



1. SCOPE

This Specification applies to all Switchgear for use on, and for connection to, the Company 132, 275, 400 kV networks. This document specifies the requirements for items of Switchgear but does not cover application, protection, and automatic switching requirements; neither does it cover fixed ancillary installations where they have no direct bearing on the service of the operation of the Switchgear specified. These aspects are covered in the other relevant SPTS documents.

For Switchgear for use on the Company Network (at voltages exceeding 1kV), these are detailed in the relevant Power Systems specifications. However, the general principles of this document apply to all switchgear connected to the Scottish Power System.

2. ISSUE RECORD

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4. REVIEW

This document will be reviewed as and when required.



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6. INTRODUCTION

This document is a Level 2 Specification defining the technical requirements for switchgear 132 kV, 275 kV and 400 kV. Additional requirements for Equipment, Apparatus and services are given in the Level 3 Specifications. Where possible, references are made to relevant Company documents. Where no such Company document yet exists, reference is made to the existing relevant National Grid document.

For Switchgear with rated voltages below 132 kV, reference should be made to the following Company documents:

SWG-03-021 Primary & Secondary Substations Specification for 12kV Indoor Switchgear
SWG-03-020 Specification for 36kV Indoor Circuit-Breakers & Switch-Disconnectors
SWG-03-022 Specification for 33kV Outdoor Circuit Breakers

7. REFERENCES

This specification makes reference to and should be read in conjunction with the latest edition of the following documents:

SPTS1	Ratings and General Requirements for Plant, Equipment and Apparatus for the ScottishPower System and Connection Points To It
BS 1710	Specification for Identification of Pipelines and Services
IEC 60694	Common Specifications for High Voltage Switchgear and Controlgear Standards
IEC 60050	International Electrotechnical Vocabulary
IEC 60376	Specification for Sulphur Hexafluoride for Electrical Equipment
IEC 60480	Guidelines for the checking and treatment of Sulfur Hexafluoride (SF ₆) taken from electrical equipment and specification for its re-use
IEC 61264	Ceramic Pressurised Hollow Insulators for High-Voltage Switchgear and Controlgear
IEC 61462	Composite Insulators for use in Outdoor and Indoor Electrical Equipment
ENA-TS-41-37	Switchgear for use on 66kV to 132kV Distribution Systems
ENA-TS-41-36	Distribution switchgear for service up to 36kV (Cable and Overhead conductor connected)
CIGRE WG 23-10 TF01	Recycled SF ₆ Gas

8. DEFINITIONS



The terms used in this document are defined in IEC 60050 or as below.

Local Control Cubicle (LCC)

The LCC is the point from which control over a piece of Switchgear is executed.

Company

Refers to SP Transmission Ltd, SP Distribution Ltd, and SP Manweb plc including all associated design and planning practices.

SP Distribution Ltd.

The distribution Licence Holder for the Distribution service area formerly known as ScottishPower.

SP Manweb Plc

The distribution Licence Holder for the Distribution service area formerly known as MANWEB (Mersey And North Wales Electricity Board).

SP Transmission

The distribution Licence Holder for the Transmission service area formerly known as ScottishPower.

Apparatus

Physical components of, or associated with, the Company system which are required in support of the plant and Equipment. Examples are substation structures, auxiliary plant and portable test Equipment.

Equipment

Secondary (LV) elements of the Company System such as those for control, measurements, protection and auxiliary supplies.

9. GENERAL REQUIREMENTS

9.1 General

9.1.1 All mandatory requirements of IEC 60694 shall be met.

9.1.2 Switchgear should have an anticipated asset life of not less than 30 years (as per ENA-TS-41-37)

9.1.3 The Supplier shall indicate the maintenance requirements (both time based and duty based), and any mid-life refurbishment activity required to achieve the anticipated asset life (as per ENA-TS-41-37)

9.1.4 Provision shall be made for condition monitoring, diagnostics and site testing. Where these facilities are integral to the switchgear, they shall not reduce the integrity of the prime function of the switchgear or that of neighbouring switchgear. The application and nature of this monitoring and test equipment and apparatus is detailed in the appropriate Company SWGR documents.

