Electricity Distribution

nationalgrid

Company Directive

ENGINEERING SPECIFICATION
EE SPEC 185/2

12kV Primary Type Indoor Circuit Breakers

Author: **Anthony Smith**

Implementation Date: **February 2025**

Approved by

Andrew Reynolds
Engineering Policy Manager

Date: **29th January 2025**

Target Staff Group	**Anyone involved with the addition, or alteration of, 12kV indoor switchboards inclusive of but not limited to Planners, Project Engineers, Technicians, EDS, PND and Purchasing for any tenders**
Impact of Change	**Green – No impact on current working practices**
Planned Assurance checks	**Team Managers of target staff group shall be contacted within 3 months to confirm staff have been made aware of the documents reissue with minimal changes**

IMPLEMENTATION PLAN

Introduction

This document specifies the requirements for 12kV Primary Type Indoor fixed pattern Circuit Breakers for use on the National Grid Electricity Distribution (NGED) 11kV Network

Main Changes

This version replaces EESPEC 185/1 which will be withdrawn.

Reorganisation of the document to align with the clause layout within ENATS 41-40. Minimal changes to equipment requirements from EE185/1 other than clause repositioning.

Reduction in standard panel types available for normal use. Other types archived to appendices for ad-hoc use with existing arrangements as necessary.

Impact of Changes

The updated EESPEC has been issued to allow NGED procurement to tender for replacement contracts for 12kV Primary Type Indoor Fixed Pattern circuit breakers/ switchboards.

Any new contract will be based on this updated specification

This specification is nor retrospective for current contracts or orders.

There is no change to items being supplied under the existing NGED Framework Contracts for 12kV Primary Type Indoor Circuit Breakers

Implementation Actions

Managers, including Managers of Independent Connection Providers (ICPs) shall ensure that all staff and contractors involved in the tendering and purchasing of 12kV indoor substations as well as those involved with the design, installation, modification and maintenance of NGED 12kV substations are aware of, and follow, the requirements of this specification.

Implementation Timetable

EESPEC 185/2 will be used as part of the 2025 tender process for 12kV Primary Type Indoor Fixed Pattern Circuit breakers and shall be implemented on issue.

ICPs will be expected to comply with this new specification within 6 months of its issue. (e.g., from 1st August 2025)

Items currently on order/under an active quotation by an ICP, to EE185/1 shall continue to be acceptable to NGED so long as the order was placed before 1st August 2025 but the unit is to be commissioned after 1st August 2025.

Exception to this may be made by NGED DNO Policy team upon formal request.

REVISION HISTORY

Document Revision & Review Table		
Date	**Comments**	**Author**
Feb 2025	This document has been updated following the withdrawal of ENATS 41-36 and issue of its replacements under the ENATS 41-40 series of documents which in turn are based on BS EN 62271-1. The base document for EE185/2 is ENATS 41-40 iss1 which is part of a suite of new ENATS created to replace ENATS 41-36. The structure of the new documents aligns with that of BS EN 62271-1 and as such the new clause numbering is very different than before therefore there is no direct correlation clause to clause from EE185/1 to EE185/2 however the technical requirements for 12kV Primary Type Indoor Fixed Pattern switchgear have not altered from EE185/1. Certain parts been clarified where ambiguity existed and duplicated items have been removed. The standard panel types within Schedules A and B to be used going forward are a reduced subset of the previous Schedules. The others have been archived for ad-hoc use at the end of the document.	Anthony Smith
April 2018	Minor text revisions to Document title 1.1 to reflect document title 2.7.1 correction Appendix E to Appendix B 3.4.14.2(a) & (b) kA for kV 3.4.14.2(b) values revised in the formula for determining the knee point voltage for high impedance protection. Schedule A Part 1 o correction to drawing references SL12ITA & SPC12ITA o 12C5A & 12C6A applicability to network substations changed to No Schedule A Part 2 o Remove drawing reference SL12C7A o 12C13A CT requirements changed to 2 sets of 3 Schedule A Part 3 o Remove drawing reference SL12B3A o CT requirements – ratios clarified/corrected o Requirement for TSS added to 12B4A Schedule B Part 1 o Drawing reference corrected 12ITB o 12C2B protection relay requirements amended to include CD option Schedule B Part 2 o Drawing reference added to 12C8B	S Hennell / A Hood

CONTENTS

1.0 INTRODUCTION

1.1.1 This Technical Specification (TS) sets out National Grid Electricity Distributions (NGEDs) requirements for 12kV primary type indoor circuit breakers (CBs), and busbar metering units with associated protection / control and ancillary electric equipment for use on its 11kV system. This document specifies the requirements for protection / control systems, and electrical ancillary equipment associated with 12kV indoor circuit breakers and busbar metering units.

1.1.2 Protection equipment associated with 12kV ring main units (RMUs), fuse switches and fuse switch equivalents are outside the scope of this document (See latest version of EE SPEC: 2).

1.1.3 Transformer protection cubicles and protection requirements for outdoor circuit breakers are specified in the latest version of EE SPEC: 87.

1.1.4 This document is based on and must be read in conjunction with the current version of Energy Networks Association (ENA) Technical Specification 41-40 and other referenced Standards and Technical Specifications listed either within the ENATS or this NGED TS. NGED options, changes or additions to the ENATS requirements are stated in this NGED TS. Unless otherwise stated the requirements of the relevant part(s) of ENATS 41-40 shall apply.

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

1.1.6 Where this NGED TS is being used for Tender purposes then unless otherwise specified in writing at the time of Tender, all equipment offered against this TS shall be compliant with this TS.

1.1.7 NGED has a distinct preference for equipment which holds an ENA Notice of Conformity (NoC) to the current version or a previous version of an ENA Technical Specification (TS). Where equipment does not have a valid ENA NoC then the following preferences apply in order: -

- Equipment from a design where other ratings have an ENA NoC;
- Equipment manufactured in a facility where other equipment having an ENA NoC is manufactured;
- Other non-ENA Assessed equipment.

1.1.8 Where equipment offered does not have an ENA NoC then the manufacturer will be required to provide NGED with details and test data for review that will be equivalent to completing and ENA NoC Assessment. There is no guarantee that following NGED assessment of the equipment that it will be accepted for use by NGED.

1.1.9 Standard arrangements for HV Customer connections are given in ST:SD4OB.

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

2.0 REQUIREMENTS

2.1 General

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

2.1.2 All equipment 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 BS EN 61000-6-2 and BS EN 61000-6-4 and also all relevant EMC product standards.

2.2 Guarantee

2.2.1 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 60 months (five years) from the date of completion of cold commissioning on site of the relevant plant / equipment; or where equipment has been manufactured but not delivered to NGED but placed into storage at NGED request, or delivered to NGED but not cold commissioned within 6 months, then the warranty period shall be 66 months from the date of storage or delivery.

2.2.2 This requirement applies to plant / equipment purchased by Independent Connection Providers (to be adopted by NGED) as well as equipment purchased directly by NGED. The 60-month timeframe commences on transfer of ownership to NGED

2.3 Drawings

2.3.1 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. One paper copy of each drawing, prepared in accordance with EA TS 50-18 and not exceeding A1 size, one electronic .dwg/.dxf CAD format and one electronic copy in .pdf format shall be supplied for approval.

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

2.3.2 Once approval has been obtained an updated electronic copy .dwg/.dxf and .pdf format shall be supplied. 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. The manufacturer shall provide final drawings in .dwg/.dxf CAD and .pdf formats.

