



Electricity Specification 340

Issue 1 July 2005

132kV Open Terminal Circuit Breakers

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Approved for issue by the Technical Policy Panel

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Amendment Summary

Amendment No. Date	Brief Description and Amending Action
<p>0 1/07/05</p>	<p>Issue 1 First Issue Prepared by: G Bryson Approved by the Technical Policy Panel and signed on its behalf by:</p>

132 kV CIRCUIT BREAKERS

1. SCOPE

This Electricity Specification (ES) covers the supply, erection, testing and commissioning of 132kV Open Terminal Circuit Breakers, for use on a 50Hz, solidly earthed, three phase system of nominal voltage 132kV and highest voltage 145kV, generally in accordance with ENA TS 41-37, Issue 1:2004, operated by Electricity North West Limited, hereinafter referred to as Electricity North West.

Schedules of information included in Appendix A and the Self Certification Conformance Declaration in Appendix B of this document shall be completed by the tenderer and returned to Electricity North West as part of the tender documentation.

2. GENERAL REQUIREMENTS FOR APPROVALS AND TESTING

2.1 Product not to be changed

No change in the product, packaging or labelling shall be made after approval has been granted without prior notice to the engineer, and receipt of agreement from the engineer, in writing to the proposed change.

2.2 Electricity North West Technical Approval

2.2.1 The tenderer shall submit, with this tender, proposals for testing which will demonstrate, to the satisfaction of the engineer, compliance with this ES. Such tests shall be carried out without expense to Electricity North West.

2.2.2 Alternatively, the tenderer may submit technical reports and other data, in addition to the conformance schedules in Appendix B, that he considers will demonstrate, to the satisfaction of the engineer, compliance with this ES. Acceptance of this evidence shall be at the discretion of the engineer but will not be unreasonably withheld.

2.2.3 Approval shall be 'site specific' and is not transferable to another site without the written approval of the engineer.

2.2.4 The supplier and product shall comply with all the relevant requirements of Electricity North West ' documents EPD311 and CP311.

2.3 Quality Assurance

2.3.1 The tenderer shall confirm whether or not approval is held in accordance with a Quality Assurance Scheme accredited under ISO 9000. If not, he shall submit a statement of the quality assurance procedures employed to control the quality of the product, including the performance of suppliers and sub-contractors.

2.3.2 The right is reserved for the engineer to require, from time to time, the repeat of such tests as he may deem to be reasonably necessary to demonstrate continued compliance with this ES.

2.3.3 The right is reserved for the engineer to make, from time to time, such inspections of the tenderer's facilities as he may deem to be reasonably necessary to ensure compliance with this ES and any contract of which it forms a part.

- 2.3.4 The tenderer shall submit, with his tender, such details of product packaging disposal, as will enable Electricity North West to comply with the requirements of BS EN ISO 14001: 1996 – Environmental Management Systems.

The tenderer shall include for removal off site of used SF₆ bottles.

2.4 Formulation

The tenderer shall submit, with his tender, such details of the formulation and use of the product and associated substances as will enable Electricity North West to comply with the obligations of the Health and Safety at Work Act 1974 and the Control of Substances Hazardous to Health Regulations 1988, in the use, storage and disposal of the product. The tenderer may stipulate, prior to submission of such information, that he requires it to remain confidential and the engineer will, if requested, confirm his agreement to this prior to receipt of the information.

2.5 Identification Markings

2.5.1 The tenderer shall submit, with his tender, details of markings which it is proposed to apply to the product or packaging to identify manufacturing batches or items. The forms and content of such markings shall be subject to the approval of the engineer, and shall in all cases include the Electricity North West Approved Description and Commodity Code Number.

2.5.2 The tenderer shall submit, with his tender, such details of marking gross weight on components, assemblies and packages, as will enable Electricity North West to comply with the Health and Safety Manual Handling Operation Regulations 1992, for components, assemblies and packages supplied with a gross weight over 1kg. The forms and content of such markings shall be subject to the approval of the engineer.

2.6 Minimum Life Expectancy

The minimum life expectancy of all products covered by this ES is 40 years.

2.7 Manufacturers Already Approved

Clauses 2.2.1, 2.2.2, 2.3.1, 2.3.3, 2.3.4, 2.4 will be waived in the case of products already approved.

2.8 Product Conformity

Preference will be given to those suppliers who can provide suitable Product Conformity Certification to a recognised or specified standard, or an equivalent certification.

3. REQUIREMENTS FOR TYPE AND ROUTINE TESTING.

The specifier shall set out the requirement of the following tests to be carried out by the supplier at the suppliers' cost.

3.1 Requirement for type tests at the suppliers' premises

These are a series of one-off type tests, which are carried out to ensure the satisfactory performance of the product design, under extremes of operating stresses, and of endurance, as may be appropriate, to be determined by the specifier.

These may or may not be destructive tests.

3.2 Requirement for routine tests at the suppliers' premises

These tests may be required to be carried out on every individual unit or component, as specified, or at some regular frequency to be determined by the specifier.

The results of these tests may be required to be supplied to Electricity North West with each unit purchased.

4. TECHNICAL AND PERFORMANCE REQUIREMENTS

Except where modified by requirements specified elsewhere in this document, switchgear shall be designed, manufactured and tested to comply fully with the requirements of:

ENA TS 41-37, Issue 1:2004 'Switchgear for use on 66kV to 132 kV Distribution Systems',

BS EN 60694 1997 'Common specification for high-voltage switchgear and controlgear standards'

IEC 62271-100:2001 'High-voltage alternating-current circuit-breakers'.

