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Electricity Substation Construction

400kV and 275kV Gas Insulated Switchgear (GIS) and Air Insulated Switchgear (AIS) Substation Buildings

Design Handbook

**DH 18
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1 **INTRODUCTION**

1.1 **SCOPE**

- 1.1.1 This document details mandatory prescriptive and functional requirements relating to the construction of new and, where suitable, modifications to existing buildings and associated infrastructure on 400kV and 275kV Gas Insulated Switchgear (GIS) substation sites and where, appropriate Air Insulated Switchgear (AIS) substations. It is a development of, and shall be read in conjunction with, all relevant National Grid standards as appropriate.
- 1.1.2 For the purposes of this document it is assumed that a GIS substation shall comprises up to three distinct groups of buildings described below. These building units shall be used individually or in combination as necessary to achieve the project objectives. Design and configuration shall be as economic as possible whilst achieving the required levels of functionality. On new build projects all building groups may be utilised whilst at existing sites only certain elements may be required to supplement existing facilities.
- 1.1.3 Barring the exceptions in 1.1.4 the requirements contained herein shall constitute the design standards for all GIS substation buildings and, where appropriate, the equivalent buildings on AIS substations. Only where it is proven that there is a more technically proficient and/or cost effective solution shall alternative arrangements be permitted.
- 1.1.4 These requirements shall not apply to 132kV GIS Substation Buildings (which are generally elevated to facilitate cable entry) or multi-storey 400kV and 275kV GIS Substation buildings. This document shall be supplemented with additional specifications for such installations.
- 1.1.5 Design work shall comply with all appropriate National Grid Technical Specifications (NGTS's and TS's), Design Handbooks, British Standards, European Standards and Codes of Practice as appropriate and be in accordance with recognised analytical methods. Where the requirements of this document or any other relevant project specifications are in conflict those specifically detailed within this document shall take precedence.
- 1.1.6 The building groups shall be as follows;

a) **SWITCH HALL**

The primary function of the switch hall building shall be to act as a 'weather shield' for the Gas Insulated Switchgear contained therein.

b) **ANCILLARY PLANT ROOM BUILDINGS**

Comprising individual prefabricated modular buildings housing one or more of each of the following facilities;

- LVAC Supplies/Distribution Room
- Protection Room
- Battery Room
- Telecoms Room
- Substation Control System/Permit Room

c) **AMENTIES BLOCK**

Comprising a single prefabricated modular building containing one or more of the following as necessary;

- Kitchen/Mess facilities
- Toilet
- Office

- Drying/Shower room
- Meeting/Records room

Guide drawings showing key building features are included in the appendices.

1.2 GENERAL REQUIREMENTS

- 1.2.1 As the works are for a Statutory Undertaker, they are technically exempt from the requirements of the Building Regulations however notwithstanding this or any other exemptions that may be applicable and unless specified to the contrary in this document, all building work shall be in accordance with the appropriate requirements of the Building Regulations. Where literal compliance is not possible the work shall be to an agreed standard that takes the Building Regulations as its basis. Wherever possible specific consideration shall be given to those requirements relating to the health, safety and welfare of people, the conservation of fuel and energy, ease of access and facilities for disabled people and fire safety and means of escape.

INFORMATIVE: With regard to interpreting the Building Regulations and any other relevant legislation the Switch Hall Building is not to be classed as a 'work place'.

INFORMATIVE: Due to the generally physical and potentially hazardous nature of the majority of operational tasks necessary in substations it is considered unsafe and impractical to assign such work to individuals having certain types of disability. Moreover the broad spectrum of conditions covered by the Disability Discrimination Act (DDA) make it unviable to make advance provision for every potential employee. Consequently the Switch Hall and Ancillary Plant Room Buildings shall not be required to include any specific or general provision for disabled users in accordance with the DDA.

Where it is reasonable, and it can be confirmed that they will not endanger themselves or their colleagues, employees with disability may be asked to work in an operational substation environment. In such instances an assessment of the designated place of work will be carried out and the necessary building modifications made retrospectively to facilitate this.

The exception to this will be the Amenities Block which will make full provision for wheelchair users because;

- a) It is considered more likely that such individuals (both employees and visitors) will use these facilities (for meetings etc), and*
- b) To retrospectively make such provision would be prohibitive.*

It is assumed that all visitors who are identified as disabled will be escorted by National Grid personnel while on site to ensure they are fully aware of the areas into which they may safely go.

- 1.2.2 All building systems shall have a 40 year design life unless noted otherwise
- 1.2.3 In all instances consultation with the appropriate planning authority in accordance with the Town and Country Planning (General Permitted Development) Order shall be necessary with respect to the external appearance of the building.
- 1.2.4 Dedicated SF₆ washing facilities shall not be required where a permanent shower/drying room is provided in accordance with Section 4 of this document or in accordance with the Civil, Structural and Building Engineering Design Handbook, DH10. Where such facility is not

provided an outdoor area comprising a 6m x 4m concrete slab and complying with the requirements specified in DH10 shall be installed.