9.2 Compressed Gas

9.2.1 Where compressed gas is used for arc-extinction or operation, abnormal gas system condition alarms should be provided. The alarms shall indicate falling gas density/pressure and shall operate at a higher level than any low gas density/pressure lockout devices.

9.2.2 Provision shall be made for remote indication or alarm of density/pressure recharging equipment failure, abnormal gas system conditions and low density/pressure lockout.

9.2.3 Provision shall be made for the connection of equipment for monitoring the rate of change of gas density/pressure of insulation and interruption systems.

9.2.4 The function of the various components of the gas system shall be clearly identified at the switchgear. Different gases or different conditions of the same gas shall be



identified by colour on pipework, vessels, and diagrams¹. The colour shall conform to BS 1710 standard colours for gases.

9.2.5 Instruments and alarms shall be provided to ensure safe and reliable operation of all compressed gas systems.

9.3 Operating Mechanisms, Ancillary Equipment and their Enclosures

9.3.1 The local control and monitoring apparatus shall be accommodated at the switchgear that it controls (this is termed the LCC, or Local Control Cubicle). Such accommodation shall be clearly labelled to indicate the apparatus it contains and the switchgear controlled.

9.3.2 The LCC shall be located at ground (floor/fixed access) level.

9.3.3 Indication of the operational position of the switchgear being controlled shall be unambiguous and clearly visible from ground (floor/fixed access) level.

9.3.4 Switchgear with power operated mechanisms shall be provided with means of initiation of closing and opening, and selection of local/remote control, at the LCC.

9.3.5 Three phase switching devices with separate phase mechanisms shall be controllable from a single point, being the LCC.

9.3.6 The supplier shall clearly state the maximum available number of auxiliary switches and the number normally pre-allocated for use within the switchgear itself. In addition, provision shall be made for at least 30 spare auxiliary switches on circuit breakers, switches and disconnectors. Such provision shall be for 5 early make, 5 early break, ID normally open (NO) and ID normally closed (NC). Disconnectors with busbar transfer switching capacity shall be equipped with auxiliary switches for busbar protection CT secondary switching. Earth Switches shall provision for at least 10 spare auxiliary switches of which 5 shall be NO and 5 NC.

9.3.7 Auxiliary switches shall be positively driven in both directions.

¹ If white is specifically required to reduce the effect on the equipment of radiated heat from adjacent apparatus or excessive solar gain then unambiguous and clear marking shall indicate the gas contained.



9.3.8 Where anti-condensation heaters are fitted in cubicles of switchgear, they shall be physically and electrically shrouded to protect operators of the switchgear from danger.

9.4 Sulphur Hexafluoride Gas (SF₆)

9.4.1 New SF₆ gas shall conform to IEC 60376.

9.4.2 If approved, recycled SF₆ gas shall conform to IEC 60480 and Appendix A of this document.

9.4.3 At the time of commissioning of switchgear containing SF₆ gas, the gas shall have a moisture content of no greater than 25ppm (approximately –35°C dew point at atmospheric pressure).

9.4.4 Scottish Power reserves the right to require reprocessing where the differential between the moisture content of the filling gas and final moisture content is greater than 10ppm (approximately a 5°C dew point change).

10. PERFORMANCE REQUIREMENTS

10.1 Gaseous Insulation

10.1.1 The Supplier shall state the minimum density of the gaseous insulating medium at which circuit-breakers and disconnectors can withstand two fully asynchronous power frequency voltages applied to the opposite terminals of the same pole when in the OPEN position. Each voltage to be equal to the rated phase to earth power frequency voltage.

10.1.2 The Supplier shall state the density of the gaseous insulating medium at which all gas insulated equipment can withstand 1.5 times the rated phase to earth power frequency voltage between its conducting parts and earth and where appropriate between phases.

10.1.3 Where applicable, means shall be provided to enable gas systems to be safely replenished whilst the equipment is in service (not in the case of “Sealed for life” plant).

10.2 Rated Voltage of Closing and Opening Releases and Operating Devices

Direct Current (D.C) Systems

10.2.1 The rated supply voltage of the D.C system and the auxiliary and control circuits, is 125V as defined in IEC 60684, as detailed in Table 1, and indicated by SPTS 1.