If the tenderer is in any doubt concerning the requirements, he should contact the Policy & Standards Manager via Electricity North West Procurement, Oakland House, P O Box 9 Talbot Road, Old Trafford, Manchester M16 0QF

Electricity North West welcomes innovation and alternatives to traditional designs that still meet the functional requirements of this ES. Variations shall be clearly identified in Schedule B and prices for compliant and non-compliant equipment detailed separately.

4.1 General design features

4.1.1 Gas Monitoring

Gas density or temperature compensated pressure monitors shall be provided complying with Section 5.9.101 of ENA TS 41-37: Part 1. Gas monitors shall be fitted with electrical contacts for alarm, set in two stages. The first stage is to operate as an alarm that the gas pressure/density has fallen to a critical level. The second stage shall initiate an automatic lock-out of the circuit breaker by disabling the circuit breaker trip. Lock-out shall only be initiated when both first and second stages are detected. The lock-out feature for remote indication shall be provided for circuit breakers whenever SF₆ gas pressure is less than that permitted by the design for safe operation.

4.1.2 Simplicity of operation

Switchgear controls and status indicators shall facilitate a clearly defined, unambiguous operating regime. All controls and indications shall be plainly labelled with their function and (for controls) method of operation. Position indicators shall be provided showing whether the contacts are in the fully closed or fully open condition. All auxiliary switches, fuses and links shall be clearly labelled in accordance with ENA TS 50-18.

4.1.3 Earthing

Terminals capable of accepting 150mm² copper earth or equivalent via 2 x M12 bolts shall be provided for connection to the substation earth. However, the design, installation and testing of the earth installation does not form part of the scope of this ES.

4.1.4 Type

Circuit breakers shall be of the 'Puffer' type suitable for operation at low gas pressures.

4.1.5 Small current interrupting duties

In addition to the requirements of IEC 62271-100:2001 covering the interruption of terminal faults, circuit breakers shall be capable of interrupting lagging power factor, small magnitude inductive currents associated with transformer and reactor magnetising currents. In addition, circuit breakers shall be capable of interrupting leading power factor currents such as those associated with capacitive circuits. The tenderer shall provide details of the type testing that has been carried out.

If required, capacitor bank switching duties shall be specified in the contract requirements.

4.1.6 Circuit breaker re-striking

Circuit breakers shall be of the re-strike free type.

4.1.7 Short line faults and out-of-phase switching

Circuit breakers shall be capable of interrupting short line faults and such out-of-phase switching as may occur during service.

4.1.8 Minimum interruption times

It is intended to fit fast acting protection. The overall fault clearance time including relay operation shall not exceed 200ms for system fault levels within the specified extremes, including any increase of operating time due to direct current transient offset.

4.1.9 Transient Recovery Voltage

Attention is drawn to the transient recovery voltage (TRV) requirements of IEC 62271-100:2001. If not specifically stated in the type test documents, the schedules forming part of this ES that are intended to be returned with the tender shall state whether the TRV to which the circuit breaker was subjected during the short circuit tests was the most severe condition that could be imposed by the available test equipment for the first phase to clear factor of 1.5. The rated TRV at 100% of the rated short circuit breaking current shall be 249kV peak.

4.1.10 Ancillary re-striking voltage devices

Where ancillary devices are employed to limit the rate of rise of re-striking voltage, or to limit or damp any voltage oscillations across the opening contacts, they shall have a life expectancy equivalent to that of the switchgear and the design shall be subject to Electricity North West' approval.

4.1.11 Parallel operation

Circuit breakers shall be suitable for parallel operation, for example if used in a 1.5 or 1/3 circuit breaker mesh configuration, or as bus section or bus coupler switches in double busbar arrangement.

4.1.12 Auto reclosing

Circuit breakers intended to control overhead lines shall be suitable for auto reclosing, including the interruption of currents produced by out-of-synchronism conditions, with a rated out of phase breaking capability of 100A. Where auto reclosing is required, circuit breakers shall be suitable for a rated operating sequence over the range O - 0.3s - CO - 180s - CO. The drive mechanism shall store sufficient energy for the completion of an O - C - O duty cycle, even with the auxiliary power supply disconnected.

4.1.13 Gas Couplings

Any couplings required for gas filling, removal or testing shall be of the DILO type.

4.2 Circuit breaker operating mechanisms

Circuit breaker operating mechanisms shall comply with Section 5.6, 5.7 and 5.10 of ENA TS 41-37: Part 1 and shall also fulfil the following requirements.

4.2.1 Type of mechanism

Circuit breaker operating mechanisms shall be of the spring type. However other types may be acceptable, subject to specific agreement by Electricity North West.

4.2.2 Capability

Circuit breaker mechanisms shall be capable of fully closing and latching circuit breakers against their rated making current and of opening circuit breakers against their rated breaking current. Opening shall be initiated in the event that the circuit breaker is tripped during its closing operation.

4.2.3 Anti pumping

Relays or other devices shall be fitted to prevent repetitive closing, should the circuit breaker closing coil remain energised and the circuit breaker either fail to latch or be tripped during closing.

4.2.4 Pole discrepancy

The difference in time between the first and last pole to close, during circuit breaker closing, shall not exceed 5 ms.

4.2.5 Energy charge and recharge of operating mechanisms

Operating mechanisms shall be recharged automatically immediately following completion of closing. Preferably, operating mechanisms shall store sufficient energy for two complete trip/close operations without recharging.

