shall be a minimum of grade C20/25 concrete, preferably unreinforced to a minimum depth below ground level equal to one third the height of the palisade fence above ground level. Such that for a 2.4m palisade fence the post foundation shall be a minimum of 800mm deep. Exact dimensions shall be designed to suit the site ground conditions.
- 2.9** The base of excavations for 'gravity' type post foundations shall be consolidated.
- 2.10** Post foundations and cills for palisade fencing shall have a nominal fall away from embedded posts and pales in the top surfaces of the concrete to aid water run-off.
- 2.11** Where an anti burrow cill is used a grade C20/25 concrete having minimum dimensions of 300mm wide x 350mm deep (subject to site ground conditions) and projecting 25mm above finished substation level shall be installed between the fence post foundations on the same longitudinal centre line. Wherever possible (i.e. where not required structurally or to control early thermal cracking) these shall be unreinforced. Exposed arrisses shall have a nominal 25mm x 25mm chamfer. Finishes to concrete surfaces shall be in accordance with TS 3.10.04.

Expansion joints comprising longitudinal epoxy coated or stainless steel dowel bars shall be installed in the concrete cill at every other fence post position.

- 2.12** Where palisade fencing is used, concrete cover to all embedded un-galvanized or un-protected steel fencing components shall be at least 75mm.
- 2.13** Where mesh fencing is used, concrete cover to all embedded un-galvanized or unprotected steel fencing components shall be at least 75 mm in accordance to BS 1722-14- 'Fences. Specification for open mesh steel panel.'

- 2.14** Prior to hot dip galvanising a minimum of 4 no. 4mm thick steel lugs shall be welded to the back (internal face) of each fence post at appropriate centres to facilitate connection of the electric pulse fence system support posts. Shot fired nail or similar systems that will damage the hot dip galvanising shall not be used. Tops of the lugs are to be sloped at 50 degrees from the horizontal to hinder foot holds.
- 2.15** The design and fabrication of the fence system, including the electric fence, gates and access control systems shall make allowance for appropriate connection to the substation earthing mat. The functional performance and test requirements for all earthing systems shall be in accordance with TS 3.01.02 – Earthing.
- 2.16** To prevent the formation of climbing aids the horizontal alignment of fencing shall not incorporate linear changes in direction of less than 135° (when measured on the outside of the substation).
- 2.17** A clear area shall be provided outside the substation perimeter at the same level as the adjacent site. Wherever possible and dependent on site logistics, topography and ground conditions this shall be 2 metres.
- 2.18** De-mountable fencing shall be installed only when instructed by, or with the prior agreement of, National Grid.
- 2.19** Stone guards shall be installed only when instructed by, or with prior agreement of National Grid.
- 2.20** Existing fencing systems shall not be taken down and re-erected on new alignments unless instructed by, or with the prior agreement of, National Grid.

### **3 SPECIFIC REQUIREMENTS**

#### **3.1 Category 3 – Reduced**

- 3.1.1** The function of the perimeter security fence at Category 3 is to prevent danger or unauthorised access to live HV Equipment. A Category 3 fencing system shall be installed when instructed by, or with the prior agreement of, National Grid.
- 3.1.2** A Category 3, 'Reduced' fence system shall be designed as a Category 2 'Standard' fence system but without electric pulse fencing.
- 3.1.3** Fence posts shall have lugs installed in accordance with 2.14, ready to receive electric pulse fence railings should this be required as a potential retrofit.

#### **3.2 Category 2 – Standard**

##### **Palisade Fencing**

- 3.2.1** The overall height of the fence shall be 2.4m above base level, and unless otherwise specified within this technical specification, shall be designed to the general purpose fence specifications detailed in BS 1722-12:2006 – 'Fences. Specification for steel palisade fences', BS type reference GP 24.
- 3.2.2** An electric pulse fence system shall be installed to the rear (internal) face of the security fence, attached to lugs welded to the fence posts, extending 3.4m above base level.
- 3.2.3** Pale types shall be corrugated 'W' profile for SP fences in accordance with BS 1722-12:2006 – 'Fences. Specification for steel palisade fences', having a minimum face to view (width) of 70mm and a nominal thickness of 3mm. Pales shall have single pointed, splayed and returned heads.

- 3.2.4 Pales are to be fitted at a maximum 155mm centres, giving a maximum horizontal clear gap in any part of the palisade fence to not exceed 85mm.
- 3.2.5 Horizontal support rails (2 no. per panel) shall be 2730mm long, 45x45x6mm.
- 3.2.6 Pales to rail fixings are to be 8mm diameter Swaged Collar Grooved Rivets with proprietary elongated heads, shaped to suit the troughs of the W pales. Rail to fishplate fixings are to be 12mm diameter galvanized round head bolts and shear nuts. All fixings shall be in accordance with BS 1722: Pt 12. Sheared faces are to be touched up with an NG approved corrosion protection system in accordance with NGTS 3.10.14 – Painting of Substation Plant, Equipment and Structures.
- 3.2.7 All pale to rail fixing assembly samples shall be able to withstand an 18 kN loading when tested in accordance with BS 1722-12:2006 "Fences", Annex C.
- 3.2.8 There shall be a nominal clearance between the bottom of the pales and the top of the concrete cill beam of 50mm.
- 3.2.9 Fence posts, rails and pales shall, as a minimum be constructed of S275 grade steel.
- 3.2.10 All steel components (including those embedded in concrete) shall be hot dip galvanised to BS EN ISO 1461:2009 – 'Hot dip, galvanized coatings on fabricated iron and steel articles. Specifications and test methods'.
- 3.2.11 The minimum thickness of hot dip galvanising shall be 85 microns. The minimum thickness shall be increased where necessary to take account of any site specific factors which may affect the corrosion rate.
- 3.2.12 Hot dip galvanised materials shall not be post drilled. Fixings to be made after hot dip galvanising shall be made with clamped fixings.
- 3.2.13 Bolts shall be a minimum strength grade of 8.8. Nuts shall be a strength grade of 8.
- 3.2.14 Fence panels are to be anchored into the cill on the centre line with 2 no. pale extensions at 1/3rd points along the panel lengths. These pales are to extend 250mm into the cills.
- 3.2.15 The distance between adjacent changes in horizontal alignment shall not be less than 2.75 metres (i.e. the length of a standard fence panel).
- 3.2.16 Panel rails are to extend into the post between the post flanges such that the panels are captive laterally between the flanges, even if the panel bolts are removed. On the corners of fence lines it may be necessary to consider flange extensions to ensure lateral retention of the fence panels. The ends of the rails are to terminate no more than 7.5mm from the web of the posts. Fish plates are to be located in slots through the web of the posts.

### Mesh Fencing

- 3.2.17 The overall height of the fence shall be 2.4m above base level, and unless otherwise specified within this technical specification, shall be designed to the general purpose fence specifications detailed in BS 1722-14:2006 – 'Specification for open mesh steel panel'.
- 3.2.18 An electric pulse fence system shall be installed to the rear (internal) face of the security fence, attached to lugs welded to the fence posts, extending 3.4m above base level.
- 3.2.19 A fence should be a welded mesh panel built to the manufacturing standard '358 Welded Mesh Fence' or to 'Category 2 security' both in accordance with BS 1722-14:2006 Fences. 'Specification for open mesh steel panel.'
- 3.2.20 The earthing system installed should not affect the integrity of the mesh panels.