3.0 MODIFICATIONS AND ADDITIONS TO ENATS 41-40

3.1 References

3.1.1 References are in accordance with ENATS 41-40 with the following additions in Table 1, below.

3.1.2 It is important that users of all standards and technical specifications ensure they are applying the most recent editions together with any amendments.

3.1.3 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
BS HD 60269	Cartridge fuses for voltages up to and including 1000V ac and 1500V dc	IEC 60269
BS EN 60255	Specification for electrical protection relays	IEC 60255
BS EN 60688	Electrical measuring transducers for converting A.C. electrical quantities to analogue or digital signals.	IEC 60688
BS EN 60898	Circuit breakers for overcurrent protection for household and similar installations	IEC 60898
BS EN 61000-6-2	Electromagnetic compatibility (EMC) Generic standards – Immunity for industrial environments	IEC 61000-6-2
BS EN 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
EREC G110	Instantaneous High Impedance Differential Protection	
ENATS 48-4	DC Relays Associated with a Tripping Function in Protection Systems	
ENATS 48-5	Environmental Test Requirements for Protection and Control Equipment and Systems	

Table 1 Additional References

4.0 SPECIFIC REQUIREMENTS

4.1 System earthing (BSEN 62271-1 – clause 9.1)

4.1.1 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 NGEDs 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.

5.0 RATINGS

All requirement of ENATS 41-40 section 5 apply except for the following clarifications or requirements and any detail within Schedules A and B:

5.3 Rated insulation Level

Rated insulation Level shall be per ENATS 41-40 cl.5.1 which states

Rated Voltage U_r kV (r.m.s. value)	**Rated short duration power-frequency withstand voltage Ud (r.m.s. value) for 1 minute**		**Rated lightning impulse withstand voltage U_p kV (peak value)**
	Common Value Dry and Wet	**Across the isolating distance Dry and Wet**	**Common Value**
12	28	32	95

5.5 Rated Continuous Current (ENATS 41-40 cl 5.5)

5.5.1 Rated continuous current of busbar and circuit breaker panels are as shown in Schedules A and B of this document.

5.6 Rated short-time withstand current (ENATS 41-40 cl 5.6)

5.6.1 The default rating shall be a minimum of 25kA as shown in as shown in Schedules A and B. Note, it is the NGED Specifier's responsibility to check with NGED Primary Network Design (PND) that these default ratings are sufficient for the envisaged future specific site duty.

5.9 Rated Supply Voltage of Auxiliary and Control Circuits (Ua) (ENATS 41-40 cl 5.9)

5.9.1 Circuit breaker spring winding motor and protection/alarm relay auxiliary supplies for new equipment are normally rated at 110Vd.c, although in some existing NGED network substations 30Vd.c. auxiliary supplies are used instead. Where this is required, it shall be notified at time of order.

5.9.2 Tele-control auxiliary supplies for new sites are generally 48Vdc using a positive common rail with negative switching. However, for some older switchgear types and location used in South Wales the voltage used is 24Vdc and the polarity is reversed. Details will be confirmed at time of order

5.9.3 Equipment shall operate correctly over the d.c. auxiliary voltage ranges specified in ENATS 48-5, ENATS 50-18 and ENATS 41-40 issue 1 as applicable and shown below

Nominal Voltage	Criteria for rated supply voltage operating range	Closing and Opening releases and operating devices		Other operating devices
		Close volts	Open volts	Volts
110 V	Maximum operating voltage (max battery charging voltage)	137.5	137.5	137.5
	Minimum operating voltage	87.5 (80% of nominal)	77 (70% of nominal)	87.5
48 V	Maximum operating voltage (max battery charging voltage)	53	137.5	53
	Minimum operating voltage	38.5	33.6	38.5
30 V	Maximum operating voltage (max battery charging voltage)	37.5	137.5	37.5
	Minimum operating voltage	23.9	21	23.9
24 V	Maximum operating voltage (max battery charging voltage)	30	30	30
	Minimum operating voltage	19.2	16.8	19.2

Table 2 Rated Supply voltage and auxiliary control circuits

5.9.4 Rated voltage for AC supplies for heating and lighting shall be 230V 50Hz AC.

5.10 The rated supply frequency for auxiliary and control circuits

5.10.1 Rated supply frequency shall be DC.

6.0 DESIGN AND CONSTRUCTION

All requirements of ENATS 41-40 section 6 apply except for the following additions/clarifications and per the detail shown within Schedules A and B:

6.3 Earthing of Switchgear and controlgear

6.3.1 Cubicle earthing requirements and earthing of small apparatus shall be in accordance with BSEN IEC 62271-1, BS EN IEC 62271-200 and EATS 50-18. An earth bar of not less than 25mm x 3mm copper shall be provided internally with bolted connections between cubicles. The earth bar shall be provided with means to connect the earthing of small apparatus within the cubicle.

6.4 Auxiliary and control equipment and circuits

6.4.1 Protection and Alarm Relays

6.4.1.1 Protection, alarm and control relays shall be chosen in accordance with Schedule A and Schedule B and with NGED's standard drawings. Relay types shall be agreed with NGED at the time of Tender.

6.4.1.2 On a given suite of panels and cubicles, protection relays shall, as far as reasonably practicable, be obtained from one relay manufacturer. The types of relays and their position shall be consistent across the suite of panels and cubicles.

6.4.1.3 Protection relays shall comply with ENATS 48-4, ENATS 48-5, BSEN 6025, BSEN 61810 and BSEN 61811 as appropriate and be of a type and make approved for use within NGED. A list of approved relays and relay test blocks is included in EE SPEC:98.

6.4.1.4 Alternative relays can be submitted to the Engineering Policy Manager for evaluation.

6.4.1.5 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.

6.4.1.6 Alarm indication functions, such as buchholz alarm, Interrupting and Isolating Gas (IIG) 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.

6.4.1.7 Unless otherwise specified, a.c. relay inputs shall be suitable for use with 1A CT and 110V VT supplies. The d.c. auxiliary supply voltage rating shall be in accordance with the value specified on the Switchgear Enquiry/Ordering Schedule (either 110Vd.c. or 30Vd.c.). If there is any doubt over the required relay ratings the tenderer shall confirm the requirements with NGED at the time of tender.

6.4.2 Ancillary Equipment

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

6.4.3 Busbar Protection

6.4.3.1 Busbar protection for 11kV indoor switchboards shall comprise a partial differential protection scheme. 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.

6.4.4 ASC Earth Fault Detection Relay

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

6.4.5 Accessibility of Auxiliary and Control Equipment (EN 60694 cl 5.4.2.2)

6.4.5.1 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.

6.4.202 Cables and wiring.

6.4.202.1 Small wiring and terminals shall comply with EA TS 41-40 with the following additions:

6.4.202.1.1 The application of small wiring, ancillary electrical equipment and protection shall in general follow the principles in Engineering Recommendation S15.

6.4.202.1.2 A.C. and D.C. secondary wiring shall comprise of:

- A.C. wiring: 2.5mm2 (minimum) copper stranded cable with PVC insulation to BS6231 Type BR, or equivalent tri-rated cable complying with BS6231.
- D.C. wiring: 1.5mm2 (minimum) copper stranded cable with PVC insulation to BS6231 Type BR, or equivalent tri-rated cable complying with BS6231.
- Transducer output wiring: 1.0mm2 (minimum) stranded copper twisted pair cable with PVC insulation.