4.2.6 Immunity from inadvertent operation

The design of operating mechanisms shall be such that the circuit breaker is not operated by external mechanical shock for example short circuit forces, operation of adjacent units, or seismic event.

4.2.7 Operation counter

Operating mechanisms shall be fitted with 4 digit counters.

4.2.8 Indication of OPEN and CLOSED status

Mechanisms shall be fitted with mechanical position indicators, operated from the circuit breaker, showing the position of poles either OPEN or CLOSED. These indicators shall be positively actuated from the driven side of the mechanism.

4.2.9 Manual operation of circuit breakers

Provision shall be made for mechanically operated local manual tripping and closing. This shall be inaccessible for normal operation. This facility shall be labelled "Emergency operation only, refer to manufacturer's handbook". The label shall comply with BS5499-1: 2002.

4.2.10 Slow operation for maintenance

Operating mechanisms shall facilitate manual slow opening and slow closing of circuit breakers for maintenance purposes. However it shall not be possible to slow open or slow close circuit breakers when in an operational configuration.

4.2.11 Labelling

Each unit of switchgear shall be identified with a label marked with the circuit designation (rated normal current, description and connected equipment number) as specified on the project single line diagram.

Labels to indicate phases ($U_1, V_1, W_1, U_2, V_2, W_2$) shall be provided.

Labels shall be provided to identify the functions of the main components.

The separation between gas zones and the mass of SF_6 in kilogrammes contained in each zone shall be clearly marked on the outside of the circuit breaker.

All labels shall be in English.

4.2.12 Speed of recharging

Recharging of the energy storage system after completion of a circuit breaker closing operation shall be completed in not more than 30s.

4.2.13 Prevention and indication of slow or incomplete closure

Means shall be provided to ensure that the energy storage system is fully charged before a circuit breaker closure is initiated. In the event of the operating system failing to fully charge, an indicating device shall announce the condition at the local control panel and also provide electrical means (for example a pair of contacts) allowing the supervisory system to also announce the condition.

4.2.14 Manual charging

Manual charging of operating mechanisms that are normally power driven shall be possible without the need to remove a mechanism cover, although opening of the mechanism cabinet door is acceptable. Manual operation shall not require the application of force greater than 275N. During manual charging, effective electrical and mechanical means shall be provided to ensure the safety of the operator and prevent damage to the equipment.

4.3 Interlocking facilities

The circuit breaker shall meet the following requirements -

4.3.1 Mechanical interlocking

Provision for future addition of mechanical key to prevent closing.

4.3.2 Electrical interlocking

Not required.

4.3.3 Circuit breaker gas pressure

Circuit breakers shall be interlocked to prevent operation at low SF₆ pressure.

4.3.4 Circuit breaker opening

No interlock shall prevent the opening of a circuit breaker, other than in the circumstances that stated in 4.4.3 or in the contract requirements.

4.4 Locking facilities

Circuit breakers shall be fitted with locking facilities that are additional to the interlocking system described elsewhere in this document. Locking facilities shall comply with the following requirements.

4.4.1 Locking of equipment

Locking facilities shall be provided as follows.

- Circuit breaker mechanisms in the OPEN position
- Control position selector switches in all available positions.
- Air or gas system isolating valves in the OPEN and CLOSED positions.
- Operating cubicle door

4.4.2 Padlocking

All locking shall be implemented by means of removable padlocks, which shall be supplied by Electricity North West. Padlocks will be brass with a 38mm square body and a 7mm diameter shackle, with a clear inside width 20mm and an inside length of at least 16mm.

4.5 Auxiliary switches and contactors

4.5.1 Quantity

Circuit breakers shall be provided with the following auxiliary contacts

Twelve (12) Normally Open

Twelve (12) Normally Closed

4.5.2 Exclusion of repeat relays

Repeat relays shall not normally be fitted. If these are required, then a monitoring scheme shall be utilised to ensure correct operation. The repeat relays shall operate in a fail-safe manner. The use of repeat relays shall be agreed with Electricity North West.

4.6 Bushings and Insulators

Bushings shall comply with the requirements of BS EN 60137 1996 'Insulated bushings for alternating voltages above 1kV'. Insulators shall comply with the requirements of BS EN 62155:2003 'Hollow pressurised and unpressurised ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000V'.

The creepage distances shall be specified in the contract requirements.

The colour of the bushings and insulators shall be specified in the contract requirements.

4.7 Control and indication and alarms

4.7.1 Local control

Local electrical control shall be provided.

4.7.2 ON/OFF and other indications

Indication inscriptions shall be either ON or I, OFF or O, in accordance with Table 4 of ENA TS 41-37: Part 1. These indications shall be in contrasting colours.

4.8 Ratings

The ratings of the switchgear shall be as described in Section 4 of ENA TS 41-37: Part 1 and Section 4 of ENA TS 41-37: Part 3

The circuit breaker short circuit breaking current shall be in accordance with contract requirements.

The circuit breaker minimum current rating shall be in accordance with contract requirements.

4.8.1 Variation of power frequency withstand voltage with gas density

The tenderer shall declare

- The density of gas at which a circuit breaker can withstand two fully asynchronous power frequency voltages, each equal to 84.0 kV, applied to opposite terminals of the same pole in the OPEN position.
- The density of gas at which a circuit breaker can withstand a power frequency voltage of 125.6 kV between its terminals and earth

4.9 Environment, operating conditions and duty

4.9.1 Service conditions

The normal service conditions shall be as defined in Section 2 of ENA TS 41-37: Part 1

4.9.2 Noise

The maximum sound level shall not exceed 90db, in accordance with Section 5.203 of ENA TS 41-37: Part 3.

