Electricity Distribution

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Company Directive

ENGINEERING SPECIFICATION
EE SPEC: 182/1

36kV Indoor Primary Circuit Breakers

Author: Stephen Hennell / Andy Hood

Implementation Date: May 2018

Approved by

Policy Manager

Date: 21 May 2018

All references to Western Power Distribution or WPD must be read as National Grid Electricity Distribution or NGED

IMPLEMENTATION PLAN

Introduction

This document specifies the requirements for 36kV indoor circuit breakers and the associated protection, alarm and control systems.

Main Changes

This revision incorporates changes to the values used in the calculation of CT knee point voltages.

Impact of Changes

None as this document reflects the current position.

Implementation Actions

None.

Implementation Timetable

This minor change can be implemented with immediate effect.

REVISION HISTORY

Document Revision & Review Table		
Date	**Comments**	**Author**
May 2018	Minor text revisions to • 3.4.14.2(b) values revised in the formula for determining the knee point voltage for transformer bias differential and restricted earth fault protection. • 3.4.14.2(c) values revised in the formula for determining the knee point voltage for high impedance busbar protection.	Stephen Hennell & Andy Hood
July 2017	This is a new document based on EE SPEC: 3/4. The following changes have been made: • The document only relates to 36kV circuit breakers. Requirements for 12kV circuit breakers are not included. • Warrantee requirements have been added. • References have been updated. • Requirements / options for separate protection panels have been removed. • Class PX CT requirements have been amended. • Requirements for open delta VT windings have been clarified. • Power transducers are specified on 36kV circuits and bus-sections. • Data sheets associated with auxiliary relays, contactors, control / selector switches, transducers, push buttons and lamps have been removed and are included in a separate specification. • Schedule C, associated with switchgear with 2500A busbars, has been added	Stephen Hennell & Andy Hood

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1.0 INTRODUCTION

1.1 This Technical Specification sets out Western Power Distribution (WPDs) requirements for 36kV indoor primary circuit breakers, and busbar metering units with associated protection / control and ancillary electric equipment for use on its 33kV systems.

1.2 It is based on and must be read in conjunction with the current version of ENA TS 41-36 and other referenced Standards and specifications listed either within ENA TS 41-36 or this WPD specification. WPD options, changes or additions to the ENATS requirements are stated in this WPD document. Unless otherwise stated the requirements of the relevant part(s) of ENATS 41-36 shall apply.

1.3 Any selection of options or changes to this specification by WPD shall be made in writing.

1.4 Where this WPD Technical Specification is being used for Tender purposes then unless otherwise specified in writing at time of Tender, all equipment offered against this Technical Specification shall be compliant with this Technical Specification.

2.0 MODIFICATIONS AND ADDITIONS TO ENA 41-36

2.1 References

2.1.1 References are in accordance with ENA TS 41-36 with the following additions in Table 1, below.

2.1.2 Users of all standards and technical specifications shall ensure they are applying the most recent editions together with any amendments.

2.1.3 Whilst the IEC base document is listed for information, the prime document that shall take priority is the British Standard enacting the European Standard (EN) or European Harmonisation Document (HD).

BS No.	Title	IEC / ISO base
BSHD 60269	Cartridge fuses for voltages up to and including 1000V ac and 1500V dc	IEC 60269
BSEN 60255	Specification for electrical protection relays	IEC 60255
BSEN 60688	Electrical measuring transducers for converting A.C. electrical quantities to analogue or digital signals.	IEC 60688
BSEN 60898	Circuit breakers for overcurrent protection for household and similar installations	IEC 60898
BSEN 61000-6-2	Electromagnetic compatibility (EMC) Generic standards – Immunity for industrial environments	IEC 61000-6-2
BSEN 61000-6-4	Electromagnetic compatibility (EMC) Generic standards – Emission Standard for industrial environments	IEC 61000-6-4
BSEN 61000-6-5	Electromagnetic compatibility (EMC) Generic standards – Emission Standard for Power Station and Substation Environments	IEC 61000-6-5
BS IEC 61508	Functional safety of electrical/electronic/programmable electronic safety-related systems	IEC 61508
EA TS 48-3	Instantaneous High Impedance Differential Protection	
ENA TS 48-4	DC Relays Associated with a Tripping Function in Protection Systems	
ENA TS 48-5	Environmental Test Requirements for Protection and Control Equipment and Systems	

Table 1 Additional References

2.2 System earthing

2.2.1 (BSEN 62271-1 – clause 9.1) The equipment shall be suitable for use on three phase systems in which the neutral is earthed either solidly or through a resistance or reactance of low value or through a reactor or arc suppression coil. It should be noted that parts of WPD's network employ arc suppression coil earthing and Tenderers are advised to consider carefully the implications of this, with particular emphasis on the phase voltages during earth fault conditions.

2.3 Summary of Range (ENA TS 41-36 Schedule 2.1)

2.3.1 Schedule 2.1 of ENATS 41-36 includes items for which the required option is already stated within the text of 41-36, for example, rated frequency. Schedule 2.1 of 41-36 is replaced in this WPD Technical Specification by Schedules A, B and C below. For the avoidance of doubt, where the selected option is already stated in the text of 41-36 it is not repeated within the WPD Schedules.

2.4 Ratings

2.4.1 Rated short-time withstand current (ENATS 41-36 cl 1.4.5). In the interests of standardisation default switchgear ratings are shown in **bold** in WPD Schedule A, B and C and these options shall normally be selected. However, it is the WPD User's responsibility to check with WPD Primary System Design Team that these default ratings are sufficient for the envisaged future specific site duty. Standard EN options include 16, 20, 25 and 31.5kA.

2.4.2 Rated short-circuit breaking current (ENATS 41-36 cl 2.4.101). The rated short-circuit breaking current shall be not less that the rated short-time withstand current as specified in 2.4.1 above.
The rated value of short-circuit breaking current shall be assigned at dc time constants of both 45ms and 120ms.

2.5 Rated Supply Voltage of Closing and Opening Devices and of Auxiliary and Control Circuits (Ua) (ENATS 41-36 cl 1.4.8)

2.5.1 In addition, equipment shall operate normally when the supply voltage is within the tolerances specified in ENA TS 50-18 and BSEN 62271-1.

2.6 Cable Compartments (ENATS 41-36 clause 1.5.103.1.101)

2.6.1 It should be noted in particular that some 36kV circuit breakers call for 9 single core cable terminations up to 1000 mm^2. It is known that some designs of separable connector such as Pfisterer Size 3 or Euromold Interface C, do not cover this size of cable, and so Tenderers whose offer includes use of separable connectors MUST state at time of tender if their offer cannot meet the WPD requirement for size and number of cables to be terminated. Care is also necessary to ensure that cable oversheath sizes will fit a given size and type of separable connector, as past experience has indicated mismatch in range tolerances between some connectors and cables.

2.6.2 It should be noted that it is WPD's preference that the terminations should be screened terminations of either inner cone Size 3 or outer cone interface C, but if this cannot be achieved then, the supplier shall note that ENA TS 41-36 clause 1.5.103.1.101 refers to ENA TS 12-11 clause 5.7.2 which states:

"Where the facility for a fully-insulated bolted connection termination is provided, the bushing profile shall be of an outside cone type as dimensioned in BSEN 50181. Where the facility for a partially-insulated bolted connection cable termination is provided the bushing design shall be to the manufacturers standard.

Cable lugs shall not be supplied, but the design of the cable compartments shall permit use of compression or mechanical shear bolt cable lugs which have centre or off set palms with the dimension from the centre of the hole to the closed (top) end of the barrel along the axis of the barrel being a minimum of 23mm at 12kV and 33mm at 24kV and 36kV."

Note, WPD use mechanical shear bolt cable lugs which have a centre palm therefore the cable box dimensions shall reflect this fact.

2.6.3 The WPD Schedules A, B and C attached, do not call up insulated glands. WPD Project staff will need to specify insulating glands on the Enquiry Schedule where an existing switchboard with frame leakage busbar protection is being extended.

2.7 Auxiliary Switches (ENATS 41-36 cl 2.5.4)

2.7.1 In addition to auxiliary switches required for normal circuit breaker function, further auxiliary switches, in accordance with Appendix B, shall be provided for WPD use and all these, including spares, shall be wired out to an accessible terminal block within the fixed portion.

2.8 Accessibility of Auxiliary and Control Equipment (BSEN 62271-1 cl 5.4.2.2)

2.8.1 In addition, to provide resilience against flooding it is preferred that all HV and LV live parts, mechanism and control equipment, including cable terminations are located as high as practicable above ground level.

3.0 REQUIREMENTS

3.1 General

3.1.1 Suppliers and Manufacturers shall satisfy the requirements of BS EN ISO 9000 and BS EN ISO 9001 for all products supplied.

3.1.2 All equipment and systems shall satisfy requirements of the EMC directive. EMC emissions and immunity requirements shall, as a minimum, satisfy the requirements of the generic emission and immunity standards for industrial environments BSEN 61000-6-2 and BSEN 61000-6-4 and also all relevant EMC product standards.

3.2 Guarantee

3.2.1 The supplier of the plant / equipment covered by this specification shall provide a guarantee for that equipment. The guarantee period that the supplier warrants will be a minimum of five (5) years from the date of completion of commissioning of the relevant plant / equipment. Note, this requirement applies to plant / equipment purchased by Independent Connection Providers (to be adopted by WPD) as well as equipment purchased directly by WPD.