6.4.202.1.3 The insulation of A.C. and D.C. wiring shall be coloured white in all circuits, except earthing which shall be coloured green/yellow and 240V systems which shall be brown/blue. A.C. and D.C. wiring shall be terminated with crimped connections in accordance with EA TS 50-18.

6.4.202.1.4 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 24Vd.c. and 48Vd.c. telecontrol 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.

6.4.202.1.5 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 NGED 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”.

6.4.202.2 Auxiliary Switches

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

6.4.203 Terminals and terminations

6.4.203.1 Terminals

6.4.203.1.1 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.

6.4.203.1.2 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.

6.4.203.2 Fuses and Links

6.4.203.2.1 Secondary fuselinks, links and fuse carriers shall be in accordance with EATS 50-18, BS HD 60269-2 reference A. Fuses and fuse holders up to 20A rating shall be in accordance with BS HD 60269-2 reference A1.

6.4.203.2.2 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

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

6.4.203.2.4 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.

6.4.203.2.5 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.

6.12 Locking Devices

6.12.201 Interlocking

6.12.201.1 In additional to the requirements of ENATS 41-40 cl.6.12.201, provision for Permissive Earth and Proof of Earth interlocking shall be provided on incoming transformer circuits (12ITA and 12ITB) as detailed in ENATS 41-40 clause 6.12.201.1.

- This requirement is for use at 132/11kV and 66/11kV substations, and particularly where double-wound secondary transformers are installed.
- Castell Type Q or Fortress Type H are required. Numbering/legend will be provided at the time of order.

6.102 Enclosure

6.102.2 Covers and Doors

6.102.2.203 Heater

6.102.2.203.1 Anti-Condensation Heaters. 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.

6.103 High Voltage compartments

6.103.1.201 Connection (Cable) Compartments (ENATS 41-40 clause 6.103.1.201)

It should be noted that it is NGED's requirement that all terminations shall be screened terminations of either inner cone size 3 or outer cone interface C.

If this cannot be achieved then, the supplier shall note that this clause 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 manufacturer's 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, NGED use mechanical shear bolt cable lugs which have a centre palm therefore the cable box dimensions shall reflect this fact.

6.103.1.201.1 The NGED Schedules A and B do not call up insulated glands. NGED Project staff will need to modify this requirement where an existing switchboard with frame leakage busbar protection is being extended.

6.201 CT and VT General Requirements

6.201.1 CT Requirements

6.201.1.1.1 Current transformers (CTs) shall be in accordance with EA TS 41-40 and BSEN 61869-2 with the following additions. Characteristics and ratios are specified in the accompanying Schedules and as set out below.

6.201.1.1.2 With the exception of neutral current transformers, all CTs shall be mounted on bushings inside the switchgear, unless otherwise agreed by NGED's Policy Team.

6.201.1.1.3 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.

6.201.1.1.4 Irrespective of the ratio of protective CTs, the rated continuous thermal current of the CTs (Icth) shall match the full current rating of the circuit breaker.

6.201.1.1.5 For measurement class CTs the rated continuous thermal current (Icth) shall be 120% of the rated primary current (Ipr) of the CT unless a higher rating is specified.

6.201.1.1.6 CTs and secondary wiring within live compartments shall be fully and affectively 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.

6.201.1.1.7 Incoming transformer equipment calls for the supply of outdoor mounted current transformers for use with 6.6kV or 11V 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.

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

6.201.1.1.9 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.

6.201.1.1.10 Externally mounted CTs for use with 11kV or 6.6kV neutral busbars shall satisfy the minimum voltage ratings in the following Table:

System Voltage	**Minimum Voltage Rating**	
	CT mounted on Transformer Side of Earthing Resistor/Reactor	**CT mounted on earth side of Earthing Resistor / Reactor**
11kV or 6.6kV	7kV a.c. (continuous rating)	2kV a.c. (for 1 minute)

Table 2 CT Voltage Ratings

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

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

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

6.201.1.1.14 By agreement between the manufacturer and the NGED Engineering Policy Team, low energy output devices may be prescribed in lieu of CTs where there is a significant cost benefit over the entire life of the switchboard.

6.201.1.2 Class PX CTs

6.201.1.2.1 Class PX current transformers shall comply with BSEN 61868-2 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.

6.201.1.2.2 The minimum knee point requirements for CTs are specified in the following clauses, where;

VK = Knee point voltage
R_{CT} = d.c. secondary resistance of the CT
N = ratio of the CT (i.e., primary current / rated secondary current)

6.201.1.2.3 The minimum knee point voltage for Class PX CTs is the higher of 80V and the following requirement:

(a) CTs for Current Differential and Pilot Wire Protection:

- For 25kA switchgear: $VK \geq 3.4 \times 10^4 (R_{CT} + 0.5)/N$
- For 31.5kA switchgear: $VK \geq 3.6 \times 10^4 (R_{CT} + 0.5)/N$

(b) CTs for High Impedance Protection (Busbar & Restricted Earth Fault Protection):

- For 25kA switchgear: $VK \geq 5.0 \times 10^4 (R_{CT} + 0.5)/N$
- For 31.5kA switchgear: $VK \geq 6.3 \times 10^4 (R_{CT} + 0.5)/N$

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

6.201.1.2.5 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

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

6.201.1.2.7 In addition to the knee point requirement the magnetising current for each CT shall be less than 50mA at the CT's knee point voltage.

6.201.2 VT General Requirements

6.201.2.1 Voltage transformers (VTs) shall be in accordance with ENA TS 41-40 with the following additions:

6.201.2.1.1 Dry type, encapsulated, voltage transformers are required.

6.201.2.1.2 Facilities shall be provided for disconnecting and isolating the VT.

6.201.2.1.3 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.

6.201.2.1.4 All secondary neutral points shall be brought out to accessible terminal blocks.

6.201.2.1 VT Performance Characteristics

6.201.2.1.1 Each VT star winding shall have a rating of 25VA per phase.

6.201.2.1.2 Open delta windings shall also be rated at 25VA.

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

6.201.2.1.4 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.

6.201.2.1.5 Voltage transformer rated transformation ratios shall be in accordance with Table4

6.201.2.1.6 Voltage transformers shall have their rated transformation ratios and voltages shown on drawings, diagrams and rating plates as shown in Table 4.

System Voltage	Primary Winding	Secondary Windings		
		Protection	Metering	Residual [1]
	Voltage (Upn)	Voltage (Usn)	Voltage (Usn)	Voltage (Usn)
11kV	11000/√3	110/√3	110/√3	110/3
6.6kV	11000/√3 and 6600/√3	110/√3	110/√3	110/3

Table 4 VT Windings

Note 1 Where the VT is used for metering purposes an additional secondary star winding is required.

Note 2 Voltage transformers specified for use on the 6.6kV system shall initially be connected for use at 6.6kV. It shall be possible to subsequently convert the VT to 11kV operation by means of internal links with minimal operational difficulty.

6.201.2.1.7 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.

6.201.2.2 Ferroresonance Damping Resistors

6.201.2.2.1 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.

6.201.2.3 Voltage Transformer Connections

6.201.2.4 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.