4.9.3 EMC Compatability

Tenderers are requested to confirm that the equipment complies with the Electromagnetic Compatibility (EMC) Directive and associated standards or to state those items that are not considered a requirement for EMC Conformity.

4.10 Auxiliary Supplies

Mechanisms, alarms, indications, controls and spring charging motor shall be 110V (nominal) direct current operated. The maximum current drawn under operational conditions shall be declared by the manufacturer in the tender document.

The 110V DC system normally operates with charger infeed at 125V. With charger disconnected the voltage is expected to fall to 110V and satisfactory operation is required down to a minimum voltage of 80% of 110V.

Auxiliary equipment intended to operate on 50Hz alternating current supplies shall be declared in the tender documents e.g. Heaters. The tenderer shall state whether the alternating current supplies required are single or three phase.

4.11 Finish colour

The tenderer shall agree the finish colour of the switchgear with Electricity North West.

4.12 Operating Cubicle

An operating cubicle shall be provided for each circuit breaker and it shall fulfil the following requirements.

4.12.1 General

Cubicles shall contain all the control, interlocking and links appropriate to the circuit breaker.

Electricity North West use single trip and single close circuits. Duplicate trip coils are not required unless detailed within the contract requirements.

The cubicle shall have a minimum IP rating of IP54.

4.12.2 Local/remote operation

Cubicles shall be provided with switches to select between local and remote operation.

4.12.3 Ferruling

All wiring shall be clearly marked with cable numbering and ferrules at each point of termination. These shall be clearly identified on the wiring diagrams such that all internal wiring is unambiguously identifiable.

All control and internal wiring shall be easily identifiable and traceable throughout the circuit schematic and wiring diagrams.

Wiring shall be fitted with interlocking numbered ferrules. Ferrules shall be fitted at both ends of the wire unless the wire is individually routed and less than 100mm long. Ferrules shall be indelibly marked. It shall be necessary to disconnect the termination to remove the ferrules.

Ferruling shall be to ENA TS 50-19.

4.12.4 Terminals and Terminal Blocks

Conductor ends for connections shall be fitted with a crimped, hooked palm type termination devices having an insulated shank or other approved method of termination that ensures that a reliable connection is made that cannot be loosened under different thermal or vibration conditions.

Terminals having different voltages shall be separated. The voltage shall be marked on the terminals. All terminals shall be fully segregated and insulated from adjacent terminals so that inadvertent contact is prevented. Sufficient spare terminals shall be provided to cater for spare cores on multicore cables.

All terminal blocks provided within the control cubicle, for multicore cable terminations, shall be able to accept a hooked palm type crimp termination. Whilst insulation displacement type terminal blocks will be accepted for internal cubicle wiring, these shall not be permitted for multicore terminations.

All terminal blocks used for CT wiring shall have a locking screw termination. Ring crimps or hooked palm type with spring loaded terminal shall be used throughout.

All terminal blocks, terminals, CT wiring and crimps proposed for use shall be subject to approval by Electricity North West prior to contract award.

4.12.5 Internal Wiring

Internal wiring conductors shall have a minimum cross-section of 1.5mm^2 and a minimum of seven copper strands, unless otherwise approved. Any CT wiring shall have a minimum cross-section of 2.5mm^2 . The insulation shall be LSF.

4.12.6 External Wiring

Multicore and auxiliary cables external to the circuit breaker are outside the scope of this ES. The operating mechanism box shall be provided with a removable undrilled gland plate to accommodate this wiring. Provision shall be made for earthing of all multicore cable glands.

4.13 Special Tools

Requirements for special tools and equipment necessary for the erection, operation, testing and maintenance of the switchgear shall be detailed and provided by the manufacturer.

4.14 Support Structure

Each circuit breaker shall be provided with a support structure. Aluminium or galvanised steel are acceptable.

If galvanised steel is used, galvanising should be at least 610g/m^2 on steelwork of 6mm or greater thickness.

4.15 HV Terminals

The HV terminals shall be of the aluminium pad type and shall have four (4) 19mm diameter holes on a 127mm pitched circle diameter (PCD). The HV connector and bolts are outside the scope of this ES.

4.16 Current Transformers for Dead Tank Breakers

Current transformers shall comply with the requirements of BS EN 60044-1:1999 'Instrument Transformers - Current Transformers' as required. In addition, they shall comply with the following requirements.

4.16.1 Location of CTs

Current transformer chambers on both sides of the circuit breaker are normally required.

4.16.2 Marking and positioning of CTs

The position of each CT with respect to its P1 and P2 terminals shall be shown on the circuit breaker general arrangement drawing. The order of CTs within chambers shall be as specified in the contract requirements.

4.16.3 Requirements for CTs

Protection CTs shall be 30VA 5P20 or Class X as appropriate to the application. Instrument CTs shall be Class 1 and those for metering, if metering is additionally specified, shall be Class 0.2 or Class 0.2s.

CT ratio requirements will be specified in contract requirements.

Feeder main protection CTs shall conform to the following parameters.

$$V_k > (85200/N) * (R_s + 1.5) \text{ Volt}$$

$$I_m < 50/N \text{ amps @ } V_k$$

Where N = CT ratio, R_s = CT secondary resistance.