3.3 Auxiliary Supplies

3.3.1 Circuit breaker spring winding motor and protection/alarm relay auxiliary supplies for new equipment are normally rated at 110Vdc.

3.3.2 Equipment shall operate correctly over the DC auxiliary voltage ranges specified in ENATS 48-5, ENATS 50-18 and ENATS 41-36 issue 2, as applicable.

3.3.3 Tele-control auxiliary supplies are either 48Vdc or 24Vdc depending on where the equipment is to be installed. In general a positive common rail is used with negative switching, however, for switchgear used in South Wales this polarity is reversed. Details will be confirmed at time of order.

3.4 Current Transformers

3.4.1 Current transformers (CTs) shall be in accordance with EA TS 41-36 and BSEN 61869-2 with the following additions. Characteristics and ratios are specified in the accompanying Schedules and as set out below.

3.4.2 With the exception of neutral current transformers, all CTs shall be mounted on the bushings inside the switchgear, unless otherwise agreed in writing by Western Power Distribution's Policy Team.

3.4.3 All connections from secondary windings shall be brought out and taken, by means of separate insulated leads, to an accessible terminal board to permit testing of individual CTs. Any joints or connections in the secondary leads shall be carried out at an accessible terminal board.

3.4.4 Irrespective of the ratio the rated continuous thermal current of the CTs (I_{cth}) of protection class CTs shall match the full continuous current rating of the circuit breaker. For measurement class CTs the rated continuous thermal current (I_{cth}) shall be 120% of the rated primary current (I_{pr}) of the CT unless a higher rating is specified.

3.4.5 CTs and secondary wiring within live compartments shall be fully and effectively shrouded by a substantial, earthed, metal screen. Care shall be taken to ensure that the cable sheath and its earth connections do not short out the current transformers.

3.4.6 Incoming transformer equipments call for the supply of outdoor mounted current transformers for use with 33kV transformer neutral connections. The requirements for externally mounted CTs depend on its position (i.e. whether it is on the transformer side or the earth side of the earthing resistor/reactor, where fitted) and the type of neutral conductor used (cable or busbar). Requirements shall be agreed at the time of order.

3.4.7 All externally mounted CTs shall be suitable for outdoor use and shall have a IP rating of IP54 of better.

3.4.8 CTs for use with an insulated neutral cable shall be a slip over type. Where the CT is fitted inside a metal housing an insulated sleeve shall be fitted inside the bore between the neutral cable and the earthed portion of the housing. This insulation shall withstand 2kV ac to earth for 1 minute. The internal diameter of the bore through the housing shall be agreed at time of tender but shall in any event be not less than 55mm. The CT and, where applicable, the housing, shall be suitable for the maximum cable size specified for the application and shall also include provision for the cable screen to be passed back through each CT alongside the main cable.

3.4.9 Externally mounted CTs for use with 33kV neutral busbars shall satisfy the following minimum voltage ratings:

- For CTs mounted on the transformer side of an earthing resistor or reactor: 22kV AC RMS, continuously.
- For CTs mounted on the earthed side of an earthing resistor or reactor: 2kV AC RMS, for 1 minute.

3.4.10 Each current transformer forming part of a group of CTs to provide a given function shall have a knee point voltage within 20% of the other CTs within the same group. For example, a group of 3 CTs used as part of an overcurrent and earth fault protection scheme shall have knee point voltages within 20% of each other.

3.4.11 Current transformer ratios and characteristics are specified within the schedules, unless they are required to match those at existing substations for unit protection schemes.

Where dual ratio CTs are specified the required class, accuracy and VA rating applies to both ratios, unless otherwise stated.

Type test certificates shall be provided by the purchaser, on request.

3.4.12 Current transformer secondary windings shall have a bare wire diameter (copper) of not less than 0.8mm.

3.4.13 By agreement between the manufacturer and the WPD Policy Team, low energy output devices may be prescribed in lieu of CTs.

3.4.14 Class PX CTs

3.4.14.1 Class PX current transformers shall comply with BSEN 61869-2 and shall provide accurate transformation up to the maximum fault current rating of the associated main plant and ensure this performance under steady state conditions without undue saturation.

3.4.14.2 The minimum knee point requirements for CTs with a 1A secondary rating are specified below, where:

- V_K = Knee point voltage
- R_{CT} = DC secondary resistance of the CT
- N = Ratio of the CT (i.e. primary current / rated secondary current)

(a) CTs for Current Differential, Pilot Wire or Distance Protection:
- For 25kA switchgear: $V_K \geq 9.1x10^4(R_{CT} + 0.5)/N$
- For 31.5kA switchgear: $V_K \geq 9.5x10^4(R_{CT} + 0.5)/N$

(b) CTs for Transformer Bias Differential and REF Protection
- For 25kA switchgear: $V_K \geq 5.0 \times 10^4(R_{CT} + 1.5)/N$
- For 31.5kA switchgear: $V_K \geq 6.3 \times 10^4(R_{CT} + 1.5)/N$

(c) CTs for High Impedance Busbar Protection
- For 25kA switchgear: $V_K \geq 5.0 \times 10^4(R_{CT} + 1)/N$
- For 31.5kA switchgear: $V_K \geq 6.3 \times 10^4(R_{CT} + 1)/N$

For CTs with an alternative secondary rating, the minimum knee point requirement shall be calculated in accordance with the protection relay manufacturer's recommendations.

3.4.14.3 Where multi-ratio CTs are specified the knee point requirements shall be satisfied on each CT ratio.

3.4.14.4 In addition to the knee point requirements, the magnetising current for each CT shall be less than 50mA at the CT's knee point voltage. This requirement must be satisfied for each CT ratio.

3.4.15 Metering Current Transformers

3.4.15.1 Metering current transformers shall have independent cores and secondary windings from those provided for protection purposes. Provision shall be made to prevent un-authorised access to metering CTs and CT circuits.

3.4.15.2 Where metering CTs are specified the CT ratios shall be selected by WPD from the options listed in Table 2.

3.4.15.3 **Metering CTs shall be tested to confirm compliance with BSEN 61869-2 on each ratio. In addition to these requirements, CT errors shall be supplied for each ratio at 5%, 20%, 100% and 120% test load points at the burden specified in the following table. These additional CT errors shall either be separately tested or calculated from other error test results.**

CT Ratio Options	VA Rating	Class	Additional Error Data
200/100/1 300/150/1 400/200/1 600/300/1 800/400/1 1200/600/1 1600/800/1 2000/1000/1	5VA	0.2S	Additional error data to be provided for 5%, 20%, 100% and 120% load points with a burden of 2.5VA with a 0.9 lagging power factor

Table 2 Metering CT Requirements

3.4.15.4 Electronic copies of the of test certificates in PDF format, including any error tests used as the basis of the calculations described above, shall be provided in advance of switchboard delivery for each metering current transformer. These shall be sent to the WPD project engineer by electronic mail.

3.5 Voltage Transformers

3.5.1 Voltage transformers (VTs) shall be in accordance with EA TS 41-36 with the following additions. Dry type, encapsulated, voltage transformers are required. Facilities shall be provided for disconnecting and isolating the VT.

3.5.2 Voltage transformers used for metering and protection purposes shall comprise of three single phase VTs connected in primary star with the centre point earthed. The secondary neutral shall also be earthed. All secondary neutral points shall be brought out to accessible terminal blocks.

3.5.3 Each VT star connected winding shall have a rating of 25VA per phase. Residual voltage windings for use in broken delta arrangement shall also be rated at 25VA.

3.5.4 All windings shall be rated for a voltage factor of 1.9 for 8 hours.

3.5.5 All Star connected windings shall satisfy the requirements for both Class 3P and Class 0.5 irrespective of their intended use. Residual voltage windings connected to form a broken delta shall be Class 3P but are not required to satisfy Class 0.5.

3.5.6 Voltage transformer rated transformation ratios shall be in accordance with Table 3.

3.5.7 Voltage transformers shall have their rated transformation ratios and voltages shown on drawings, diagrams and rating plates as shown in Table 3.

System Voltage	Primary Winding	Secondary Windings		
		Protection	Metering	Residual[1]
	Voltage (Upn)	Voltage (Usn)	Voltage (Usn)	Voltage (Usn)
33kV	33000/√3	110/√3	110/√3	110/3

Table 3 VT Ratios

Note 1: Residual voltage windings shall be connected to form a broken delta that will provide an output voltage from the broken delta winding of 3 x 110/3 (i.e. 110 volts for a solid single phase earth fault close to the switchgear).

3.5.8 Where the three single phase voltage transformer arrangement as detailed above is not possible or available, then a three phase 5 limb VT may be offered instead. Secondary neutral points shall be brought out and terminated in accessible terminal blocks. Three phase VTs shall have the same ratings and characteristics as detailed above.

3.5.9 Voltage Transformer Connections

3.5.9.1 VT star type secondary windings used for protection circuits shall be connected through suitable miniature circuit breakers (MCBs) and links. The arrangement of MCBs and links shall be in accordance with Figure 1.

3.5.9.2 MCBs used for protection of the VT secondary circuits shall, unless otherwise agreed at the time of tender, be rated at 6A and, as a minimum, satisfy the requirements of BS EN 60898. Two adequate, normally closed auxiliary contacts shall be provided per MCB for alarm and protection blocking purposes. The status of each contact shall reflect the open/closed status of the associated MCB. MCB characteristics shall be chosen to grade with the following type and rating of fuses, over the full range of available fault current:

- 2A fuses to BS HD 60269-2, reference F1 and F2
- 2A fuses to BS HD 60269-2, reference A1

3.5.9.3 Secondary windings used for metering purposed shall be fused at 6A.

3.5.9.4 VT residual windings shall be connected through removable links.

3.5.9.5 MCBs, fuses and links shall be located as close as practicable to the VT (subject to being able to gain ready access to them with the equipment in service).