6.201.2.5 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. 2 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

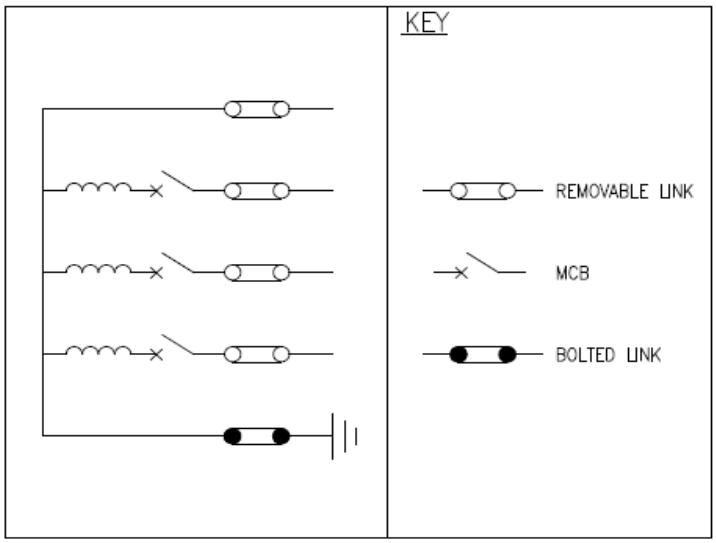
6.201.2.6 Secondary windings used for metering purposed shall be fused at 6A.

6.201.2.7 VT residual windings shall be connected through removable links.

6.201.2.8 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).

6.201.2.9 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



6.201.2.10 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.

6.201.2.11 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.

6.201.2.12 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.

6.202 Metering Requirements

Metering CTs and VT shall comply with latest version of the UK Balancing and Settlement Code. NGED specific requirements are as follows

Provision shall be made to prevent un-authorised access to metering CTs and VTs and their associated secondary circuits. A lockable securing bar or equivalent shall be fitted across any fuses and links and an appropriate securing measure across any points of access to the current and voltage wiring of the metering equipment.

6.202.1 Metering CTs

6.202.1.1 Metering CT ratio options and class requirement are as follows

CT Ratio Options	VA Rating	Class	Additional Error Data
12kV Switchgear			
200/100/5 300/150/5 400/200/5 600/300/5 800/400/5 1200/600/5 1600/800/5 2000/1000/5	10VA	0.2S	5%, 20%, 100% and 120% load points with a burden of 7.5VA 0.9 power factor

Table 3 Metering CT Requirements

Table 3 specifies the metering CT ratios that shall be available from CB suppliers to choose for use on NGEDs network.

Specifiers of metering CTs will be required to consider and justify the choice of metering CTs based on the following requirements:

6.202.1.2 The lower of the secondary metering CT ratio shall be chosen to match the size of the connection being made (irrespective of export or import) and shall also be chosen to ensure that under all running conditions the Rated Measuring Current does not fall below 1% or exceed 120%. This includes export and import power measurements but needs to be pragmatic and reasoned when considering final CT ratio choice. This requirement is based on the requirements of the 2024 Elexon Balancing and Settlement Code, Code of Practice which depends on the connection size

6.202.1.3 Metering current transformers shall have independent cores and secondary windings from those provided for protection purposes.

6.202.1.4 Metering CTs shall be tested to confirm compliance with BSEN 60044-1 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.

6.202.1.5 Electronic copies of the 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.

All test certificates shall be sent to the NGED by electronic mail.

A hard cope of the test certificate/s shall accompany any circuit breaker in which a metering current transformer is installed.

6.202.2 Metering VTs

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

6.202.2.2 All metering VT test certificates shall include tests to confirm compliance with BS EN 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.

6.202.2.3 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 NGED project engineer by electronic mail.

6.202.2.4 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

7.0 Schedule A Switchgear and Protection Panel Types for use with 1250A Busbars

Description	Further Details	**12ITA** Incoming T/F feeder	**12C4A** O/H Circuit (includes SEF and A/R)	**12C8A** Outgoing Circuit with Metering	**12C11A** Incoming Circuit with Directional Protection		**12B1A** Bus-section CB with 2x Partial Diff
Standard Drawings [1]	Single Line Diagram: Schematic Diagram:	SL12ITA SPC12ITA	SL12C4 SPC12C4	SL12C8A SPC12C8A	SL12C11A SPC12C11A		SL12B1 SPC12B1
Applicability	Primary Substation:	Yes	Yes	Yes	No		Yes
	Network Substation:	No	Yes	Yes	Yes		No
Rated voltage (kV)		12	12	12	12		12
Number of phases / poles		3	3	3	3		3
Rated insulation level (lightning impulse) kV	ENATS 41-40 Clause 5.3	95	95	95	95		95
Rated normal current (A) busbar	ENATS 41-40 Clause 5.5	1250	1250	1250	1250		1250
Rated normal current A – circuit breaker	ENATS 41-40 Clause 5.5	1250	630	630	630		1250
Rated short-time withstand current kA	ENATS 41-40 Clause 5.6	25	25	25	25		25
Auxiliary Supply frequency (D.C. or 50Hz)	ENATS 41-40 Clause 5.9	D.C.	D.C.	D.C.	D.C.		D.C.
Auto Reclose duty capability requirement	ENATS 41-40 Clause 5.300.104	YES	YES	YES	YES		Y
Mechanism type	ENATS 41-40 Clause 6.7	XEM [2]	XEM [2]	XEM [2]	XEM [2]		XEM [2]
Voltage presence indicating system	ENATS 41-40 Clause 6.103.203.10	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible		Yes- pfisterer compatible
Arc extinction medium		Vacuum	Vacuum	Vacuum	Vacuum		Vacuum
Cable terminations required	Partially-insulated bolted connection or Euromold interface C Clause 6.103.1.201	6 x 1c 630 mm^2 (1250A rated separable connectors)	3 x 1c 300 mm^2	3 x 1c 300 mm^2	3 x 1c 300 mm^2		
CTs and VTs							
CT for tap-change control and transducers	1200/1 7.5VA class 0.5S Clause 6.201	3					
CTs for partial differential busbar protection	1200/1 5VA 5P20 Clause 6.201	3			3		2 sets of 3 1200/1 CTs. One set each side of circuit breaker
CTs for overcurrent and earth fault protection	1200/1 5VA 5P20 Clause 6.201	3					3
	600/1 5VA 5P20 Clause 6.201		3	3	3		
CT for standby earth fault protection	1200/1 15VA 5P10 Clause 6.201	1 externally mounted neutral CT					
CTs for high impedance / restricted EF protection	1200/1 Class PX Clause 6.201	4 inc. 1 externally mounted neutral CT					
CTs for Metering	To be confirmed at time of Order. Clause 6.202.1			3			
CTs for transducers etc.	600/1 5VA Class 0.5S Clause 6.202.1			3			
Circuit VT	Clause 6.201	1 Star/star/ open delta		1 Star/star/star/ open-delta	1 Star/star/ open-delta		
Busbar VT [3]	Clause 6.201		(1)[1] (Star/star/ open-delta)				
Control / Relay Panel							
Circuit Breaker Control Switch and Handle.	Clause 6.4.2	1	1	1	1		1
Local/Supervisory Switch and Handle.	Clause 6.4.2	1	1	1	1		1
Remote Control Terminals	Clause 6.4.203	4	4	4	4		4
CB Open Interposing Relay	Clause 6.4.2	AR1	AR1	AR1	AR1		AR1
CB Close Interposing Relay	Clause 6.4.2	AR1	AR1	AR1	AR1		AR1
Inst. In/Out Relay	Clause 6.4.2		AR2				
Inst. In/Out Push Buttons	Clause 6.4.2		PB1 / PB2				
SEF In/Out Relay	Clause 6.4.2		AR2				
SEF In/Out Push Buttons	Clause 6.4.2		PB1 / PB2				
A/R In/Out Relay	Clause 6.4.2		AR2				
A/R In/Out Push Buttons	Clause 6.4.2		PB1 / PB2				
AC/DC indication interposing relay	Clause 6.4.2						(AR6) [5]
AC/DC/Off double pole control switch and handle	Clause 6.4.2						(1)[5]
Low Frequency Demand Disconnection Links	Clause 6.4.203.2	Yes					
Current / Voltage / MW and MVAR transducer	Clause 6.4.2	TD4	TD4	TD4	TD4		TD4
Terminal Blocks	Clause 6.4.203	As required	As required	As required	As required		As required
Fuses and Links	Clause 6.4.203.2	As required	As required	As required	As required		As required
Test Block	Clause 6.4	As specified on schematics	As specified on schematics	As specified on schematics	As specified on schematics		As specified on schematics
Protection Relay 1	Clause 6.4	3DOCIT(LB) 3DOCIT(VC) TCS VTS	3OC, 3OCIT E, EIT, SEF AR TCS	3OCIT / 3DOCIT EIT / DEIT NVD TCS VTS	3DOCIT DEIT TCS VTS		3OCIT EIT TCS
Protection Relay 2	Clause 6.4		VTS[1]				3OCIT EIT
ASC Earth Fault Detection Relay	A-Eberle EOR-3DS		(1)[3]	(1)[3]	(1)[3]		
Trip relay/s	Clause 6.4	TH	TH	TI (TH) [4]	TH		TH (2 off)