The following are the maximum values for R_s for the range of ratios.

$$R_{s(max)} = 1.5 \Omega \text{ for } 500:1$$

$$R_{s(max)} = 2.0 \Omega \text{ for } 600:1$$

$$R_{s(max)} = 2.5 \Omega \text{ for } 800:1$$

$$R_{s(max)} = 3.0 \Omega \text{ for } 1000:1$$

$$R_{s(max)} = 4.0 \Omega \text{ for } 1200:1$$

Transformer main protection CTs shall conform to the following parameters.

$$V_k > ((48 * fI_c) / N) * (R_s + 3) \text{ Volt}$$

$$I_m < 50/N \text{ amps for phase CTs}$$

$$I_m < 20/N \text{ amps for neutral CTs}$$

Where $N = CT$ ratio, $R_s = CT$ secondary resistance.

The maximum values of secondary winding resistance shall be the same as those specified for feeder CTs.

Busbar protection CTs shall conform to the following parameters.

$$V_k > (66000/N) * (R_s + 3) \text{ Volt}$$

$$I_m < 50/N \text{ amps @ } V_k$$

$$R_{s(max)} = 6.0 \Omega$$

Where $N = CT$ ratio, $R_s = CT$ secondary resistance.

Backup protection CTs shall conform to the following parameters.

$$V_k > (60R_s + 150) \text{ Volt}$$

$$I_m < 50/N \text{ amps @ } V_k$$

Where $N = CT$ ratio, $R_s = CT$ secondary resistance.

The following are the maximum values for R_s for the range of ratios.

$$R_{s(max)} = 1.0 \Omega \text{ for } 200:1$$

$$R_{s(max)} = 1.5 \Omega \text{ for } 300:1$$

$$R_{s(max)} = 2.0 \Omega \text{ for } 400:1$$

$$R_{s(max)} = 2.5 \Omega \text{ for } 500:1$$

$$R_{s(max)} = 3.0 \Omega \text{ for } 600:1$$

$$R_{s(max)} = 4.0 \Omega \text{ for } 800:1$$

$$R_{s(max)} = 5.0 \Omega \text{ for } 1000:1$$

$$R_{s(max)} = 6.0 \Omega \text{ for } 1200:1$$

4.16.4 Dual Ratio CTs

Where dual ratio CTs are specified in the contract requirements, the performance specification as detailed above shall be provided for the low ratio tapping unless specified.

4.16.5 CT Ratings

All current transformers shall fully match the ratings of the primary equipment they are installed within. These ratings include long time thermal, short time emergency and fault ratings.

For example, A 1000/500:1 feeder protection CT fitted to a 2000A circuit breaker shall have a continuous rating of $I_{thermal} = 200\%$.

4.16.6 Magnetisation, core loss and secondary resistance curves

Magnetisation, core loss and secondary resistance graphs shall be provided for each type and rating of CT used in the construction of the equipment. Where CTs are tapped or otherwise multi ratio, graphs shall be provided for all available combinations.

5. ERECTION AND SITE ASSEMBLY

5.1 Final erection in works

Erection in works shall be carried out under clean room conditions. Facilities shall be made available for Electricity North West, or his authorised inspection contractor, to view and approve the equipment after final assembly.

5.2 First filling of gas

The supplier shall include the first pressurising of all enclosures with SF₆ gas and any topping up of gas required during the period of warranty.

5.3 Site works

The manufacturer shall include for delivery, offloading, installation and pre-commissioning of the circuit breaker(s).

Holding down bolts of the drill and fix type shall be provided by the manufacturer.

5.4 Test equipment

All test equipment required for type testing, works and site testing shall be provided by the manufacturer or the manufacturer's contractor.

6. DRAWINGS

Manufacturers standard versions of the following drawings shall be provided at the tender stage.

At contract plus 2 months, the following drawings shall be submitted for review.

- (i) General Arrangement Drawings showing
 - Full dimensions
 - Weights and static & dynamic loads
 - Civil interface information
 - CT locations and characteristics
 - Terminal details
 - Operating box internal layout.
- (ii) Circuit Diagrams showing all circuit breaker control and indication equipment.
- (iii) Wiring Diagrams

Within four weeks of final commissioning the following drawings shall be supplied.

- (i) Contract drawing list with number, title and revision of each drawing.
- (ii) Two paper prints of each drawing and equivalent AutoCad (.dwg) and Adobe Acrobat (pdf) format files.

Notes on drawings and drawing format:

- (a) Orthographic drawings shall use metric units and be reproduced to a scale that is declared on each print. The scale for general arrangement drawings shall not be less than 1 to 50 and that for detail drawings shall not be less than 1 to 20.
- (b) All drawing, schematic and wiring diagrams shall comply with UK ESI convention and be produced on conventional format up to a maximum A1 paper size. AC and DC schemes shall be depicted as comprehensively on one drawing as possible. Multi-page **is not** acceptable.
- (c) Drawings shall be submitted for approval by Electricity North West on paper in duplicate. They shall also be accompanied by equivalent AutoCad .dwg format files on a CDROM.
- (d) The name of the site, the drawing number and the date and number of revision shall be marked on all drawings. All drawings shall be numbered according to a logical scheme.

7. OPERATIONAL LIFE, INSPECTION, MAINTENANCE AND TRAINING

7.1 Operational life

The switchgear shall be designed and constructed for an operational lifetime of at least 40 years. The supplier shall provide technical support and a source of spares over this period.

7.2 Operating and maintenance manuals

Details of the recommended schedules of inspection and maintenance shall be provided with the tender to allow Electricity North West to analyse the lifecycle costs.