3.5.9.6 Each voltage transformer assembly shall be capable of being isolated from the associated equipment. If isolation of the primary winding is carried out by movement of the voltage transformer assembly, a set of automatic positively-driven padlockable shutters shall be provided over the resultant apertures.

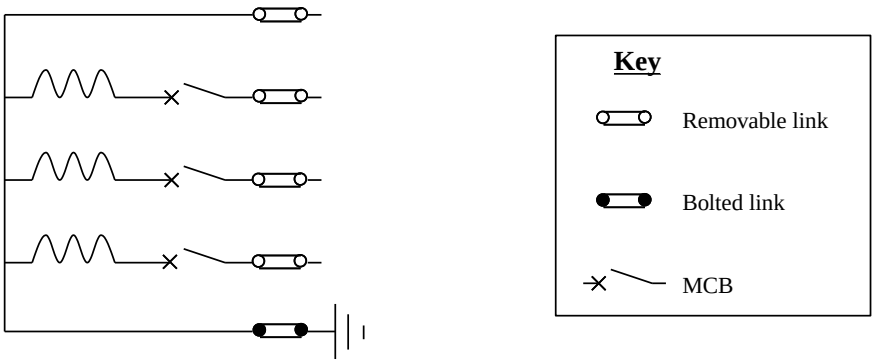

Figure 1 VT Miniature Circuit Breaker (MCB) and Link Arrangement

3.5.9.7 VT Primary windings shall be earthed independently of secondary windings. Where three single-phase voltage transformers are used, the arrangement shall be earthed at a single point on the secondary side.

3.5.9.8 Where HV VT fuses are provided and these can be removed and replaced without withdrawing the entire voltage transformer assembly, the means of removing the fuses shall automatically open and close automatically the access to the interior of the voltage transformer assembly and simultaneously make and break the secondary circuits.

3.5.9.9 A cover, capable of being padlocked, shall be provided so that when the entire voltage transformer is removed from the circuit breaker equipment, access to the interior of the equipment can be prevented. It shall be possible for the circuit to be restored to service after the voltage transformer has been removed.

3.5.10 Metering Voltage Transformers

3.5.10.1 Provision shall be made for preventing access to the secondary fuses and links associated with metering circuits and the points of access to the current and voltage wiring of the metering equipment.

3.5.10.2 Metering VTs shall be error tested by the manufacturer. In all cases individual test certificates shall be provided.

3.5.10.3 **All metering VT test certificates shall include tests to confirm compliance with BSEN 61869-3.**

In addition, VT errors shall be supplied on brown/black (L1/L2) and black/grey (L2/L3) phases at 10VA 0.5 power factor lagging burden. These additional VT errors shall either be separately tested or alternatively calculated from other error test results.

3.5.10.4 Electronic copies of the of test certificates in PDF format, including any error tests used as the basis of the calculations described above, shall be provided in advance of switchboard delivery for each metering voltage transformer. These shall be sent to the WPD project engineer by electronic mail.

3.5.10.5 On feeder circuits and bus section units with customer metering arrangements, the VT connections shall, as far as possible, be before the metering current transformers in respect of normal power flow direction.

3.6 Earthing

3.6.1 Earthing requirements shall be in accordance with ENA TS 41-24 and ENA TS 50-18.

3.7 Small wiring and Terminals

3.7.1 Small wiring and terminals shall comply with ENA TS 41-36 with the following additions:

- The application of small wiring, ancillary electrical equipment and protection shall in general follow the principles in Engineering Recommendation S15.
- Secondary wiring shall comprise of:
    - AC wiring: 2.5mm^2 (minimum) copper stranded cable with PVC insulation to BS6231 Type BR, or equivalent tri-rated cable complying with BS6231.
    - DC wiring: 1.5mm^2 (minimum) copper stranded cable with PVC insulation to BS6231 Type BR, or equivalent tri-rated cable complying with BS6231.

- Transducer output wiring: 1.0mm^2 (minimum) stranded copper twisted pair cable with PVC insulation.

- The insulation of AC and DC wiring shall be coloured white in all circuits, except earthing which shall be coloured green/yellow. A.C. and D.C. wiring shall be terminated with crimped connections in accordance with ENA TS 50-18.

- Terminal blocks used for protection, alarm and control circuits shall be screw clamp with spring type, in accordance with EATS 50-18 Type B. Terminal blocks for 24VDC and 48VDC tele-control wiring, and for transducer output wiring shall be screw clamp type, to EATS 50-18 Type C with a hinged link for isolation purposes. Sufficient space shall be allowed so that connections can be tightened or un-tightened and wires removed and re-inserted. Spare cores shall be terminated at the terminal blocks furthest from the cable gland.

- All circuit breakers are to be equipped with pairs of plug test sockets of a type to be agreed at the time of tender, fitted to the trip and close circuits and connected as shown on WPD drawings. These terminals shall be mounted in accessible position within the circuit breaker control panel compartment and shall be labelled “remote trip socket” and “remote close socket”.

3.8 Fuses and Links

3.8.1 Secondary fuselinks, links and fuse carriers shall be in accordance with EATS 50-18 and BS HD 60269-2 reference A.

3.8.2 Fuses and fuse holders up to 20A rating shall be in accordance with BS HD 60269-2 reference A1.

3.8.3 The fuse holders and bases shall be coloured as follows:

- 2A, 4A, 6A, 10A fuselink ratings: black (colour 642 of BS 381C)
- 16A fuselink rating: green (colour 216 of BS 381C)
- Solid links: white

3.8.4 GE Power Controls or Mersen Red Spot fuse holders shall be provided unless otherwise agreed at the time of tender.

3.8.5 All fuses and links shall be mounted vertically, grouped logically and consistently on the front of the panel and shall be clearly labelled. The label shall show the function of the fuses/links and include the fuse/link number as specified on the schematic drawings. Where a double row of fuses and links is required, the labelling of the bottom row may need to be mounted on a stand-off bracket to ensure they are clearly visible. Fuses shall, as far as possible, be positioned consistently across the suite of panels and cubicles.

3.8.6 Fuse terminals shall be suitably shrouded to minimise electric shock hazards. The incoming (supply) side of each circuit shall be connected on the bottom terminal of the fuse/link.

3.9 Protection and Alarm Relays

3.9.1 Protection, alarm and control relays shall be chosen in accordance with schedules A, B, & C and with WPD's standard drawings. Relay types shall be agreed with WPD at the time of Tender.

3.9.2 On a given suite of panels and cubicles, protection relays shall, as far as reasonably practicable, be obtained from one relay manufacturer (unless otherwise required to satisfy clause 3.2). The types of relays and their position shall be consistent across the suite of panels and cubicles.

3.9.3 Protection relays shall comply with BS EN 60255, IEC 60255, BS EN 61810 and BS EN 61811 as appropriate and be of a type and make approved for use within Western Power Distribution. A list of WPDs approved relays is provided in EE SPEC: 98.

3.9.4 Alternative relays may be submitted to the WPD Policy Engineer responsible for Protection and Design for evaluation.

3.9.5 Relays that can be set / programmed via a personal computer (PC) shall be provided with an accessible connection facility (e.g. a USB connection). This shall either be mounted on the front of the relay itself or on a separate connector mounted on the front of the relay panel.

3.9.6 Alarm indication functions, such as buchholz alarm, SF6 low alarm and winding temperature alarm may be provided by programmable LEDs available on some protection relays. Alternatively, separate alarm indication relays may be provided instead. SF6 low alarm indication shall be consistent in type and location across a multi-panel switchboard.

3.9.7 Unless otherwise specified, AC relay inputs shall be suitable for use with 1A CT and 110V VT supplies. The DC auxiliary supply voltage rating shall be in accordance with the value specified at the time of order. If there is any doubt over the required relay ratings the tenderer shall confirm the requirements with WPD at the time of tender.

3.10 Ancillary Equipment

3.10.1 Requirements for ancillary equipment including relays, contactors, control / selector switches, transducers, push buttons and lamps are specified in EE SPEC:136.

3.11 Busbar Protection

3.11.1 Busbar protection for 33kV indoor switchboards shall comprise of a full unit protection scheme with an over-current and earth fault check feature. Where space permits busbar protection relays shall be mounted on the bus-section/interconnector panel/s. If the relays cannot be accommodated on the bus-section panel/s or where there is no bus-section/interconnector panel, relays shall be mounted on a dummy switchgear panel.

3.11.2 WPD standard schemes utilise the high impedance circulating current principle. Alternative schemes that can be demonstrated by the tenderer, at the time of tender, to perform the equivalent functions may be acceptable subject to agreement prior to placement of the contract.

3.11.3 Busbar Protection Auxiliary Switches

3.11.3.1 CT isolation and shorting auxiliary switches are required where a circuit earth or busbar earth facilities connect within the zone covered by busbar protection CTs. Auxiliary switches shall be in accordance with EATS 50-18. The operating sequence for these auxiliary switches is as follows:

- When a busbar disconnector is opened, the associated CT isolation auxiliary switches shall open before the CT shorting switches are closed.