Notes:

Schedule A Part 1

Note 1: One 3 phase busbar VT and VTS relay is required per section of busbars unless all the circuits have their own feeder VTs

Note 2: Alternative mechanism types will be considered at the time of tender

Note 3: ASC Earth Fault Detection Relay is only required where ASC earthing is used (this typically applies to substations in Cornwall)

Note 4: Hand reset trip relay is required where partial differential protection is specified

Note 5: One AC/DC control switch, handle and interposing relay is required per switchboard

8.0 Schedule B Switchgear and Protection Panel Types for use with 2000A Busbars

Description	Further Details	**12ITB** Incoming T/F feeder	**12C4B** O/H Circuit (Includes SEF and A/R)	**12C5B** Interconnector with High Impedance Relay	**12C6B** Interconnector without High Impedance Relay		**12B1B** Bus-section CB with 2x Partial Diff Relays for Primary Substation
Standard Drawings [1]	Single Line Diagram: Schematic Diagram:	SL12ITB SPC12ITB	SL12C4 SPC12C4	SL12C5 SPSC12C5	SL12C6 SPS12C6		SL12B1 SP12B1
Applicability	Primary Substation:	Yes	Yes	Yes	Yes		Yes
	Network Substation:	No	No	No	No		No
Rated voltage (kV):		12	12	12	12		12
Number of phases / poles:		3	3	3	3		3
Rated insulation level (lightning impulse withstand voltage) kV	ENATS 41-40 Clause 5.3	95	95	95	95		95
Rated normal current (A) busbar	ENATS 41-40 Clause 5.5	2000	2000	2000	2000		2000
Rated normal current A – circuit breaker	ENATS 41-40 Clause 5.5	2000	630	2000	2000		2000
Rated short-time withstand current kA	ENATS 41-40 Clause 5.6	25	25	25	25		25
Auxiliary supply frequency (D.C. or 50Hz)	ENATS 41-40 Clause 5.9	D.C.	D.C.	D.C.	D.C.		D.C.
Auto Reclose duty capability requirement	ENATS 41-40 Clause 5.300.104	Y	Y	Y	Y		Y
Mechanism type	ENATS 41-40 Clause 6.7	XEM [2]	XEM [2]	XEM [2]	XEM [2]		XEM [1]
Voltage presence indicating system	ENATS 41-40 Clause 6.103.203.10	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible		Yes- pfisterer compatible
Arc extinction medium		Vacuum	Vacuum	Vacuum	Vacuum		Vacuum
Cable terminations required	Partially-insulated bolted connection or Euromold interface C Clause 6.103.1.201	9 x 1c 630 mm^2 (1250A rated separable connectors)	3 x 1c 300 mm^2	9 x 1c 630 mm^2 (1250A rated separable connectors)	9 x 1c 630 mm^2 (1250A rated separable connectors)		None
CTs and VTs							
CT for tapchange control and transducers	2000/1 7.5VA class 0.5S Clause 6.201	3					
CTs for partial differential busbar protection	2000/1 5VA 5P10 Clause 6.201	3		3	3		2 sets of 3
CTs for over-current and earth fault protection	2000/1 5VA 5P10 Clause 6.201	3		3	3		
	600/1 5VA 5P20 Clause 6.201		3				
CTs for standby earth fault protection	1200/1 15VA 5P10 Clause 6.201	1 externally mounted neutral CT					
CTs for high impedance / Restricted EF protection	2000/1 Class PX Clause 6.201	4 including 1 externally mounted neutral CT		3	3		
CTs for pilot wire / current differential protection	600/1 Class PX Clause 6.201						
CTs for Metering	Details to be confirmed at time of order. Clause 6.202.1						
CTs for transducer etc	600/1 5VA Class 0.5S Clause 6.202.1						
Circuit VT	Clause 6.201	1 Star/star/ open-delta					
Busbar VT	Clause 6.201		(1)[1] (Star/Star/ open-delta)				
Control / Relay Panel							
Circuit Breaker Control Switch and Handle.	Clause 6.4.2	1	1	1	1		1
Local/Supervisory Switch and Handle.	Clause 6.4.2	1	1	1	1		1
Remote Control Terminals	Clause 6.4.203	4	4	4	4		4
CB Open, Interposing Relay.	Clause 6.4.2	AR1	AR1	AR1	AR1		AR1
CB Close Interposing Relay	Clause 6.4.2	AR1	AR1	AR1	AR1		AR1
Instantaneous In/Out Relay	Clause 6.4.2		AR2				
Instantaneous In/Out Push Buttons	Clause 6.4.2		PB1 / PB2				
SEF In/Out Relay	Clause 6.4.2		AR2				
SEF In/Out Push Buttons	Clause 6.4.2		PB1 / PB2				
Auto-Reclose In/Out Relay	Clause 6.4.2		AR2				
Auto-Reclose In/Out Push Buttons	Clause 6.4.2		PB1 / PB2				
AC/DC indication interposing relay	Clause 6.4.2						(AR6)[2]
AC/DC/Off double pole control switch and handle	Clause 6.4.203						(1)[2]
Low Frequency Demand Disconnection Links	Clause 6.4.203.2	Yes					
Current, Voltage, MW and MVAR transducer	Clause 6.4.2	TD4	TD4	TD4			TD4
Terminal Blocks	Clause 6.4.203	As required	As required	As required	As required		As required
Fuses and Links	Clause 6.4.203.2	As required	As required	As required	As required		As required
Test Block	Clause 6.4	As specified on schematics	As specified on schematics	As specified on schematics	As specified on schematics		As specified on schematics
Protection Relay 1	Clause 6.4	3DOCIT(LB) 3DOCIT(VC) TCS VTS	3OC, 3OCIT E, EIT SEF AR TCS	3OCIT EIT TCS	3OCIT EIT TCS		3OCIT EIT TCS
Protection Relay 2	Clause 6.4		VTS[1]	3BBOC			3OCIT EIT
ASC Earth Fault Detection Relay	A-Eberle EOR-3DS		(1)[3]				
Trip relay/s	Clause 6.4	TH	TH	TH (2 off)	TH		TH (2 off)

Notes:

Schedule B Part 1:

Note 1: One 3 phase busbar VT and one VTS relay is required per section of busbars unless all the circuits have their own feeder VTs

Note 2: Alternative mechanism types will be considered at the time of tender

Note 3: ASC earth fault detection relay is only required where ASC earthing is used (this typically applies to substations in Cornwall)

Note 4: Continuous rating of 1200/1 CTs shall be at least 2000A

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
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

APPENDIX B 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 NGEDs 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 EE185/1 dated April 2018 which has now been withdrawn.