All necessary operating and maintenance manuals for the switchgear and all ancillary equipment including the gas handling plant shall be provided within two months of the award of contract, including recommended schedules of inspection and maintenance.

Final versions of the manuals shall be provided in PDF format.

7.3 Gas Handling Equipment

Any gas handling equipment provided must be fitted with a device to allow the mass in kilogrammes extracted or injected to be determined.

7.4 Training

The manufacturer shall provide on-site training in the operation and maintenance of the switchgear and ancillary equipment to all project staff and selected UU maintenance staff as required.

8 VARIATIONS

The tender shall include using Schedule B attached, any variations from the foregoing Technical and Performance Specification, including those that in his opinion enhance the performance of the equipment.

9. DOCUMENTS REFERENCED

- 9.1 Health and Safety at Work Act 1974.
- 9.2 EC Directives:

'Management of Health, Safety and Welfare'.

'Manual Handling Regulations'.

'Workplace Health, Safety and Welfare'.

'Provision and Use of Work Equipment Regulations'.

Control of Substances Hazardous to Health Regulations 1988

Health and Safety Manual Handling Operation Regulations 1992

Electromagnetic Compatibility Directive

- 9.3 IEC 62271-100:2001 'High-voltage alternating-current circuit-breakers'.
- 9.4 BS EN ISO 9000 'Quality Management and Quality Assurance Standards'.
- 9.5 BS EN 14001:1996 'Environmental Management Systems'.
- 9.6 BS EN 60044-1:1999 'Instrument Transformers. Current Transformers'.
- 9.7 BS EN 60137:1996 'Insulated bushings for alternating voltages above 1 kV'.
- 9.8 BS EN 60694:1997 'Common specification for high-voltage switchgear and controlgear standards'.
- 9.9 BS EN 62155:2003 'Hollow pressurised and unpressurised ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000V'.
- 9.10 BS 5499-1:2002 'Graphical symbols and signs. Safety signs, including fire safety signs. Specification for geometric shapes, colours and layout'.
- 9.11 ENA TS 41-37, Issue 1:2004 'Switchgear for use on 66kV to 132 kV Distribution Systems'.
- 9.12 ENA TS 50-18 'Design and Application of Auxiliary Electrical Equipment'.
- 9.13 ENA TS 50-19 'Standard Numbering for Small Wiring (for Switchgear and Transformers together with their associated relay panels)'.
- 9.14 Electricity North West EPD311 'Approval of Equipment'.
- 9.15 Electricity North West CP311 'Equipment Approval Process'.

10. KEYWORDS

132kV; SWITCHGEAR;

APPENDIX A

SCHEDULES OF INFORMATION

Schedule A - Ratings

Schedule B - List of variations from the specification

Schedule C - Recommended Tools And Spare Parts

Schedule D – General Particulars of Definite Work

SCHEDULE A - RATINGS

Schedule A1 - Circuit Breakers - to be completed by Tenderer for each type

	Type		
1.	Type reference of circuit breaker		
	Rated values and characteristics		
2.	Number of poles		
3.	Class: Indoor (I) or outdoor (O)		
4.	Rated voltage		
	(a) Rated lightning impulse withstand voltage to earth and between poles	kV	
	(b) Rated lightning impulse withstand voltage between terminals of open poles	kV	
	(c) Rated 1 minute power frequency withstand voltage	kV	
5.	Rated frequency	Hz	
6.	Rated normal current	A	
7.	Rated line charging breaking current	A	
8.	Rated cable charging breaking current	A	
9.	Rated (single) capacitor breaking current	A	
10.	Rated low inductive breaking current		
	(a) Transformer, frequency 500Hz	A	
	(b) Reactor, frequency 2 - 3kHz	A	
11.	Rated short circuit breaking current		
	(a) Symmetrical single phase	A	
	(b) Symmetrical three phase	A	
	(c) Asymmetrical single phase	A	
	(b) Asymmetrical three phase	A	

Schedule A1 - Circuit Breakers - to be completed by Tenderer for each type (continued)

12.	Rated transient recovery voltage		
	(a) First reference voltage U_1	kV	
	(b) Time to reach $U_1 - t_1$	μ s	
	(c) TRV peak value U_c	kV	
	(d) Time to reach $U_c - t_2$	μ s	
	(e) Time delay t_d	μ s	
	(f) Voltage co-ordinate U'	kV	
	(g) Time co-ordinate t'	μ s	
	(h) Rate of rise U_1/t_1	kV/ μ s	
13.	Rated short circuit making current		
	(a) Peak three phase	kV	
	(b) Peak single phase	kV	
14.	Rated operating sequence		
15.	Rated short time current/duration		
	(a) Three phase	kA/s	
	(b) Single phase	kA/s	
16.	Rated out of phase breaking current	kA	
17.	Opening time without current	ms	
18.	Minimum break time at rated breaking current	ms	
19.	Minimum auto reclose dead time following opening under fault conditions	ms	
20.	Closing time without current	ms	
21.	Close - open time; maximum time to open following closure onto a prepared trip fault	ms	
22.	Type tests verifying the above ratings		

Schedule A1 - Circuit Breakers - to be completed by Tenderer for each type (continued)