- When a busbar disconnector is closed, the associated CT shorting switches shall open before CT isolation switch closes. Both the CT isolation and the CT shorting switches shall operate before the pre-arcing distance of the busbar disconnector is reached.

3.11.3.2 When the auxiliary switches are specifically approved by WPD for switching current transformer circuits a single contact may be used for each function. When such approval has not been given, two silver-plated switches in parallel shall be used for all normally open functions and one silver-plated contact for each normally closed function.

CT isolation and shorting facilities shall not be derived from auxiliary relays, unless otherwise approved by WPD's Policy Team at the time of tender.

3.12 Multicore / Multipair Terminal Boxes and Glands

3.12.1 Where a multicore / multipair terminal box is fitted it shall be placed so that work can be carried out on this box with the equipment after the equipment is installed and cables jointed. With the multicores / multipairs made off, they shall not interfere with the making or breaking down of the main cable box.

3.12.2 Adequate terminal blocks shall be provided to terminate all the cores of all multicore / multipair cables. Insulated cable glands, where required shall be insulated to 4kVac. for 1 minute.

3.13 Interlocking

3.13.1 Permissive Earth and Proof of Earth interlocking shall be provided on incoming transformer circuits (36ITB and 36ITC) as detailed in ENATS 41-36 clause 2.5.11.101.

Castell Type Q or Fortress Type H are required. Numbering/legend will be provided at the time of order.

3.14 Surge Arrestors

3.14.1 The facility for the connection of surge arrestors shall be provided as detailed in Schedules A, B and C.

The surge arrestors will be provided by others.

3.15 ASC Earth Fault Detection Relay

3.15.1 The requirement for an ASC Earth Fault Detection relay will be specified at the time of order.

3.16 Anti-Condensation Heaters

3.16.1 A heater shall be provided at an appropriate location in each panel. The heaters shall be 230Vac. One control thermostat per switchboard shall be provided. The supply to the heater/s shall be controlled by a double pole switch which shall be located at a readily accessible position on the switchboard and clearly labelled/identified.

3.17 Ferroresonance Damping Resistors

Ferroresonance damping resistors shall be provided for VT open delta windings. The VTs and resistors shall have sufficient thermal rating to satisfy the requirements of 3.5.4.

3.18 Drawings

3.18.1 The manufacturer shall provide the following drawings for approval within one month of the commencement date of the contract or by mutually agreed date at the placement of the order:

- General Arrangement of each circuit breaker / cubicle
- Schematic Diagram for each circuit breaker / cubicle
- Wiring diagram for each circuit breaker / cubicle

3.18.2 Once approval has been obtained an additional copy of the drawings shall be provided.

3.18.3 After on-site installation and commissioning of the cubicles has been completed the manufacturer shall incorporate any alterations within 3 months of the drawings being returned for correction and provide a final copy of the drawings.

3.18.4 All drawings shall be provided electronically in .dwg CAD format.

APPENDIX A

PROTECTION FUNCTIONS

Reference	Description
A	Alarm indication relay (used for buchholz alarm (BA), winding temperature alarm (WTA), SF6 pressure low alarm (SF6A) etc.)
AR	Auto-reclose
AR(CSYNC)	Auto-reclose with check synchronizing facilities
AR(LLDBC)	Auto-reclose with live line, dead bus charge
ASC	ASC Control Relay
AX	Auxiliary relay
AXF	Auxiliary relay with hand reset flag
BBCK	Busbar protection check relay
BBCKA	Busbar protection check auxiliary relay
3BBOC	3 element busbar overcurrent (high impedance)
BD	Biased differential
BEF	Balanced earth Fault
CD	Current Differential (unit protection)
CTS	CT supervision
DEIT	Directional IDMT earth fault
3DOCIT	3 element directional IDMT overcurrent
3DOCIT(LB)	3 element directional IDMT overcurrent with load blinding
3DOCIT(VC)	3 element voltage controlled directional IDMT overcurrent
E	Instantaneous earth fault
EIT	IDMT earth fault
3HOC	3 element high set overcurrent
IT	Intertrip send/receive system
NVD	Neutral voltage displacement
2OC	2 element instantaneous overcurrent
3OC	3 element instantaneous overcurrent
2OCIT	2 element IDMT overcurrent
3OCIT	3 element IDMT overcurrent
3OV	3 element overvoltage relay
PW	Pilot wire protection (unit protection)
RTB	Relay test block
SBEF	Standby earth fault
SBEF1	Standby earth fault stage 1
SBEF2	Standby earth Fault stage 2
SEF	Sensitive earth fault
TCS	Trip circuit supervision
TI	Trip indication relay (used in series with trip coil or trip relay coil, e.g. buchholz trip (BT), winding temperature trip (WTT) etc.)
TRS	Trip relay supervision
TDS	Trip relay with 2.5s time delay reset contact and hand reset flag
TE	Trip relay with electrically reset contacts and hand reset flag
TH	Trip relay with hand reset contacts and flag
TS	Trip relay with instantaneous self reset contacts and hand reset flag
TSS	Trip Supply Supervision
VTS	VT supervision
Z	Distance protection

AUXILIARY SWITCHES

Auxiliary switches shall comply with ENA TS 50-18.

Sufficient auxiliary switches shall be provided for the associated protection and control functions. Specific requirements are defined in WPDs standard schematic drawings.

In addition, each circuit breaker shall be provided with the following spare auxiliary switches, each wired back to accessible terminals blocks:

- 6 off normally open circuit breaker auxiliary switches
- 6 off normally closed circuit breaker auxiliary switches
- 6 off normally open busbar selector switch
- 6 off normally closed busbar selector switch
- 2 off normally open springs charged auxiliary switches
- 2 off normally closed springs charged auxiliary switches

APPENDIX C

SUPERSEDED DOCUMENTATION

This document supersedes EE SPEC: 182 dated July 2017 which has now been withdrawn

APPENDIX D

ASSOCIATED DOCUMENTATION

ENA TS 41-36 Switchgear for service up to 36kV (Cable and overhead line connected)

ENA TS 41-24 Guidelines for design, installation, testing and maintenance of main earthing systems in substations

ENA TS 50-18 Application of ancillary electrical equipment

EE SPEC: 87 Protection and control cubicles for outdoor 72kV and 36kV circuit breakers and for primary substation transformers

EE SPEC: 98 Approved protection, voltage control and alarm relays

EE SPEC: 136 Ancillary Electrical Equipment for Use in Conjunction with Switchgear and Protection/Control Panels

APPENDIX E

KEY WORDS

Circuit Breaker, Panel, Cubicle, Protection, Alarm, Transducer, Telecontrol

Schedule A 36kV Primary Substation Switchgear (1250A Busbars) Part 1

Description	**Further Details**	**36C1A** T/F feeder circuit without intertripping	**36C2A** T/F feeder circuit with surge proof intertripping	**36C3A** T/F feeder circuit with Local intertripping	**36C4A** Circuit with distance protection	**36C5A** Circuit with pilot wire protection	**36C6A** Circuit with current differential protection	**36C7A** Circuit with basic protection
Standard drawings	Single Line Diagram: Schematic Diagram:	SL36C1 SPC36C1	SL36C2 SPC36C2	SL36C3 SPC36C3	SL36C4 SPC36C4	SL36C5A SPC36C5A	SL36C6A SPC36C6A	SL36C7A SPC36C7A
Switchgear:								
Rated voltage kV		36	36	36	36	36	36	36
Number of phases / poles		3	3	3	3	3	3	3
Rated insulation level (lightning impulse withstand voltage) kV	ENATS 41-36 Clause 1.4.2	170	170	170	170	170	170	170
Rated normal current A busbar	ENATS 41-36 Clause 1.4.4	1250	1250	1250	1250	1250	1250	1250
Rated normal current A - circuit breaker	ENATS 41-36 Clause 1.4.4	1250	1250	1250	1250	1250	1250	1250
Rated short-time withstand current kA	ENATS 41-36 Clause 1.4.5	31.5 / **25**	31.5 / **25**	31.5 / **25**	31.5 / **25**	31.5 / **25**	31.5 / **25**	31.5 / **25**
Rated supply frequency of closing and opening and of auxiliary circuits (D.C. / 50Hz)	ENATS 41-36 Clause 1.4.9	D.C.	D.C.	D.C.	D.C.	D.C.	D.C	D.C
Auto reclose duty capability requirement	ENATS 41-36 Clause 2.4.111	Y	Y	Y	Y	Y	Y	Y
Mechanism type	ENATS 41-36 Clause 2.5.5 to 2.5.7	XEM	XEM	XEM	XEM	XEM	XEM	XEM
Gas monitoring	ENATS 41-36 Clause 1.5.9	2 stage pressure switch	2 stage pressure switch	2 Stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch
Voltage presence indicating system	ENATS 41-36 Clause 1.5.201.3	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes – pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible
Arc extinction medium		Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
Cable termination type: required	Pfisterer size 3 or Euromold interface C Clause 2.6	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters
CTs and VTs:								
CTs for over-current and earth fault protection and/or transducers	800/1[3] 7.5VA 5P20 Clause 3.4	3	3	3	3	3	3	3
CTs for distance protection or pilot wire protection	800/1[3] Class PX Clause 3.4				3	3	3	
CTs for busbar protection	1200/1[3] Class PX Clause 3.4	3	3	3	3	3	3	3
Circuit VT	Clause 3.5				1 Star/star/ open-delta			