10.2.2 To ensure satisfactory operation in this system, the Rated Supply Voltage of closing and opening releases and operating devices measured at their terminals shall be 110 V and as detailed in Table 2. The manufacturer shall indicate any precautions required to ensure satisfactory operation in cases where the voltage of the D.C. Supply System at the equipment location in the switchgear is in the range 121 V to 137.5 V

10.2.3 The supplier shall declare the characteristics of the current required by the closing and opening releases and operating devices when operating at the minimum operating voltage.

Rated Supply Voltage and Range	D.C. System	Closing and Opening Releases and Operating Devices	
		Close	Open
Rated Supply Voltage (V)	125	110	110
Maximum Operating Voltage (V)	137.5	121	121
Minimum Operating Voltage (V)	93.5	87.5	77

Table 1 – Rated Supply and Operating Voltage Range for D.C. Systems and Operating Devices at Grid Substations

Alternating Current (A.C.) Systems

10.2.4 A.C. control systems are not acceptable for the control of circuit-breakers, switches, disconnectors or earthing switches.



11. TEST REQUIREMENTS FOR SWITCHGEAR

11.1 Dielectric Tests

Gas Insulated Switchgear (GIS)

11.1.1 Dielectric tests shall be to the requirements of IEC 62271-203. Where doubt exists regarding the path of any breakdown during testing it shall be assumed that the breakdown involved non-self restoring insulation.

Air Insulated Switchgear (AIS)

11.1.2 Dielectric tests shall be to the requirements of IEC 60694. Where doubt exists regarding the path of any breakdown during testing it shall be assumed that the breakdown involved non-self restoring insulation

11.2 Mechanical Strength of Hollow Ceramic and Composite Pressurised Insulation

General

11.2.1 Hollow ceramic support pressurised insulation shall be designed and tested according to IEC 61264 for pressure and bending stresses.

Duties of the Supplier

11.2.2 The Supplier shall state the type test withstand bending moment, routine test bending moment and the bending moment equivalent to design pressure. In addition the Supplier shall state the bending moment, above that required to satisfy the total loading requirements of the switchgear itself, which is available for the connections to adjacent switchgear².

² The total loading requirement includes consideration of the 100% wind pressure without ice accretion, 100% short-circuit forces, equipment internal pressure, equipment mass and mechanical operation.



11.2.3 Hollow composite insulation for unpressurised and pressurised applications shall be designed and tested according to the rules prescribed in IEC 61462 (Technical Report Type 2). The Supplier shall self-certificate that the insulator materials and insulator design satisfy the design test criteria defined in Clause 7 in IEC 61462.

11.2.4 The Supplier shall state the following insulator mechanical cantilever and internal pressure loads:

Cantilever

Maximum Mechanical Load (MML), i.e., the equipment design load; the routine cantilever bending load; the damage limit; the type test cantilever bending load and the Specified Mechanical Load (SML).

Internal Pressure

Maximum Service Pressure (MSP), i.e, the equipment design pressure; the routine test pressure; the damage limit; the type test pressure and the specified internal pressure (SIP).

11.2.5 The Supplier shall self-certificate the compliance of the routine tests with Clause 10 of IEC 61462.

11.2.6 In addition the Supplier shall state the cantilever bending load, above that required to satisfy the total loading requirements of the switchgear itself, which is available for the connections to adjacent switchgear.



11.3 Routine Tests

- 11.3.1 Routine Tests shall normally be performed at the point of manufacture and shall satisfy the requirements of SPTS 1, this specification, and the appropriate NGTS Level 3 documentation.
- 11.3.2 Where routine tests are performed on site they shall satisfy these requirements, including the production of fully auditable documentation of the test results. The witnessing of such tests at site shall be agreed between the supplier and the Company.
- 11.3.3 Power-operated switchgear shall be operated 50 times to the satisfaction of the Company. This number may include other routine tests, subject to agreement between the supplier and the Company. The operations shall be initiated as in service.