Constructional features			
23.	Mass of each installed circuit breaker	kg	
24.	Shock loading of circuit breaker	kg	
25.	SF ₆ gas		
	(a) Total gas quantity in circuit breaker enclosure		
	(b) Number of gas zones		
	(c) Mass of gas in each gas zone		
	(d) Normal operating pressure at 20°C	bar g	
	(e) Maximum operating pressure at 20°C	bar g	
	(f) Low pressure alarm pressure at 20°C	bar g	
	(g) Low pressure lock out pressure at 20°C	bar g	
	(h) Minimum gas pressure to achieve rated breaking current at 20°C	bar g	
	(i) Minimum pressure to withstand two asynchronous rated power frequency voltages across open poles at 20°C	bar g	
	(j) Minimum pressure to withstand 1.5 x phase to earth voltage between terminals and earth at 20°C	bar g	
	(k) Maximum leakage rate of gas from circuit breaker enclosures	percentage per annum	
	(l) Type of filter		
	Number of breaks in series per pole		
26.	Minimum clearance		
27.	(a) Between poles	mm	
	(b) To earth	mm	
	Stroke of moving contacts	mm	
28.	Material of main contacts	mm	
29.	Material of moving contacts		
30.	Type of arc control device		
31.	Type of device used to limit rate of rise of re-striking voltage		
32.	Resistance across main contacts at rated current	μΩ	

33.			
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Schedule A1 - Circuit Breakers - to be completed by Tenderer for each type (continued)

34.	Is the contact current used to increase the contact pressure?		
35.	Material of tank		
36.	Thickness of tank		
37.	Routine pressure test on circuit breaker enclosure	bar g	
38.	Type pressure test on circuit breaker enclosure	bar g	
	Operating mechanism		
39.	Type reference of circuit breaker operating mechanism		
40.	Is the circuit breaker trip free or fixed trip?		
41.	Method of operating circuit breaker, for example, stored energy		
42.	Pre-charge pressure of energy storage system	bar g	
43.	Capacity of energy storage system, pump cut in to pump cut out	litre	
44.	Operating sequences available with stored energy at pump cut out		
45.	Pneumatic or hydraulic pressures		
	(a) Pump motor cut in	bar g	
	(b) Pump motor cut out	bar g	
	(c) Close lock out pressure	bar g	
	(d) Close lock out reset pressure	bar g	
	(e) Trip lock out	bar g	
	(f) Trip lockout	bar g	
	(g) Low pressure alarm	bar g	
	(h) Low pressure alarm reset	bar g	
	(i) Safety device operate	bar g	
	(j) Safety device reset	bar g	
46.	Motor		
	(a) Electrical supply AC or DC?		
	(b) Rated voltage of operation	V	
	(c) Starting current	A	

Schedule A1 - Circuit Breakers - to be completed by Tenderer for each type (continued)

	(d) Operating current	A	
	(e) Motor speed	RPM	
47.	Type of compressor		
48.	Type of safety valve		
49.	Type of non return valve		
50.	Type of isolating valve		
51.	Type of pressure switch		
52.	Closing coils		
	(a) Rated voltage	V	
	(b) Current to close circuit breaker at rated voltage	A	
	(c) Minimum operating voltage	V	
53.	Trip coils		
	(a) Rated voltage	V	
	(b) Current to open circuit breaker at rated voltage	A	
	(c) Minimum operating voltage	V	
54.	Current rating and type of auxiliary switches provided		
55.	State the number of circuit breaker interruptions that may be performed before maintenance is required		
	(a) At the rated current		
	(b) At 10kA		
	(c) At 20kA		
56.	State the method by which contact wear is externally indicated and/or may be measured		

SCHEDULE C – TOOLS AND SPARE PARTS

i) List of tools recommended for use with each installation

DESCRIPTION	PRICE EACH £	TOTAL PRICE £

ii) Recommended spare parts, to be ordered at the discretion of the company

DESCRIPTION	PRICE EACH £	TOTAL PRICE £

SCHEDULE D – GENERAL PARTICULARS OF DEFINITE WORK

(Relevant details to be completed by Electricity North West)