APPENDIX D RECORD OF COMMENT DURING CONSULTATION

No comments required as document has only been updated to align with ENATS 41-40 from previous version. Equipment types have not changed, number of primary options reduced to simplify only.

APPENDIX E ASSOCIATED DOCUMENTATION

ENA TS 41-40	Ground Mounted Major Substation 12 to 36kV Rated Indoor Fixed Pattern Switchgear
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

ST: SD4O Standard HV Connection Arrangements

APPENDIX F IMPACT ON COMPANY POLICY

NONE as only minor amendment. No impact on current working practices.

APPENDIX G KEY WORDS

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

APPENDIX Y Archived Schedule A (1250A) Items from 2018-2024; Internal Use Only

2018-2024 Archived Schedule A 12kV Switchgear and Protection (1250A Busbars) - Part 1

Description	Further Details	**12C1A** Cable Circuit	**12C2A** Cable Circuit with Pilot Wire / Current Diff. Protection	**12C3A** Mixed Cable & O/H Circuit (includes SEF)	**12C5A** Interconnector with High Impedance Relay	**12C6A** Interconnector without High Impedance Relay
Standard Drawings[1]	Single Line Diagram: Schematic Diagram:	SL12C1 SPC12C1	SL12C2 SPC12C2	SL12C3 SPC12C3	SL12C5 SPC12C5	SL12C6 SPC12C6
Applicability	Primary Substation:	Yes	Yes	Yes	Yes	Yes
	Network Substation:	Yes	Yes	Yes	No	No
Rated voltage (kV)		12	12	12	12	12
Number of phases / poles		3	3	3	3	3
Rated insulation level (lightning impulse) kV	ENATS 41-40 Clause 5.3	95	95	95	95	95
Rated normal current (A) busbar	ENATS 41-40 Clause 5.5	1250	1250	1250	1250	1250
Rated normal current A – circuit breaker	ENATS 41-40 Clause 5.5	630	630	630	1250	1250
Rated short-time withstand current kA	ENATS 41-40 Clause 5.6	25	25	25	25	25
Auxiliary Supply frequency (D.C. or 50Hz)	ENATS 41-40 Clause 5.9	D.C.	D.C.	D.C.	D.C.	D.C.
Auto Reclose duty capability requirement	ENATS 41-40 Clause 5.300.104	YES	YES	YES	YES	YES
Mechanism type	ENATS 41-40 Clause 6.7	XEM[2]	XEM[2]	XEM[2]	XEM[2]	XEM[2]
Voltage presence indicating system	ENATS 41-40 Clause 6.103.203.10	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible
Arc extinction medium		Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
Cable terminations required	Partially-insulated bolted connection or Euromold interface C Clause 6.103.1.201	3 x 1c 300 mm^2	3 x 1c 300 mm^2	3 x 1c 300 mm^2	6 x 1c 630 mm^2 (1250A rated separable connectors)	6 x 1c 630 mm^2 (1250A rated separable connectors)
CTs and VTs						
CTs for partial differential busbar protection	1200/1 5VA 5P20 Clause 6.201.1.2				3	3
CTs for overcurrent and earth fault protection	1200/1 5VA 5P20 Clause 6.201				3	3
	600/1 5VA 5P20 Clause 6.201	3	3	3		
CTs for high impedance / restricted EF protection	1200/1 Class PX Clause 6.201				3	3
CTs for unit/pilot wire protection	600/1 Class PX Clause 6.201		3			
CTs for Metering	Details to be confirmed at time of Order. Clause 6.202.1					
CTs for transducers etc.	600/1 5VA Class 0.5S Clause 6.202.1					
Circuit VT	Clause 6.201					
Busbar VT[3]	Clause 6.201	(1)[1] (Star/star/ open-delta)	(1)[1] (Star/star/ open/delta)	(1)[1] (Star/star/ open-delta)		
Control / Relay Panel						
Circuit Breaker Control Switch and Handle.	Clause 6.4.2	1	1	1	1	1
Local/Supervisory Switch and Handle.	Clause 6.4.2	1	1	1	1	1
Remote Control Terminals	Clause 6.4.203	4	4	4	4	4
CB Open Interposing Relay	Clause 6.4.2	AR1	AR1	AR1	AR1	AR1
CB Close Interposing Relay	Clause 6.4.2	AR1	AR1	AR1	AR1	AR1
SEF In/Out Relay	Clause 6.4.2			AR2		
SEF In/Out Push Buttons	Clause 6.4.2			PB1 / PB2		
Current / Voltage / MW and MVAR transducer	Clause 6.4.2	TD4	TD4	TD4	TD4	
Terminal Blocks	Clause 6.4.203	As required	As required	As required	As required	As required
Fuses and Links	Clause 6.4.203.2	As required	As required	As required	As required	As required
Test Block	Clause 6.4	As specified on schematics	As specified on schematics	As specified on schematics	As specified on schematics	As specified on schematics
Protection Relay 1	Clause 6.4	3OCIT EIT TCS	PW or CD	3OCIT EIT SEF TCS	3OCIT EIT TCS	3OCIT EIT TCS
Protection Relay 2	Clause 6.4	VTS[1]	3OCIT EIT TCS	VTS[1]	3BBOC	
Protection Relay 3	Clause 6.4		VTS[1]			
ASC Earth Fault Detection Relay	A-Eberle EOR-3DS	(1)[3]	(1)[3]	(1)[3]		
Trip relay/s	Clause 6.4	TH	TH	TH	TH (2 off)	TH

Notes:

Schedule A Part 1

Note 1: One 3 phase busbar VT and VTS relay is required per section of busbars unless all the circuits have their own feeder VTs

Note 2: Alternative mechanism types will be considered at the time of tender

Note 3: ASC Earth Fault Detection Relay is only required where ASC earthing is used (this typically applies to substations in Cornwall)

Note 4: Hand reset trip relay is required where partial differential protection is specified

Note 5: Where metering facilities are required the (M) suffix shall be specified otherwise the (M) shall be omitted

Note 6: Trip indication relay is required where metering facilities (i.e., suffix M) are specified

Note 7: Metering CTs and the 2nd VT secondary star winding are only required where metering (suffix M) is specified

2018-2024 Archived Schedule A 12kV Switchgear and Protection (1250A Busbars) - Part 2