Schedule A 36kV Primary Substation Switchgear (1250A Busbars) Part 1

Description	**Further Details**	**36C1A** T/F feeder circuit without intertripping	**36C2A** T/F feeder circuit with surge proof intertripping	**36C3A** T/F feeder circuit with Local intertripping	**36C4A** Circuit with distance protection	**36C5A** Circuit with pilot wire protection	**36C6A** Circuit with current differential protection	**36C7A** Circuit with basic protection
Busbar VT	Clause 3.5	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)
Control / Relay Panel:								
Circuit breaker control switch and handle	Clause 3.10	1	1	1	1	1	1	1
Local/supervisory switch and handle	Clause 3.10	1	1	1	1	1	1	1
Remote control terminals	Clause 3.7	4	4	4	4	4	4	4
Telecontrol CB open, interposing relay	Clause 3.10	AR1	AR1	AR1	AR1	AR1	AR1	AR1
Telecontrol CB close interposing relay	Clause 3.10	AR1	AR1	AR1	AR1	AR1	AR1	AR1
Terminal blocks	Clause 3.10	As required	As required	As required	As required	As required	As required	As required
Fuses and links	Clause 3.8	As required	As required	As required	As required	As required	As required	As required
Relay test block	Clause 3.9	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings
Telecontrol auto-reclose in/out relay	Clause 3.10	AR2			AR2			
Telecontrol auto-reclose in/out push buttons	Clause 3.10	PB1 PB2			PB1 PB2			
Current transducer	Clause 3.10							
Current/Voltage/MW and MVAr transducer	Clause 3.10	TD4	TD4		TD4	TD4	TD4	TD4
Protection relay 1	Clause 3.9	3HSOC 3OCIT EIT AR TCS	3HSOC 3OCIT EIT TCS	3HSOC 3OCIT EIT TCS	Z 3DOCIT DEIT AR BBCK[4] TCS VTS	PW	CD 3DOCIT DEIT BBCK[4] TCS VTS	3HSOC 3OCIT EIT TCS
Protection relay 2	Clause 3.9	VTS[2]	VTS[2]	VTS[2]	VTS[2]	3DOCIT DEIT BBCK[4] TCS VTS	VTS[2]	VTS[2]
Protection relay 3	Clause 3.9					VTS[2]		
ASC Earth Fault Detection Relay	A-eberle EOR-3D	1[5]	1[5]		1[5]	1[5]	1[5]	1[5]

Schedule A 36kV Primary Substation Switchgear (1250A Busbars) Part 1

Description	**Further Details**	**36C1A** T/F feeder circuit without intertripping	**36C2A** T/F feeder circuit with surge proof intertripping	**36C3A** T/F feeder circuit with Local intertripping	**36C4A** Circuit with distance protection	**36C5A** Circuit with pilot wire protection	**36C6A** Circuit with current differential protection	**36C7A** Circuit with basic protection
Trip/intertrip relays	Clause 3.9	TH	IT TH TS TDS	TH TDS	TH	TH	TH	TH
Alarm / indication relays	Clause 3.9	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]

Notes:

Schedule A Part 1:

Note 1: SF6 Low indication is only required where the switchgear utilises SF6 gas.

Note 2: One 3 phase busbar VT and an associated VTS relay is required per section of busbars.

Note 3: CTs shall have a continuous rating of 1250A or more, in accordance with clause 3.3.

Note 4: Busbar protection check output (BBCK) is only required where the circuit provides a major fault infeed into the switchboard; details to be confirmed at time of tender.

Note 5: ASC earth fault detection relay is only required where ASC earthing is used (this typically applies to substations in Cornwall)

Schedule A 36kV Primary Substation Switchgear (1250A Busbars) Part 2

Description	**Further Details**	**36C8A** Interconnector Circuit with High Impedance Relay	**36C9A** Interconnector without High Impedance Relay	**36C10A** Circuit Without Protection	**36C11A** Incoming Circuit with Metering	**36C12A** Outgoing Circuit with Metering	**36B1A** Bus-section with 2 High Impedance Relays	**36B2A** Bus-section with 1 High Impedance Relay
Standard drawings	Single Line Diagram: Schematic Diagram:	SL368 SPC368	SL36C9 SPC36C9	SL36C10A SPC36C10A	SL36C11A SPC3611A	SL3612A SPC3612A	SL36B1 SPC36B1	SL36B2 SPC36B2
Switchgear:								
Rated voltage kV		36	36	36	36	36	36	36
Number of phases / poles		3	3	3	3	3	3	3
Rated insulation level (lightning impulse withstand voltage) kV	ENATS 41-36 Clause 1.4.2	170	170	170	170	170	170	170
Rated normal current A busbar	ENATS 41-36 Clause 1.4.4	1250	1250	1250	1250	1250	1250	1250
Rated normal current A - circuit breaker	ENATS 41-36 Clause 1.4.4	1250	1250	1250	1250	1250	1250	1250
Rated short-time withstand current kA	ENATS 41-36 Clause 1.4.5	31.5 / **25**	31.5 / **25**	31.5 / **25**	31.5 / **25**	31.5 / **25**	31.5 / **25**	31.5 / **25**
Rated supply frequency of closing and opening and of auxiliary circuits (D.C. / 50Hz)	ENATS 41-36 Clause 1.4.9	D.C.	D.C.	D.C	D.C	D.C	D.C.	D.C.
Auto reclose duty capability requirement	ENATS 41-36 Clause 2.4.111	Y	Y	Y	Y	Y	Y	Y
Mechanism type	ENATS 41-36 Clause 2.5.5 to 2.5.7	XEM	XEM	XEM	XEM	XEM	XEM	XEM
Gas monitoring	ENATS 41-36 Clause 1.5.9	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch
Voltage presence indicating system	ENATS 41-36 Clause 1.5.201.3	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible
Arc extinction medium		Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
Cable termination type: required	Pfisterer size 3 or Euromold interface C Clause 2.6	6 x 1c (up to 630 mm^2)	6 x 1c (up to 630 mm^2)	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	None	None
CT and VTs:								
CTs for over-current and earth fault protection and/or transducers	800/1[3] 7.5VA 5P20 Clause 3.4				3	3		
	1200/1[3] 7.5VA 5P20 Clause 3.4	3	3				3	3
CTs for busbar protection	1200/1[3] Class PX Clause 3.4	2 sets of 3	2 sets of 3			3[6]	2 sets of 3	2 sets of 3

Schedule A 36kV Primary Substation Switchgear (1250A Busbars) Part 2

Description	Further Details	36C8A Interconnector Circuit with High Impedance Relay	36C9A Interconnector without High Impedance Relay	36C10A Circuit Without Protection	36C11A Incoming Circuit with Metering	36C12A Outgoing Circuit with Metering	36B1A Bus-section with 2 High Impedance Relays	36B2A Bus-section with 1 High Impedance Relay
CTs for metering	Ratio to be agreed at the time of tender 5VA Class 0.2S Clause 3.4				3	3		
CTs for transducers etc.	800/1 7.5VA Class 0.5s Clause 3.4				3	3		
Circuit VT	Clause 3.5				1 Star/star/star open-delta	1 Star/star/star open-delta		
Busbar VT	Clause 3.5	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)		1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)		
Control / Relay Panel:								
Circuit breaker control switch and handle	Clause 3.10	1	1	1	1	1	1	1
Local/supervisory switch and handle	Clause 3.10	1	1	1	1	1	1	1
Remote control terminals	Clause 3.7	4	4	4	4	4	4	4
Telecontrol CB open, interposing relay	Clause 3.10	AR1	AR1	AR1	AR1	AR1	AR1	AR1
Telecontrol CB close interposing relay	Clause 3.10	AR1	AR1	AR1	AR1	AR1	AR1	AR1
Terminal blocks	Clause 3.7	As required	As required	As required	As required	As required	As required	As required
Fuses and links	Clause 3.8	As required	As required	As required	As required	As required	As required	As required
Relay test block	Clause 3.9	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings
AC/DC indication interposing relay	Clause 3.10						1[6]	
AC/DC/Off double pole control switch and handle	Clause 3.10						1[6]	
Current/Voltage/MW and MVAr transducer	Clause 3.10	TD4			TD4	TD4	TD4	TD4
Protection relay 1	Clause 3.9	3BBOC	3OCIT EIT TCS		3HSOC 3OCIT EIT 3DOCIT DEIT NVD TCS VTS	3HSOC 3OCIT EIT 3DOCIT DEIT NVD TCS VTS	3BBOC (2 off)	3BBOC

Schedule A 36kV Primary Substation Switchgear (1250A Busbars) Part 2

Description	Further Details	36C8A Interconnector Circuit with High Impedance Relay	36C9A Interconnector without High Impedance Relay	36C10A Circuit Without Protection	36C11A Incoming Circuit with Metering	36C12A Outgoing Circuit with Metering	36B1A Bus-section with 2 High Impedance Relays	36B2A Bus-section with 1 High Impedance Relay
Protection relay 2	Clause 3.9	3OCIT EIT TCS	VTS[2]		VTS[2]	VTS[2]	3OCIT EIT TCS	3OCIT EIT TCS
Protection relay 3	Clause 3.9	VTS[2]						
ASC Earth Fault Detection Relay	A-eberle EOR-3D					1[8]		
Check / supervision relays	Clause 3.9			TSS			CTS (2 off) TSS BBCKA	CTS TSS
Trip / intertrip relays	Clause 3.9	TH (2 off)	TH		TDS	(TH)[6] TDS	TH (2 off)	TH (2 off)
Alarm / indication relays	Clause 3.9	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1] TI	A (SF6 low)[1] TI	A (SF6 low)[1]	A (SF6 low)[1]

Notes

Schedule A Part 2:

Note 1: SF6 Low indication is only required where the switchgear utilises SF6 gas.

