Electricity Distribution

nationalgrid

Company Directive

EE SPEC: 140/2

Steel Substation Buildings

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Approved by

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Engineering Policy Manager

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Target Staff Group	**Purchasing, Primary system design and Engineering design, Major Projects**
Impact of Change	**Green**
Planned Assurance checks	**Issue of successful contracts and first orders**

IMPLEMENTATION PLAN

Introduction

This Engineering Specification details the design for Steel Substation Buildings.

Main Changes

This document has been revised to change the standard temperature in a substation switch house to avoid temperature changes for the switchgear, dehumidification requirements and removal of forced air cooling vents/systems.

Impact of Changes

This Engineering Specification is relevant to:

- All staff who are involved with Substation installation at Primary and Distribution levels.
- All staff who are involved with specifying or purchasing Steel substation buildings.

Implementation Actions

Managers should notify relevant staff that this Engineering specification has been issued and brief them on its requirements.

Implementation Timetable

This Engineering specification shall be implemented with immediate effect.

REVISION HISTORY

Document Revision & Review Table		
Date	**Comments**	**Author**
February 2025	• Update to include clarifications on heating, dehumidification, internal arc venting	Geoff Budd
September 2020	• Update to include clarifications	Andrew Reynolds
January 2019	• First issue of document specification of steel substation buildings.	Andrew Reynolds

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1.0 INTRODUCTION

National Grid Electricity Distribution (NGED) has a requirement to install all switchgear in a building or housing, requirements to use modular steel buildings has increased with time but their use shall be limited to small installation with 5 or fewer circuit breakers.

Steel buildings have disadvantages over conventional brick built buildings and GRP housings hence limited use. This specification covers NGEDs requirements for those steel buildings.

Where the term “shall” or “must” is used in this document, it means the requirement is mandatory. The term “should” is used to express a recommendation. The term “may” is used to express permission.

2.0 BUILDING DESIGN

2.1 General

The Building needs to be designed and constructed so that it can be lifted and transported with switchgear installed inside it but consideration is therefore required to how the overall unit can be physically lifted into its final position on site e.g. a lifting plan. The building and its surrounds needs to consider the likely requirement to remove and add panels so appropriate access and supporting platforms have to be incorporated.

2.2 Design Life

The Steel building has to have a design life of 50 years. Inspection and preventive maintenance and a periodic recoat is understood however any repaint should not.

2.3 Building dimensions

Example building dimensions are

External: 7,730mm long x 4,030mm wide x 3,850mm high

Internal: 7,500mm long x 3,800mm wide x 3,000mm high

Weights need to be specified at the time of tender. Exact dimensions will be advised at the time of tender but minimum distances to the rear and side of the switchgear shall be maintained to allow access/egress/switchgear testing or maintenance.

2.4 Support

The building should be designed to be supported on either of the following concrete foundations (raft, strip or pad/pile) and can also be elevated on steel legs capable of taking the full weight of building and contents for its design life, to create an above ground cable basement.

Buildings to be installed in areas of flood risk will need to have support legs to mitigate the risk of flooding.

2.5 Design

The building shall be designed to an in accordance with the following BS EN 1993-1-1: 2014 (Eurocode 3) with wind loadings based on BS EN 1991-1-4: 2005 (Eurocode 1).

2.6 Construction

The building shall be constructed in accordance with BS EN 1090-1 with processes and procedures in accordance with BS EN 1090-2 Execution Class 2 (EXC2), and will be 'CE' certified accordingly.

2.7 Thermal Ratings

The building shall have as a minimum the following thermal ('U') values –
Roof – 0.37W/m²K, Walls - 0.37W/m²K, Base - 0.35W/m²K. Solar gain needs to be considered and how this is effectively dissipated. Consideration should be given to solar shields to walls/roof.

2.8 Fire Resistance

The building shall be manufactured from fire resistant, non-combustible materials throughout. The building shall have a design that has been independently fire tested to EN1364 and achieves up to 60 minutes fire resistance (stability/integrity). Standard performance of 60 minutes to walls, roof, floor and doors is included.

2.9 Moisture Ingress

Enclosure doors shall be IP55. This is to ensure the door seals are suitably protected from ingress of dust and significant weather events which are increasing the intensity of rain in excess of the test standard an IP54 is required to pass.

Blast vents shall be as close to IP55 as realistically possible.

IP rating of the rest of the enclosure shall be IP55W. The requirements for the weather protection shall be

Installation of external solar shields to the outer body of the enclosure. Shields to be same colour of rest unit, RAL7004 Signal Grey

Main access doors to have appropriate permanent shielding fitted to minimise rain entering the enclosure when doors are open.

Application of suitable insulation to ensure that condensation cannot easily occur internally during external temperature changes.

2.10 Building Finish

The building module exterior walls, roof and doors shall be painted, and consideration should be given to the diverse nature of NGEDs network and locations that these buildings may be situated in from town centres to coastal locations an atmospheric corrosivity category C4 should be used as a standard. Enhanced coating systems should be offered for use in atmospheres up to and including Marine Coastal and Offshore. Consideration for special coatings such anti-graffiti top-coats must be considered.