Description	**Further Details**	**12C7A** Circuit without Protection	**12C9A** Incoming Circuit with Metering	**12C10A(M)**[5] Incoming Circuit with Directional Protection & Partial Diff. Relay	**12C12A(M)**[5] Incoming Circuit with Directional Protection, Pilot Wire / Current Diff. & Partial Diff. Relay	**12C13A** Incoming Circuit with Directional Protection & Pilot Wire / Current Diff. Protection
Standard Drawings[1]	Single Line Diagram: Schematic Diagram:	 SPC12C7A	SL12C9A SLC12C9A	SL12C10A SPC12C10A	SL12C12A SPC12C12A	SL12C13A SPC12C13A
Applicability	Primary Substation:	No	No	No	No	No
	Network Substation:	Yes	Yes	Yes	Yes	Yes
Rated voltage (kV)		12	12	12	12	12
Number of phases / poles		3	3	3	3	3
Rated insulation level (lightning impulse) kV	ENATS 41-40 Clause 5.3	95	95	95	95	95
Rated normal current (A) busbar	ENATS 41-40 Clause 5.5	1250	1250	1250	1250	1250
Rated normal current A – circuit breaker	ENATS 41-40 Clause 5.5	630	630	630	630	630
Rated short-time withstand current kA	ENATS 41-40 Clause 5.6	25	25	25	25	25
Auxiliary Supply frequency (D.C. or 50Hz)	ENATS 41-40 Clause 5.9	D.C.	D.C.	D.C.	D.C.	D.C.
Auto Reclose duty capability requirement	ENATS 41-40 Clause 5.300.104	YES	YES	YES	YES	YES
Mechanism type	ENATS 41-40 Clause 6.7	XEM[2]	XEM[2]	XEM[2]	XEM[2]	XEM[2]
Voltage presence indicating system	ENATS 41-40 Clause 6.103.203.10	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible
Arc extinction medium		Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
Cable terminations required	Partially-insulated bolted connection or Euromold interface C Clause 6.103.1.201	3 x 1c 300 mm^2	3 x 1c 300 mm^2	3 x 1c 300 mm^2	3 x 1c 300 mm^2	3 x 1c 300 mm^2
CTs and VTs						
CTs for partial differential busbar protection	1200/1 5VA 5P20 Clause 6.201.1.2			3	3	3
CTs for overcurrent and earth fault protection	1200/1 5VA 5P20 Clause 6.201					
	600/1 5VA 5P20 Clause 6.201		3	3	3	3
CTs for high impedance / restricted EF protection	1200/1 Class PX Clause 6.201					
CTs for unit/pilot wire protection	600/1 Class PX Clause 6.201				3	3
CTs for Metering	Details to be confirmed at time of Order. Clause 6.202.1		3	(3)[7]	(3)[7]	
CTs for transducers etc.	600/1 5VA Class 0.5S Clause 6.202.1		3			
Circuit VT	Clause 6.201		1 Star/star/star/ open-delta	1 Star/star/(star)/ open-delta [7]	1 Star/star/(star)/ open-delta [7]	1 Star/star/ open-delta
Busbar VT[3]	Clause 6.201					
Control / Relay Panel						
Circuit Breaker Control Switch and Handle.	Clause 6.4.2	1	1	1	1	1
Local/Supervisory Switch and Handle.	Clause 6.4.2	1	1	1	1	1
Remote Control Terminals	Clause 6.4.203	4	4	4	4	4
CB Open Interposing Relay	Clause 6.4.2	AR1	AR1	AR1	AR1	AR1
CB Close Interposing Relay	Clause 6.4.2	AR1	AR1	AR1	AR1	AR1
SEF In/Out Relay	Clause 6.4.2					
SEF In/Out Push Buttons	Clause 6.4.2					
Current / Voltage / MW and MVAR transducer	Clause 6.4.2		TD4	TD4	TD4	TD4
Terminal Blocks	Clause 6.4.203	As required	As required	As required	As required	As required
Fuses and Links	Clause 6.4.203.2	As required	As required	As required	As required	As required
Test Block	Clause 6.4	As specified on schematics	As specified on schematics	As specified on schematics	As specified on schematics	As specified on schematics
Protection Relay 1	Clause 6.4		3OCIT / 3DOCIT EIT / DEIT NVD TCS VTS	3DOCIT DEIT TCS VTS	3DOCIT DEIT TCS VTS	3DOCIT DEIT TCS VTS
Protection Relay 2	Clause 6.4			3OCIT EIT	PW or CD	PW or CD
Protection Relay 3	Clause 6.4				3OCIT EIT	
ASC Earth Fault Detection Relay	A-Eberle EOR-3DS		(1)[3]	(1)[3]	(1)[3]	(1)[3]
Trip relay/s	Clause 6.4	TSS	TI	(TI)[6] TH	(TI)[6] TH	TH

Notes:

Schedule A Part 2

Note 1: One 3 phase busbar VT and VTS relay is required per section of busbars unless all the circuits have their own feeder VTs

Note 2: Alternative mechanism types will be considered at the time of tender

Note 3: ASC Earth Fault Detection Relay is only required where ASC earthing is used (this typically applies to substations in Cornwall)

Note 4: Hand reset trip relay is required where partial differential protection is specified

Note 5: Where metering facilities are required the (M) suffix shall be specified otherwise the (M) shall be omitted

Note 6: Trip indication relay is required where metering facilities (i.e., suffix M) are specified

Note 7: Metering CTs and the 2nd VT secondary star winding are only required where metering (suffix M) is specified

2018-2024 Archived Schedule A 12kV Switchgear and Protection (1250A Busbars) - Part 3

Description	Further Details	**12B2A** Bus-section CB with 1x Partial Diff Relay	**12B3A** Bus-section CB without Protection without CTs	**12B4A** Bus-section CB without protection with CTs	**12B5A** Bus-section CB with 2x Partial Diff Relays	**12B6A** Bus-section Metering CB
Standard Drawings [1]	Single Line Diagram: Schematic Diagram:	SL12B2 SPC12B2	 SPC12B3A	SL12B4A SPC12B4A	SL12B5A SPC12B5A	SL12B6A SPC12B6A
Applicability	Primary Substation:	Yes	No	No	No	No
	Network Substation:	No	Yes	Yes	Yes	Yes
Rated voltage (kV)		12	12	12	12	12
Number of phases / poles		3	3	3	3	3
Rated insulation level (lightning impulse) kV	ENATS 41-40 Clause 5.3	95	95	95	95	95
Rated normal current (A) busbar	ENATS 41-40 Clause 5.5	1250	1250	1250	1250	1250
Rated normal current A – circuit breaker	ENATS 41-40 Clause 5.5	1250	1250	1250	1250	1250
Rated short-time withstand current kA	ENATS 41-40 Clause 5.6	25	25	25	25	25
Auxiliary Supply frequency (D.C. or 50Hz)	ENATS 41-40 Clause 5.9	D.C.	D.C.	D.C.	D.C.	D.C.
Auto Reclose duty capability requirement	ENATS 41-40 Clause 5.300.104	Yes	Yes	Yes	Yes	Yes
Mechanism type	ENATS 41-40 Clause 6.7	XEM[1]	XEM[1]	XEM[1]	XEM[1]	XEM[1]
Voltage Presence Indicating System	ENATS 41-40 Clause 6.103.203.10	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible
Arc Extinction Medium		Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
CTs and VTs						
CTs for Partial Differential Busbar Protection	1200/1 or 600/1 5VA 5P20 Clause 6.201	2 sets of 3 1200/1 CTs. One set each side of the circuit breaker		2 sets of 3 600/1 CTs. One set each side of circuit breaker	2 sets of 3 600/1 CTs. One set each side of the circuit breaker	
CTs for Protection / Analogues	1200/1 5VA 5P20 Clause 6.201	3				
	600/1 5VA 5P20 Clause 6.201					3
CTs for Metering.	Details to be confirmed at time of Order. Clause 6.202.1					3
CTs for transducers etc.	600/1 5VA Class 0.5S Clause 6.202.1					3
Busbar VT	Clause 6.201					1 Star/star/star
Control / Relay Panel						
Circuit Breaker Control Switch and Handle.	Clause 6.4.2	1	1	1	1	1
Local/Supervisory Switch and Handle.	Clause 6.42.	1	1	1	1	1
Remote Control Terminals	Clause 6.4.203	4	4	4	4	4
CB Open Interposing Relay.	Clause 6.4.2	AR1	AR1	AR1	AR1	AR1
CB Close Interposing Relay	Clause 6.4.2	AR1	AR1	AR1	AR1	AR1
AC/DC indication interposing relay	Clause 6.4.2	(AR6)[2]	(AR6)[2]	(AR6)[2]	(AR6)[2]	(AR6)[2]
AC/DC/Off double pole control switch and handle	Clause 6.4.2	(1)[2]	(1)[2]	(1)[2]	(1)[2]	(1)[2]
Current / Voltage / MW and MVAR transducer	Clause 6.4.2	TD4				TD4
Terminal Blocks	Clause 6.4.203	As required	As required	As required	As required	As required
Fuses and Links	Clause 6.4.203.2	As required	As required	As required	As required	As required
Test Block	Clause 6.4	As specified on schematics	As specified on schematics	As specified on schematics	As specified on schematics	As specified on schematics
Protection Relay 1	Clause 6.4	3OCIT EIT TCS			3OCIT EIT TCS	3OCIT EIT TCS
Protection Relay 2	Clause 6.4				3OCIT EIT	VTS
Trip / Supervision Relays	Clause 6.4	TH (2 off)	TSS	TH (2off) TSS	TH (2 off)	TH[3] TI