Note 2: One 3 phase busbar VT and an associated VTS relay is required per section of busbars.

Note 3: CTs shall have a continuous rating of 1250A or more, in accordance with clause 3.3.

Note 4: Busbar protection check output (BBCK) is only required where the circuit provides a major fault infeed into the switchboard. Details to be confirmed at time of tender.

Note 5: Note 6: AC/DC Control switch and interposing relay are required on one bus-section or interconnector

Note 6: Busbar protection is not used at teed network substations and at ringed network substations utilising 36C10A circuit breakers. Where this is the case busbar protection CTs are omitted.

Note 7: TH relay is only required where busbar protection is used (See Note 7)

Note 8: ASC earth fault detection relay is only required where ASC earthing is used (this typically applies to substations in Cornwall)

Free Standing Metering Circuit Breaker – 36FSA

An arrangement may be offered for teed metered customer connections consisting of a 36C11A “incoming Circuit Breaker with Metering”, a busbar cable box and a busbar earth switch. The busbar earth switch shall be of “make-proof” design having a spring assisted independent manual mechanism, and shall be interlocked with the disconnector of the circuit breaker three position switch. The equipment and arrangement shall achieve IAC AFL without the use of screens to limit substation access.

A fully rated switch disconnector may be used in place of the busbar cable box. A disconnector panel shall not be used.

The WPD network connection shall be on the circuit breaker with the customer connection on the busbar cable box/switch disconnector.

Schedule B 36kV BSP Switchgear (2000A Busbars) Part 1

Description	**Further Details**	**36ITB** Incoming T/F Circuit	**36C1B** T/F Feeder Circuit without intertripping	**36C2B** T/F Feeder Circuit with surge proof intertripping	**36C3B** T/F Feeder Circuit with Local intertripping	**36C4B** Circuit with Distance Protection	**36C5B** Circuit with Pilot Wire protection	**36C6B** Circuit with Current Differential Protection
Standard drawings	Single Line Diagram: Schematic Diagram:	SL36IT SPC36IT	SL36C1 SPC36C1	SL36C2 SPC36C2	SL36C3 SPC36C3	SL36C4 SPC36C4	SL36C5B/C SPC36C5B/C	SL36C6B/C SPC36C6B/C
Switchgear								
Rated voltage kV		36	36	36	36	36	36	36
Number of phases / poles		3	3	3	3	3	3	3
Rated insulation level (lightning impulse withstand voltage) kV	ENATS 41-36 Clause 1.4.2	170	170	170	170	170	170	170
Rated normal current A busbar	ENATS 41-36 Clause 1.4.4	2000	2000	2000	2000	2000	2000	2000
Rated normal current A - circuit breaker	ENATS 41-36 Clause 1.4.4	2000	1250	1250	1250	1250	1250	1250
Rated short-time withstand current kA	ENATS 41-36 Clause 1.4.5	**31.5** / 25	**31.5** / 25	**31.5** / 25	**31.5** / 25	**31.5** / 25	**31.5** / 25	**31.5** / 25
Rated supply frequency of closing and opening and of auxiliary circuits (D.C. / 50Hz)	ENATS 41-36 Clause 1.4.9	D.C.	D.C.	D.C.	D.C.	D.C.	D.C.	D.C
Auto reclose duty capability requirement	ENATS 41-36 Clause 2.4.111	Y	Y	Y	Y	Y	Y	Y
Mechanism type	ENATS 41-36 Clause 2.5.5 to 2.5.7	XEM	XEM	XEM	XEM	XEM	XEM	XEM
Gas monitoring	ENATS 41-36 Clause 1.5.9	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 Stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch
Voltage presence indicating system	ENATS 41-36 Clause 1.5.201.3	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes – pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible
Arc extinction medium		Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
Cable termination type: required	Pfisterer size 3 or Euromold interface C Clause 2.6	9 x 1c 630mm^2	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters
CTs and VTs								
CTs for bias differential and restricted earth fault protection	2000/1 Class PX Clause 3.4	4 including 1 externally mounted neutral CT						
CTs for standby earth fault protection	1200/1 15VA 5P10 Clause 3.4	1 externally mounted neutral CT						
CTs for over-current and earth fault protection and/or transducers	2000/1 7.5VA 5P10 Clause 3.4	3						

Schedule B 36kV BSP Switchgear (2000A Busbars) Part 1

Description	Further Details	36ITB Incoming T/F Circuit	36C1B T/F Feeder Circuit without intertripping	36C2B T/F Feeder Circuit with surge proof intertripping	36C3B T/F Feeder Circuit with Local intertripping	36C4B Circuit with Distance Protection	36C5B Circuit with Pilot Wire protection	36C6B Circuit with Current Differential Protection
	800/1[3] 7.5VA 5P20 Clause 3.4		Two sets of 3	Two sets of 3	Two sets of 3	3	3	3
CTs for Tap-change Control and transducers	2000/1 7.5VA Class 0.5S Clause 3.4	3						
CTs for distance protection or pilot wire protection	800/1[3] Class PX Clause 3.4					3	3	3
CTs for busbar protection	1200/1[3] Class PX Clause 3.4	3	3	3	3	3	3	3
Circuit VT	Clause 3.5	1 Star/star/ Open-delta				1 Star/star/ open-delta		
Busbar VT	Clause 3.5		1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)
Control / Relay Panel								
Circuit breaker control switch and handle	Clause 3.10	1	1	1	1	1	1	1
Local/supervisory switch and handle	Clause 3.10	1	1	1	1	1	1	1
Remote control terminals	Clause 3.7	4	4	4	4	4	4	4
Telecontrol CB open, interposing relay	Clause 3.10	AR1	AR1	AR1	AR1	AR1	AR1	AR1
Telecontrol CB close interposing relay	Clause 3.10	AR1	AR1	AR1	AR1	AR1	AR1	AR1
Terminal blocks	Clause 3.7	As required	As required	As required	As required	As required	As required	As required
Fuses and links	Clause 3.8	As required	As required	As required	As required	As required	As required	As required
Relay test block	Clause 3.9	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings
Telecontrol auto-reclose in/out relay	Clause 3.10		AR2			AR2		
Telecontrol auto-reclose in/out push buttons	Clause 3.10		PB1 PB2			PB1 PB2		
Current transducer	Clause 3.10							
Current/Voltage/MW and MVAr transducer	Clause 3.10	TD4	TD4	TD4		TD4	TD4	TD4

Schedule B 36kV BSP Switchgear (2000A Busbars) Part 1

Description	**Further Details**	**36ITB** Incoming T/F Circuit	**36C1B** T/F Feeder Circuit without intertripping	**36C2B** T/F Feeder Circuit with surge proof intertripping	**36C3B** T/F Feeder Circuit with Local intertripping	**36C4B** Circuit with Distance Protection	**36C5B** Circuit with Pilot Wire protection	**36C6B** Circuit with Current Differential Protection
Protection relay 1	Clause 3.9	3DOCIT (LB & VC) TCS VTS BBCK	3HSOC 3OCIT EIT AR TCS	3HSOC 3OCIT EIT TCS	3HSOC 3OCIT EIT TCS	Z 3OCIT EIT AR BBCK[4] VTS TCS	PW	CD BBCK[4] TCS
Protection relay 2	Clause 3.9		3OCIT EIT	3OCIT EIT	3OCIT EIT	3OCIT EIT	OCIT EIT BBCK[4] TCS	3OCIT EIT
Protection relay 3			VTS[2]	VTS[2]	VTS[2]	VTS[2]	VTS[2]	VTS[2]
ASC Earth Fault Detection Relay	A-eberle EOR-3D		1[5]	1[5]		1[5]	1[5]	1[5]
Trip / intertrip relays	Clause 3.9	TH	TH	IT TH TS TDS	TH TDS	TH	TH	TH
Alarm / indication relays	Clause 3.9	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]

Notes

Schedule B Part 1:

Note 1: SF6 Low indication is only required where the switchgear utilises SF6 gas

Note 2: One 3 phase busbar VT and an associated VTS relay is required per section of busbars

Note 3: CTs shall have a continuous rating equal or greater than the rating of the associated circuit breaker (i.e. 1250A or 2000A, as applicable) as specified in clause 3.3

Note 4: Busbar protection check output (BBCK) is only required where the circuit provides a major fault infeed into the switchboard. Details shall be confirmed at time of tender

Note 5: ASC earth fault detection relay is only required where ASC earthing is used (this typically applies to substations in Cornwall)