3.0 BUILDING STRUCTURE

3.1 General

The building shall be of a welded carbon steel construction with a durable coating system applied continuously to the exterior/interior surfaces to prevent corrosion.

3.2 Base

The base shall be made up of mild steel, primed to provide corrosion protection, structural sections, sized to suit the equipment loading.

The floor will be of 5mm plain mild steel plate and the base under-drawn with pre-finished, zinc coated steel sheet with the void space insulated.

The building shall be fitted with mountings to allow bolting down to a suitable foundation. Anchor bolts will be included.

Mountings are also included for bolting of jacking brackets to allow the building to be jacked for skating.

Framed apertures are provided within the floor structure for cable entry/exit underneath switchboard and ancillary equipment as required. 3mm stainless steel/aluminium plates are provided to each aperture position.

3.3 **Walls**

The wall structure shall incorporate a mild steel, primed, structural framework to take the wind and lifting loads.

The external wall skins will be formed from minimum 2mm zinc coated steel sheet with vertical and horizontal stiffening members to cater for the wind loading.

The walls are lined internally in zinc coated steel sheets with the void space insulated. Framed and lined apertures are provided for arc vent over-pressure systems and any air inlet louvres. Protection system needs to be included to prevent fire from escaping through vents and louvres. These need to come into effect after fire breaks out

3.4 **Arc Vent and Over Pressure**

Modern switchgear is designed to provide controlled release of any electric arc and arc products in the event of an internal failure such that a person at the operator position should not receive any life-changing injury.

The correct operation of the internal arc venting requires sufficient space around the switchgear and certain minimum distances to walls and ceiling need to be achieved. [This minimum space requirement is often referred to as the vent volume.] Where the minimum space requirements cannot be achieved, then direct venting of the arc and arc products to the outside of the building is required.

As well as achieving the vent volume requirements, the construction of the building containing a switch room must be sufficient to withstand the expected mechanical force and the internal pressure caused by an arc, and sufficient for absorbing any static and dynamic forces which may occur during normal operation of the switchgear. This may require the provision of over-pressure relief panels as an integral element of the switch room design.

Blast Relief Venting Manufacturer:

AFP Air Technologies LLP, Type/Size: SHX-UN 500, Clear Opening: 555mm(W) X 545mm(H). Fitted with high security grill – HD range (SG HD) & Dynamic weather louvre (DWL).

3.5 **Roof**

The roof shall have a 5° dual pitch configuration designed with welded lifting points to enable the building to be lifted with all the equipment installed.

The external skins of the roof will be of minimum 2mm zinc coated steel, under-drawn in zinc coated steel sheets with the void space insulated and to create a flat ceiling. Other materials will be considered that allow for corrosion prevention.

Rainwater guttering and down pipes are included. Factory trial-fitted and then removed for transportation.

Safety signs shall be fitted to warn of areas of the roof that are no walk areas.

3.6 **Doors**

Each building module shall have a double entrance door for both equipment installation and a personnel access/egress to the front of the switchboard elevation and rear-positioned emergency escape door.

The double door shall be 2,000mm wide x 2,500mm high, outward opening and be of a double skin, insulated construction as per the rest of the buildings construction with the following features:-

Stainless steel hinges.
Locking system including internal panic bar and external lock override supplied with NGED standard cylinder (supplied free of charge) to the normally opening leaf and shoot bolts to the normally closed.
Weather seals that last the expected 40years. All earth bonding to prevent risk of shock.
A removable threshold.
Hook and eye door retainers
Hydraulic door closer to normally opening leaf
Internal panic bars

The single Fire Exit door shall be 1,000mm wide x 2,000mm high, outward opening and of a double skin, insulated zinc-coated construction with the following features:-

Stainless steel hinges.
Internal panic bar
Weather seals to last 50 years
Earth bonding
Removable threshold
Hydraulic door closers.

3.7 **Finish**

All external surfaces will be painted in to prevent corrosion to a C5VH level or better dependent on the location that the building will be situated, this will be advised at time of specific site order.

Colour will be a standard 12B29 Juniper Green, Midnight Green BS4800/5252/ or RAL 7004 Signal Grey unless otherwise requested at time of order.

The internal walls and ceiling will be painted colour to be white and be maintenance free for the life span of the building.

The module floor surfaces will be painted and be **non-slip for 25 years life** of the building.

The underside of the base shall be coated to prevent corrosion for the life span of the building. Consideration will be given to cold dip galvanised bases

3.8 Labels and Signage

Appropriate internal/external Health and Safety signage shall be provided. Fixing points shall be provided for all NGED substation labels to prevent drilling on site.

4.0 BUILDING SERVICES

4.1 General

The electrical system shall work on a single phase neutral earth system 230V 50HZ AC.

4.2 Wiring

All internal wiring will be to a NGED standard and as per all NGED sites.