11.4 Assembly and Commissioning Tests

- 11.4.1 Adequate Quality Assurance procedures for site assembly and testing shall be detailed by the supplier to ensure that the switchgear is assembled correctly and to the satisfaction of the supplier and the Company.
- 11.4.2 Commissioning activities including on-site testing shall be performed at site on the complete product to the requirements detailed in SPTS1, this specification and the relevant NGTS level 3 documentation (where no such Company Specification exists). The test procedures and acceptance values shall be detailed by the supplier before commencement of the testing. These tests shall be fully documented together with the results obtained. The results shall be shown to be within the acceptance values.
- 11.4.3 Where assembly and commissioning programmes are to incorporate routine tests, it is essential that the requirements of clause 11.3 are satisfied.
- 11.4.4 Diagnostic tests shall be incorporated into the commissioning test programme and be performed on all equipment to establish its correct operation as installed on site. Diagnostic tests may include, but are not restricted to, the measurement of operating coil currents, contact timing, speed of operation, travel characteristics, contact engagement, synchronous operation of poles, primary circuit resistance, checks for gas and liquid leakage, checks for the correct operation of monitoring devices and checks on the quality of the insulating and arc-quenching media.

12. TYPE TEST REQUIREMENTS

The following requirements are in addition to the type tests detailed in the Level 3 Specifications.



12.1 General

12.1.1 Type tests shall be carried out to ensure that Switchgear complies with this specification.

12.2 Test Report

12.2.1 A test report shall be produced detailing the type tests carried out on the equipment³.

12.2.2 Where measurements are made during the type tests the values shall be included in the report⁴.

12.3 Type Tests

12.3.1 Further type test requirements are specified in the Level 3 Specifications.

³ Submitted test reports may be stored electronically by Scottish Power.

⁴ *The recording of a measurement in the test report is of benefit to both Scottish Power and the supplier in that it provides more information than a simple "Passed" statement.*

13. APPENDIX A

13.1 Background

13.1.1 Scottish Power supports the principle of using recycled SF₆ gas in new switchgear in line with recommendations made by CIGRE Study Committee 23, WG23.10, TF01

13.2 General Requirement for the use of Recycled SF₆ Gas

The re-use of SF₆ gas for switchgear to be supplied on Scottish Power Bulk Contracts shall satisfy the following specific checks and conditions.

13.3 Moisture Content

13.3.1 The moisture content of the gas shall be as low as possible and at most be no greater than or equal to -35°C referred to atmospheric pressure. This is approximately equivalent to 25ppm. This limit is as recommended by CIGRE and it is recognised that it is lower than the value given in IEC 60694 which is the required value to prevent condensation.

13.4 Acidic SF₆ Decomposition Products

Contamination by air, CF₄ or N₂ shall be less than 2% by volume. This shall be measured by a suitable SF₆ percentage-measuring instrument rather than by oxygen content as a precaution against N₂ contamination.

CIGRE advise that a concentration of 12 ppmv (SO₂ + SOF₂) is equivalent to 50 ppmv total acidity. Due to current lack of detailed information on correlation between (SO₂ + SOF₂) levels and total acidity, any gas with (SO₂ + SOF₂) levels in excess of 5 ppmv shall be tested for total acidity with an acceptance level of 50ppmv. The requirement for the total acidity test will be reconsidered following review of field experience.

13.5 Solid Contamination

The Supplier shall aim to have no solid contaminants present in the gas. An acceptable level is achieved by passing the gas through a dust filter of 1 μm pore size.

13.6 Instrument Calibration

All instruments used for the above tests shall have an up-to-date certificate of calibration from an organisation acceptable to Scottish Power.

13.7 Acceptable Limits

The acceptance limits specified above apply to each gas container/cylinder individually. It is not acceptable to aggregate the results from good and poor containers/cylinders when filling a switchgear product.

13.8 Identification of Containers/Cylinders

Each gas container/cylinder containing recycled gas shall be clearly marked:

RECLAIMED SF₆ SUITED FOR RE-USE IN ELECTRIC POWER EQUIPMENT

The supplier of the recycled gas shall provide documentation to certify its compliance with the above requirements.