Schedule B 36kV BSP Switchgear (2000A Busbars) Part 2

Description	**Further Details**	**36C7B** Circuit with basic protection	**36C8B** Interconnector Circuit with High Impedance Relay	**36C9B** Interconnector without High Impedance Relay	**36C12B** Outgoing Circuit with Metering	**36B1B** Bus-section with 2 High Impedance Relays	**36B2B** Bus-section with 1 High Impedance Relay
Standard drawings	Single Line Diagram: Schematic Diagram:	SL36C7 SPC36C7	SL36C8 SPC36C8	SL36C9 SPC36C9	SL3612B/C SPC3612B/C	SL36B1 SPC36B1	SL36B2 SPC36B2
Switchgear							
Rated voltage kV		36	36	36	36	36	36
Number of phases / poles		3	3	3	3	3	3
Rated insulation level (lightning impulse withstand voltage) kV	ENATS 41-36 Clause 1.4.2	170	170	170	170	170	170
Rated normal current A busbar	ENATS 41-36 Clause 1.4.4	2000	2000	2000	2000	2000	2000
Rated normal current A - circuit breaker	ENATS 41-36 Clause 1.4.4	1250	2000	2000	1250	2000	2000
Rated short-time withstand current kA	ENATS 41-36 Clause 1.4.5	**31.5** / 25	**31.5** / 25	**31.5** / 25	**31.5** / 25	**31.5** / 25	**31.5** / 25
Rated supply frequency of closing and opening and of auxiliary circuits (D.C. / 50Hz)	ENATS 41-36 Clause 1.4.9	D.C.	D.C.	D.C.	D.C	D.C.	D.C.
Auto reclose duty capability requirement	ENATS 41-36 Clause 2.4.111	Y	Y	Y	Y	Y	Y
Mechanism type	ENATS 41-36 Clause 2.5.5 to 2.5.7	XEM	XEM	XEM	XEM	XEM	XEM
Gas monitoring	ENATS 41-36 Clause 1.5.9	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch
Voltage presence indicating system	ENATS 41-36 Clause 1.5.201.3	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible
Arc extinction medium		Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
Cable termination type: required	Pfisterer size 3 or Euromold interface C Clause 2.6	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	9 x 1c 630mm^2	9 x 1c 630mm^2	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	None	None
CTs and VTs							
CTs for over-current and earth fault protection and/or transducers	2000/1 7.5VA 5P10 Clause 3.4		3	3		3	3
	800/1[3] 7.5VA 5P20 Clause 3.4	2 sets of 3			2 sets of 3		
CTs for busbar protection	1200/1[3] Class PX Clause 3.4	3	2 sets of 3	2 sets of 3	3	2 sets of 3	2 sets of 3

Schedule B 36kV BSP Switchgear (2000A Busbars) Part 2

Description	Further Details	36C7B Circuit with basic protection	36C8B Interconnector Circuit with High Impedance Relay	36C9B Interconnector without High Impedance Relay	36C12B Outgoing Circuit with Metering	36B1B Bus-section with 2 High Impedance Relays	36B2B Bus-section with 1 High Impedance Relay
CTs for metering	Ratio to be agreed at the time of tender 5VA class 0.2S Clause 3.4				3		
Circuit VT	Clause 3.5				1 Star/star/star open-delta		
Busbar VT	Clause 3.5	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)		
Control / Relay Panel							
Circuit breaker control switch and handle	Clause 3.10	1	1	1	1	1	1
Local/supervisory switch and handle	Clause 3.10	1	1	1	1	1	1
Remote control terminals	Clause 3.7	4	4	4	4	4	4
Telecontrol CB open, interposing relay	Clause 3.10	AR1	AR1	AR1	AR1	AR1	AR1
Telecontrol CB close interposing relay	Clause 3.10	AR1	AR1	AR1	AR1	AR1	AR1
Terminal blocks	Clause 3.7	As required	As required	As required	As required	As required	As required
Fuses and links	Clause 3.8	As required	As required	As required	As required	As required	As required
Relay test block	Clause 3.9	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings
AC/DC indication interposing relay	Clause 3.10					1[4]	
AC/DC/Off double pole control switch and handle	Clause 3.10					1[4]	
Current/Voltage/MW and MVAr transducer	Clause 3.10	TD4	TD4		TD4	TD4	TD4
Protection relay 1	Clause 3.9	3HSOC 3OCIT EIT TCS	3BBOC	3OCIT EIT TCS	3HSOC 3OCIT EIT TCS	3BBOC (2 off)	3BBOC
Protection relay 2	Clause 3.9	3OCIT EIT	3OCIT EIT TCS		3OCIT EIT	3OCIT EIT TCS	3OCIT EIT TCS
Protection relay 3	Clause 3.9	VTS[2]	VTS[2]	VTS[2]	VTS[2]		
ASC Earth Fault Detection Relay	A-eberle EOR-3D	1[5]	1[5]	1[5]	1[5]		

Schedule B 36kV BSP Switchgear (2000A Busbars) Part 2

Description	Further Details	36C7B Circuit with basic protection	36C8B Interconnector Circuit with High Impedance Relay	36C9B Interconnector without High Impedance Relay	36C12B Outgoing Circuit with Metering	36B1B Bus-section with 2 High Impedance Relays	36B2B Bus-section with 1 High Impedance Relay
Check / supervision relays	Clause 3.9					CTS (2 off) TSS BBCKA	CTS TSS
Trip / intertrip relays	Clause 3.9	TH	TH (2 off)	TH	TH TDS	TH (2 off)	TH (2 off)
Alarm / indication relays	Clause 3.9	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1] TI	A (SF6 low)[1]	A (SF6 low)[1]

Notes

Schedule B Part 2:

Note 1: SF6 Low indication is only required where the switchgear utilises SF6 gas

Note 2: One 3 phase busbar VT and an associated VTS relay is required per section of busbars

Note 3: CTs shall have a continuous rating equal or greater than the rating of the associated circuit breaker (i.e. 1250A or 2000A, as applicable) as specified in clause 3.3

Note 4: AC/DC Control switch and interposing relay are required on one bus-section

Note 5: ASC earth fault detection relay is only required where ASC earthing is used (this typically applies to substations in Cornwall)

Schedule C 36kV BSP Switchgear (2500A Busbars) Part 1

Description	**Further Details**	**36ITC** Incoming T/F Circuit	**36C1C** T/F Feeder Circuit without intertripping	**36C2C** T/F Feeder Circuit with surge proof intertripping	**36C3C** T/F Feeder Circuit with Local intertripping	**36C4C** Circuit with Distance Protection	**36C5C** Circuit with Pilot Wire protection	**36C6C** Circuit with Current Differential Protection
Standard drawings	Single Line Diagram: Schematic Diagram:	SL36IT SPC36IT	SL36C1 SPC36C1	SL36C2 SPC36C2	SL36C3 SPC36C3	SL36C4 SPC36C4	SL36C5B/C SPC36C5B/C	SL36C6B/C SPC36C6B/C
Switchgear								
Rated voltage kV		36	36	36	36	36	36	36
Number of phases / poles		3	3	3	3	3	3	3
Rated insulation level (lightning impulse withstand voltage) kV	ENATS 41-36 Clause 1.4.2	170	170	170	170	170	170	170
Rated normal current A busbar	ENATS 41-36 Clause 1.4.4	2500	2500	2500	2500	2500	2500	2500
Rated normal current A - circuit breaker	ENATS 41-36 Clause 1.4.4	2500	1250	1250	1250	1250	1250	1250
Rated short-time withstand current kA	ENATS 41-36 Clause 1.4.5	**31.5** / 25	**31.5** / 25	**31.5** / 25	**31.5** / 25	**31.5** / 25	**31.5** / 25	**31.5** / 25
Rated supply frequency of closing and opening and of auxiliary circuits (D.C. / 50Hz)	ENATS 41-36 Clause 1.4.9	D.C.	D.C.	D.C.	D.C.	D.C.	D.C.	D.C
Auto reclose duty capability requirement	ENATS 41-36 Clause 2.4.111	Y	Y	Y	Y	Y	Y	Y
Mechanism type	ENATS 41-36 Clause 2.5.5 to 2.5.7	XEM	XEM	XEM	XEM	XEM	XEM	XEM
Gas monitoring	ENATS 41-36 Clause 1.5.9	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 Stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch
Voltage presence indicating system	ENATS 41-36 Clause 1.5.201.3	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes – pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible
Arc extinction medium		Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
Cable termination type: required	Pfisterer size 3 or Euromold interface C Clause 2.6	12 x 1c 630mm^2	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters
CTs and VTs								
CTs for bias differential and restricted earth fault protection	2500/1 Class PX Clause 3.4	4 including 1 externally mounted neutral CT						
CTs for standby earth fault protection	1200/1 15VA 5P10 Clause 3.4	1 externally mounted neutral CT						
CTs for over-current and earth fault protection and/or transducers	2500/1 7.5VA 5P10 Clause 3.4	3						

Schedule C 36kV BSP Switchgear (2500A Busbars) Part 1

Description	**Further Details**	**36ITC** Incoming T/F Circuit	**36C1C** T/F Feeder Circuit without intertripping	**36C2C** T/F Feeder Circuit with surge proof intertripping	**36C3C** T/F Feeder Circuit with Local intertripping	**36C4C** Circuit with Distance Protection	**36C5C** Circuit with Pilot Wire protection	**36C6C** Circuit with Current Differential Protection
	800/1[3] 7.5VA 5P20 Clause 3.4		2 sets of 3	2 sets of 3	2 sets of 3	3	3	3
CTs for tap-change control and transducers	2500/1 15VA Class 0.5s Clause 3.4	3						
CTs for distance protection or pilot wire protection	800/1[3] Class PX Clause 3.4					3	3	3
CTs for busbar protection	2000/1[3] Class PX Clause 3.4	3	3	3	3	3	3	3
Circuit VT	Clause 3.5	1 Star/star/ Open-delta				1 Star/star/ open-delta		
Busbar VT	Clause 3.5		1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)
Control / Relay Panel								
Circuit breaker control switch and handle	Clause 3.10	1	1	1	1	1	1	1
Local/supervisory switch and handle	Clause 3.10	1	1	1	1	1	1	1
Remote control terminals	Clause 3.7	4	4	4	4	4	4	4
Telecontrol CB open, interposing relay	Clause 3.10	AR1	AR1	AR1	AR1	AR1	AR1	AR1
Telecontrol CB close interposing relay	Clause 3.10	AR1	AR1	AR1	AR1	AR1	AR1	AR1
Terminal blocks	Clause 3.7	As required	As required	As required	As required	As required	As required	As required
Fuses and links	Clause 3.8	As required	As required	As required	As required	As required	As required	As required
Relay test block	Clause 3.9	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings
Telecontrol auto-reclose in/out relay	Clause 3.10		AR2			AR2		
Telecontrol auto-reclose in/out push buttons	Clause 3.10		PB1 PB2			PB1 PB2		
Current transducer	Clause 3.10							
Current/Voltage/MW and MVAr transducer	Clause 3.10	TD4	TD4	TD4		TD4	TD4	TD4
Terminal blocks	Clause 3.7	As required	As required	As required	As Required	As required	As required	As required
Fuses and links	Clause 3.8	As required	As required	As required	As Required	As required	As required	As required