4.3 Cable Management

The building services wiring shall be contained in appropriately sized, multi compartment, galvanised steel trunking running round the perimeter of each room, with trunking and conduit drops for lighting and sockets. With tray risers from incoming/outgoing service routes.

Galvanised steel wall surface mounted/overhead ceiling/wall supported cable management trunking/ladder/tray shall been included for interconnecting cables between switchgear and associated panels, this will be shown on all drawings.

4.4 Equipment mounting

Support channels shall be provided where requested.

4.5 Lighting

Lighting shall be controlled through a one way wall mounted switch and of LED type but if there is more than one way to enter the substation then multiway light switches shall be provided. Light switches shall be mounted on the open side of the door opening and with a minimum of 200 lux in front of the switchgear and appropriate lighting levels behind. Lighting outside substation leading up to and on walkways shall be a minimum of 10 lux at ground level and PIR controlled. A percentage of the lights shall a maintained fitting with 3 hour integral battery backup.

A key test switch shall be fitted for testing purposes. This lighting shall operate in the event of a power failure, only if the control switch is in the ‘on’ position (battery inhibit).

A 2 hour non-maintained (Running Man) legend back-up light, shall be fitted internally above each exit door.

A bulk head light shall fitted externally adjacent to each door, with PIR operation and a minimum of 10 lux at ground level. Each light shall have an internal PIR override switch.

4.6 Lightning Protection

This needs to be considered and advised of requirements on each and every site on a site by site basis due to the differing nature of each site.

4.7 Heating

The switch room or common switch/control room should have a combined heating and dehumidification system set to provide optimum environmental conditions for the switchgear, operating in a ‘sealed room’ environment and designed to avoid rapid temperature swings.

The system should comprise:-

Wall mounted heaters sized to suit the switch room. These should be capable of providing a normal operating temperature of **16°C**.

The normal ‘background heaters may be electrically heated oil, storage units or tubular (for smaller spaces) but basic convector heaters shall be avoided due to their tendency to fail.

Heaters should be of the ‘no thermostat’ type or, if a thermostat is fitted, this shall be set to maximum allowing control by a separate dual thermostat.

The minimum number of heaters provided shall be two, so as to provide some heating in the event of a failure of a heater.

Single remote wall mounted thermostat with a “dual temperature” facility (if required) to provide control of the convector/electrically heated oil/storage heaters.

This shall be fitted with an override timer to activate the heating boost facility, and shall be of touch or push button design.

4.8 De-Humidification

The system should comprise:-

Sufficient dehumidifiers (e.g. Calorex DH30 or EBAC CD30E (or equivalent)) based on the switch room volume but a minimum of 2 dehumidifiers is always required. Some flexibility (approximately 10%) should be incorporated into this requirement. [For example, based on EBAC CD30E covering a nominal 100m^3 of switch room volume, a switch room with a total of 210m^3 would be expected to have 2 dehumidifiers, not 3.]

Where more than one unit is installed then ideally they should be positioned at different levels in the switch room (for example, one a high level and one half room height). This will ensure that the units work to their optimum.

Units will be controlled by variable remote wall mounted humidistats, one per unit. Humidistats should be set at 55% RH.

Heated condensate drain tube for each unit, fitted with an internal heating element rated at 25 watts/metre. Where possible, the drain tube shall be connected to the site drainage system. If this is not possible, consideration must be given to the discharge location due to the risk of the condensate freezing in cold weather.

Fixed remote humidistat to form the basis of an alarm system indicating failure of the dehumidification system. Alarm humidistat to be set at 70% RH.

Dehumidifier indicator panel (mounted in the control room where separate from the switch room) to give the following indications:

- Power On
- DH1 Drying - indicates dehumidifier number 1 is in drying mode
- DH2 Drying - indicates dehumidifier number 2 is in drying mode
- (Repeat above for any additional dehumidifiers)
- High RH - indicates fixed humidistat has registered a high humidity

So as to provide a non-urgent indication of high humidity an alarm should be taken from the indicator panel and connected to the tele-control system.

In order to prevent nuisance alarms the remote alarm indication should only indicate to telecontrol when the high RH has been present for 24hrs.

The alarm should be auto-resetting so as to prevent the need for unnecessary visits to site.

4.9 **Security Alarm**

To be sourced by others.

4.10 **Labels**

All electrical items are to be identified with engraved labels which are mechanically fixed. A building/site nameplate will be fitted to each door.

Safety labels ‘Mind Your Head’ are also included.

APPENDIX A

SUPERSEDED DOCUMENTATION

This document supersedes EE SPEC: 140/1 dated September 2020 which has now been withdrawn.

APPENDIX B

RECORD OF COMMENT DURING CONSULTATION

EE SPEC: 140/2 – Comments

APPENDIX C

ASSOCIATED DOCUMENTATION

ST: SD3A - LVAC Supplies at Primary Substations

BS7671 “Requirements for Electrical Installations

ST: SP1N - Heating, Dehumidification and Ventilation of Switch Rooms and Control Rooms at Grid, Primary and Major Network Substations

APPENDIX D

KEY WORDS

Housing, steel