Notes:

Schedule A Part 3:

Note 1: Alternative mechanism types will be considered at the time of tender

Note 2: One AC/DC control switch, handle and interposing relay is required per switchboard

Note 3: TH Trip relay is only required where partial differential busbar protection is specified

APPENDIX Z Archived Schedule B (2000A) Items from 2018-2024; Internal Use Only

2018-2024 Archived Schedule B 12kV Primary Substation Switchgear and Protection (2000A Busbars) – Part 1 / Part 2

Description	Further Details	**12C1B** Cable Circuit	**12C2B** Cable Circuit with Unit Protection	**12C3B** Mixed Cable & O/H Circuit (includes SEF)	**12C8B** Outgoing Cable Circuit with Metering		**12B2B** Bus-section CB with 1x Partial Diff Relay for Primary Substation
Standard Drawings[1]	Single Line Diagram: Schematic Diagram:	SL12C1 SPC12C1	SL12C2 SPC12C2	SL12C3 SPC12C3	SL12C8B SL12C8B		SL12B2 SPC12B2
Applicability	Primary Substation:	Yes	Yes	Yes	Yes		Yes
	Network Substation:	No	No	No	No		No
Rated voltage (kV):		12	12	12	12		12
Number of phases / poles:		3	3	3	3		3
Rated insulation level (lightning impulse) kV	ENATS 41-40 Clause 5.3	95	95	95	95		95
Rated normal current (A) busbar	ENATS 41-40 Clause 5.5	2000	2000	2000	2000		2000
Rated normal current A – circuit breaker	ENATS 41-40 Clause 5.5	630	630	630	630		2000
Rated short-time withstand current kA	ENATS 41-40 Clause 5.6	25	25	25	25		25
Auxiliary Supply frequency (D.C. or 50Hz)	ENATS 41-40 Clause 5.9	D.C.	D.C.	D.C.	D.C.		D.C.
Auto Reclose duty capability requirement	ENATS 41-40 Clause 5.300.104	Y	Y	Y	Y		Y
Mechanism type	ENATS 41-40 Clause 6.7	XEM[2]	XEM[2]	XEM[2]	XEM[1]		XEM[1]
Voltage presence indicating system	ENATS 41-40 Clause 6.103.203.10	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible	Yes- pfisterer compatible		Yes- pfisterer compatible
Arc extinction medium		Vacuum	Vacuum	Vacuum	Vacuum		Vacuum
Cable terminations required	Partially-insulated bolted connection or Euromold interface C Clause 6.103.203.201	3 x 1c 300 mm^2	3 x 1c 300 mm^2	3 x 1c 300 mm^2	3 x 1c 300 mm^2		None
CTs and VTs							
CTs for partial differential busbar protection	2000/1 5VA 5P10 Clause 6.201						2 sets of 3
CTs for over-current and earth fault protection	2000/1 5VA 5P10 Clause 6.201				3		
	600/1 5VA 5P20 Clause 6.201	3	3	3			
CTs for pilot wire / current differential protection	600/1 Class PX Clause 6.201		3				
CTs for Metering	Details to be confirmed at time of order. Clause 6.202.1				3		
CTs for transducer etc	600/1 5VA Class 0.5S Clause 6.202.1				3		
Circuit VT	Clause 6.201				1 Star/star/star/ open-delta		
Busbar VT	Clause 6.201	(1)[1] (Star/Star/ open-delta)	(1)[1] (Star/Star/ open-delta)	(1)[1] (Star/Star/ open-delta)			
Control / Relay Panel							
Circuit Breaker Control Switch and Handle.	Clause 6.4.2	1	1	1	1		1
Local/Supervisory Switch and Handle.	Clause 6.4.2	1	1	1	1		1
Remote Control Terminals	Clause 6.4.203	4	4	4	4		4
CB Open, Interposing Relay.	Clause 6.4.2	AR1	AR1	AR1	AR1		AR1
CB Close Interposing Relay	Clause 6.4.2	AR1	AR1	AR1	AR1		AR1
SEF In/Out Relay	Clause 6.4.2			AR2			
SEF In/Out Push Buttons	Clause 6.4.2			PB1 / PB2			
AC/DC indication interposing relay	Clause 6.4.2						(AR6)[2]
AC/DC/Off double pole control switch and handle	Clause 6.4.2						(1)[2]
Current, Voltage, MW and MVAR transducer	Clause 6.4.2	TD4	TD4	TD4	TD4		TD4
Terminal Blocks	Clause 6.4.203	As required	As required	As required	As required		As required
Fuses and Links	Clause 6.4.203.2	As required	As required	As required	As Required		As required
Test Block	Clause 6.4	As specified on schematics	As specified on schematics	As specified on schematics	As specified on schematics		As specified on schematics
Protection Relay 1	Clause 6.4	3OCIT EIT TCS	PW or CD	3OCIT EIT SEF TCS	3OCIT EIT TCS		3OCIT EIT TCS
Protection Relay 2	Clause 6.4	VTS[1]	3OCIT EIT TCS	VTS[1]	VTS		
Protection Relay 3	Clause 6.4		VTS[1]				
ASC Earth Fault Detection Relay	A-Eberle EOR-3DS	(1)[3]	(1)[3]	(1)[3]	(1)[3]		
Trip relay/s	Clause 6.4	TH	TH	TH	TI TH		TH (2 off)

Notes:

Schedule A Part 2:

Note 1: Alternative mechanism types will be considered at the time of tender

Note 2: One AC/DC control switch, handle and interposing relay is required per switchboard

Note 3: One 3 phase busbar VT is required per section of busbars unless all the circuits have their own feeder VTs