Schedule C 36kV BSP Switchgear (2500A Busbars) Part 1

Description	**Further Details**	**36ITC** Incoming T/F Circuit	**36C1C** T/F Feeder Circuit without intertripping	**36C2C** T/F Feeder Circuit with surge proof intertripping	**36C3C** T/F Feeder Circuit with Local intertripping	**36C4C** Circuit with Distance Protection	**36C5C** Circuit with Pilot Wire protection	**36C6C** Circuit with Current Differential Protection
Protection relay 1	Clause 3.9	3DOCIT (LB & VC) TCS VTS BBCK	3HSOC 3OCIT EIT AR TCS	3HSOC 3OCIT EIT TCS	3HSOC 3OCIT EIT TCS	Z 3OCIT EIT AR VTS BBCK[4] TCS	PW	CD BBCK[4] TCS
Protection relay 2	Clause 3.9		3OCIT EIT	3OCIT EIT	3OCIT EIT	OCIT EIT	OCIT EIT BBCK[4] TCS	OCIT EIT
Protection relay 3	Clause 3.9		VTS[2]	VTS[2]	VTS[2]	VTS[2]	VTS[2]	VTS[2]
ASC Earth Fault Detection Relay	A-eberle EOR-3D		1[5]	1[5]		1[5]	1[5]	1[5]
Trip / intertrip Relays	Clause 3.9	TH	TH	IT TH TS TDS	TH TDS	TH	TH	TH
Alarm / indication relays	Clause 3.9	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]

Note

Schedule C Part 1:

Note 1: SF6 Low indication is only required where the switchgear utilises SF6 gas

Note 2: One 3 phase busbar VT and an associated VTS relay is required per section of busbars

Note 3: CTs shall have a continuous rating equal or greater than the rating of the associated circuit breaker (i.e. 1250A or 2500A, as applicable) as specified in clause 3.3

Note 4: Busbar protection check output (BBCK) is only required where the circuit provides a major fault infeed into the switchboard. Details to be confirmed at time of tender

Note 5: ASC earth fault detection relay is only required where ASC earthing is used (this typically applies to substations in Cornwall)

Schedule C 36kV BSP Switchgear (2500A Busbars) Part 2

Description	**Further Details**	**36C7C** Circuit with Basic Protection	**36C8C** Interconnector Circuit with High Impedance Relay	**36C9C** Interconnector without High Impedance Relay	**36C12C** Outgoing Circuit with Metering	**36B1C** Bus-section with 2 High Impedance Relays	**36B2C** Bus-section with 1 High Impedance Relay
Standard drawings	Single Line Diagram: Schematic Diagram:	SL36C7 SPC36C7	SL36C8 SPC36C8	SL36C9 SPC36C9	SL3612B/C SPC3612B/C	SL36B1 SPC36B1	SL36B2 SPC36B2
Switchgear							
Rated voltage kV		36	36	36	36	36	36
Number of phases / poles		3	3	3	3	3	3
Rated insulation level (lightning impulse withstand voltage) kV	ENATS 41-36 Clause 1.4.2	170	170	170	170	170	170
Rated normal current A busbar	ENATS 41-36 Clause 1.4.4	2500	2500	2500	2500	2500	2500
Rated normal current A - circuit breaker	ENATS 41-36 Clause 1.4.4	1250	2500	2500	1250	2500	2500
Rated short-time withstand current kA	ENATS 41-36 Clause 1.4.5	**31.5** / 25	**31.5** / 25	**31.5** / 25	**31.5** / 25	**31.5** / 25	**31.5** / 25
Rated supply frequency of closing and opening and of auxiliary circuits (D.C. / 50Hz)	ENATS 41-36 Clause 1.4.9	D.C	D.C.	D.C.	D.C	D.C.	D.C.
Auto reclose duty capability requirement	ENATS 41-36 Clause 2.4.111	Y	Y	Y	Y	Y	Y
Mechanism type	ENATS 41-36 Clause 2.5.5 to 2.5.7	XEM	XEM	XEM	XEM	XEM	XEM
Gas monitoring	ENATS 41-36 Clause 1.5.9	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch	2 stage pressure switch
Voltage presence indicating system	ENATS 41-36 Clause 1.5.201.3	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible
Arc extinction medium		Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
Cable termination type: required	Pfisterer size 3 or Euromold interface C Clause 2.6	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	12 x 1c 630mm^2	12 x 1c 630mm^2	3 x 1c (up to 400 mm^2) & 3x 1ph surge arresters	None	None
CTs for over-current and earth fault protection and/or transducers	2500/1 7.5VA 5P10 Clause 3.4		3	3		3	3
	800/1[3] 7.5VA 5P20 Clause 3.4	2 sets of 3			2 sets of 3		
CTs for busbar protection	2000/1[3] Class PX Clause 3.4	3	2 sets of 3	2 sets of 3	3	2 sets of 3	2 sets of 3

Schedule C 36kV BSP Switchgear (2500A Busbars) Part 2

Description	Further Details	36C7C Circuit with Basic Protection	36C8C Interconnector Circuit with High Impedance Relay	36C9C Interconnector without High Impedance Relay	36C12C Outgoing Circuit with Metering	36B1C Bus-section with 2 High Impedance Relays	36B2C Bus-section with 1 High Impedance Relay
CTs for metering	Ratio to be agreed at the time of tender 5VA class 0.2S Clause 3.4				3		
Circuit VT	Clause 3.5				1 Star/star/star open-delta		
Busbar VT	Clause 3.5	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)	1[2] (Star/star/ open-delta)		
Control / Relay Panel							
Circuit breaker control switch and handle	Clause 3.10	1	1	1	1	1	1
Local/supervisory switch and handle	Clause 3.10	1	1	1	1	1	1
Remote control terminals	Clause 3.7	4	4	4	4	4	4
Telecontrol CB open, interposing relay	Clause 3.10	AR1	AR1	AR1	AR1	AR1	AR1
Telecontrol CB close interposing relay	Clause 3.10	AR1	AR1	AR1	AR1	AR1	AR1
Terminal blocks	Clause 3.7	As required	As required	As required	As required	As required	As required
Fuses and Links	Clause 3.8	As required	As required	As required	As required	As required	As required
Relay test block	Clause 3.9	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings	As specified in schematic drawings
AC/DC indication interposing relay	Clause 3.10					1[4]	
AC/DC/Off double pole control switch and handle	Clause 3.10					1[4]	
Current/Voltage/MW and MVAr transducer	Clause 3.10	TD4	TD4		TD4	TD4	TD4
Protection relay 1	Clause 3.9	3HSOC 3OCIT EIT TCS	3BBOC	3OCIT EIT TCS	3HSOC 3OCIT EIT TCS	3BBOC (2 off)	3BBOC
Protection relay 2	Clause 3.9	3OCIT EIT	3OCIT EIT TCS		3OCIT EIT	3OCIT EIT TCS	3OCIT EIT TCS
Protection relay 3	Clause 3.9	VTS[2]	VTS[2]	VTS[2]	VTS[2]		
ASC Earth Fault Detection Relay	A-eberle EOR-3D	1[5]			1[5]		

Schedule C 36kV BSP Switchgear (2500A Busbars) Part 2

Description	Further Details	36C7C Circuit with Basic Protection	36C8C Interconnector Circuit with High Impedance Relay	36C9C Interconnector without High Impedance Relay	36C12C Outgoing Circuit with Metering	36B1C Bus-section with 2 High Impedance Relays	36B2C Bus-section with 1 High Impedance Relay
Check / supervision relays	Clause 3.9					CTS (2 off) TSS BBCKA	CTS TSS
Trip / intertrip relays	Clause 3.9	TH	TH (2 off)	TH	TH TDS	TH (2 off)	TH (2 off)
Alarm / indication relays	Clause 3.9	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1]	A (SF6 low)[1] TI	A (SF6 low)[1]	A (SF6 low)[1]

Note

Schedule B Part 2:

Note 1: SF6 Low indication is only required where the switchgear utilises SF6 gas

Note 2: One 3 phase busbar VT and an associated VTS relay is required per section of busbars

Note 3: CTs shall have a continuous rating equal or greater than the rating of the associated circuit breaker (i.e. 1250A or 2500A, as applicable) as specified in clause 3.3

Note 4: AC/DC Control switch and interposing relay are required on one bus-section

Note 5: ASC earth fault detection relay is only required where ASC earthing is used (this typically applies to substations in Cornwall)