- 1.2.5 Steel reinforcement shall only be used in concrete for structural reasons or to control early thermal cracking. Where alternatives to steel (e.g. fibre reinforced concrete) are proposed a trial area having the same cross sectional area as the proposed permanent works element shall be constructed on site to demonstrate the efficacy of the methods of batching, delivery, placement, compaction and curing.
- 1.2.6 Where required earthing systems and connections shall be designed in accordance with NGTS 3.1.2, 'Earthing'.
- 1.2.7 All door lock barrels shall be suitable for replacement with National Grid master key barrels.
- 1.2.8 All buildings including cable, duct and trench entries shall be appropriately sealed to prevent vermin entry.
- 1.2.9 The external doors (including the roller shutter door) and opening windows of all buildings shall be fitted with intruder detection systems with an audible alarm. There shall be two independent systems, one covering the Amenities Block only with the control panel in that building and one for the Switch Hall and Ancillary Plant Room buildings with the control panel in the Substation Control System/Permit Room.

INFORMATIVE: The principle of the intruder detection and alarm systems shall be such that a visitor to the site may utilise the Amenity Block facilities without compromising the security of the operational buildings.

INFORMATIVE: The design principles of this document are based on the assumption that at 400kV, cable, transformer or Air Insulated Switchgear (AIS) connections shall be via Gas Insulated Busbar (GIB) tubes through the wall of the Switch Hall building to outdoor sealing ends, bushings or transformer GIB connections and not through a cable basement.

2 SWITCH HALL BUILDING

2.1 GENERAL LAYOUT

- 2.1.1 The GIS Switch Hall building shall consist of a single room sized to accommodate the proposed GIS equipment and associated Local Control Cubicles (LCC's). There shall be sufficient space to facilitate access for all necessary construction, testing and commissioning, inspection, maintenance and removal activities. The arrangement shall make allowance for the installation of future bays where specified. See appendices A and B.

INFORMATIVE: No other rooms shall be contained within, or form a structural part of, the Switch Hall building. Other equipment and facilities shall be located within separate buildings as detailed below.

- 2.1.2 An internal 'lay down' area shall be provided immediately adjacent to the roller shutter door (see below) to facilitate the assembly, installation and maintenance of the GIS plant, for storage of materials and SF₆ gas cart and bottles and to access the gantry crane for maintenance. This area shall be a minimum of 4m long by the full width of the building.

- 2.1.3 3 no. individual steel cages (nominal dimensions 1.8m x 1.8m x 1.8m) each with separate access gates shall be provided in the 'lay down' area for the storage of SF₆ gas bottles, portable earths and hoists/lifting equipment respectively.
- 2.1.4 The Switch Hall floor shall be 150mm above the external site level.
- 2.1.5 There shall be a continuous, clear route having minimum dimensions of 1.3m horizontally and 2.2m vertically from floor level around the perimeter of the switchgear 'footprint' to facilitate gas cart access.
- 2.1.6 LCC's shall be supplied with suitable humidistat controlled trace heating.

2.2 BUILDING FRAME AND CLADDING

- 2.2.1 The Switch Hall building shall comprise a single storey mono pitch steel portal frame design. It shall be of economic design such that it provides a 'weather shield' to the gas insulated switchgear and LCC's.
- 2.2.2 The external wall covering shall comprise single skin, un-insulated profiled aluminium metal cladding extending for the full height of the building.

INFORMATIVE: The only exception to the above would be where the wall is required to provide fire resistance due to the close proximity of an adjacent hazard or boundary.

- 2.2.3 The roof shall be a built up or composite insulated profiled metal cladding system. To prevent condensation forming on the internal surfaces the external sheet shall be aluminium.

INFORMATIVE: Experience has shown that aluminium cladding is susceptible to pulling off at fixing positions where an inadequate bolt and/or washer configuration has been detailed and installed. The selected system shall therefore specifically address this failure mode and where necessary demonstrate its suitability by means of design and/or testing.

- 2.2.4 To avoid electrolytic corrosion mill finish aluminium shall be separated from incompatible materials by a suitable barrier (e.g. paint, isolation tape, thermal pads etc).
- 2.2.5 The cladding system shall have a life to first inspection of 20 years.
- 2.2.6 All structural steelwork shall be galvanised.
- 2.2.7 The building frame shall be suitably connected to the substation earthing grid at the bottom of every column stanchion. No other specific lightning protection measures shall be provided.

INFORMATIVE: Windows and roof lights are not required in the Switch Hall building