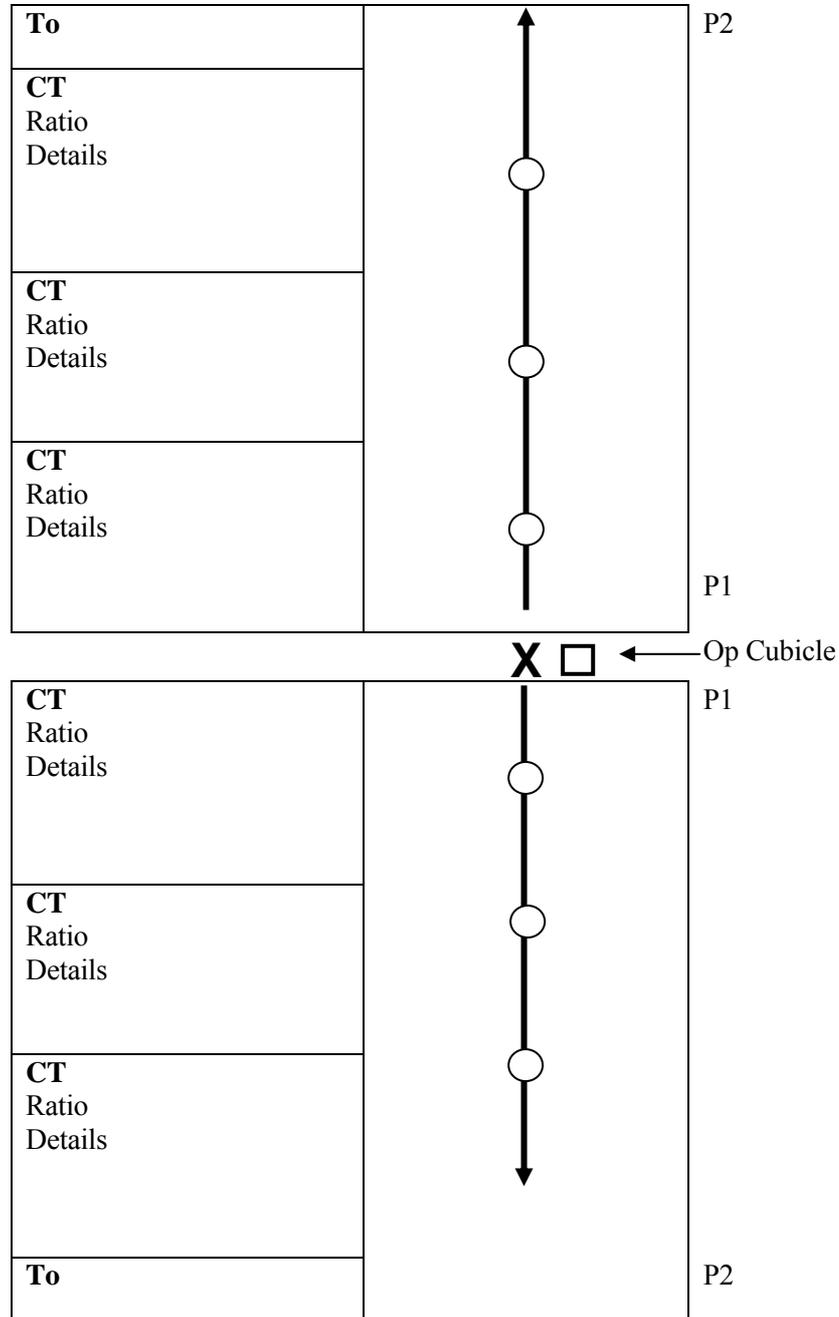
Item	Description	
1	Site Name	
2	Site Grid Reference	
3	Number of Units	
4	Rating (Amps)	
5	Is Capacitor Bank Switching Required	Yes / No *
6	Colour of Bushings / Insulators	
7	CT Ratios	See next sheet
8	Order of CTs	See next sheet
9	Creepage Distance	25mm/kV / 31mm/kV *
10	Number of TripCoils	1 / 2 *
11	Required Short Circuit Breaking Current and X/R Ratio	

* delete as appropriate

SCHEDULE D – GENERAL PARTICULARS OF DEFINITE WORK (CONTINUED)

(Relevant details to be completed by Electricity North West)

CT Arrangement



APPENDIX B

SELF-CERTIFICATION CONFORMANCE DECLARATION

CLAUSE BY CLAUSE CONFORMANCE WITH SPECIFICATION

The manufacturer shall declare conformance or otherwise, clause by clause, using the following levels of conformance declaration codes.

Conformance declaration codes

- N/A = Clause is not applicable/appropriate to the product/service
- C1 = The product/service conforms fully with the requirements of this clause
- C2 = The product/service conforms partially with the requirements of this clause
- C3 = The product/service does not conform to the requirements of this clause
- C4 = The product/service does not currently conform to the requirements of this clause, but the manufacturer proposes to modify and test the product in order to conform.

Manufacturer:

Product/Service Description

Product /Service Reference :

Assessor

Name:	Company	Signature	Date
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Clause / Sub-clause		Requirement	Conformance Code	Remarks (Must be completed if Conformance Code is not Cs1)
1		Scope		
2	1	Product not to be changed		
2	2	Electricity North West Technical Approval		
2	3	Quality Assurance		
2	4	Formulation		
2	5	Identification Markings		
2	6	Minimum Life Expectancy		
2	7	Manufacturers already approved		
2	8	Product conformity		
3	1	Requirement for type tests at the suppliers' premises		
3	2	Requirement for routine tests at the suppliers' premises		
4		Technical and Performance Requirements		
4	1	General design features		
4	1.1	Gas Monitoring		
4	1.2	Simplicity of Operation		
4	1.3	Earthing		
4	1.4	Type		
4	1.5	Small current interrupting duties		
4	1.6	Circuit Breaker Re-striking		
4	1.7	Short Line Faults and out-of-phase switching		
4	1.8	Minimum interruption times		
4	1.9	Transient recovery voltage		
4	1.10	Ancillary Re-striking Voltage Devices		
4	1.11	Parallel Operation		
4	1.12	Auto Reclosing		
4	1.13	Gas Couplings		
4	2	Circuit Breaker Operating Mechanisms		
4	2.1	Type of Mechanism		

Clause / Sub-clause		Requirement	Conformance Code	Remarks (Must be completed if Conformance Code is not Cs1)
4	2.2	Capability		
4	2.3	Anti-pumping		
4	2.4	Pole discrepancy		
4	2.5	Energy Charge and Recharge of Operating Mechanism		
4	2.6	Immunity from Inadvertent Operation		
4	2.7	Operation counter		
4	2.8	Indication of OPEN and CLOSED status		
4	2.9	Manual operation of circuit breakers		
4	2.10	Slow operation for maintenance		
4	2.11	Labelling		
4	2.12	Speed of recharging		
4	2.13	Prevention and indication of slow or incomplete closure		
4	2.14	Manual Charging		
4	3	Interlocking Facilities		
4	3.1	Mechanical interlocking		
4	3.2	Electrical interlocking		
4	3.3	Circuit breaker gas pressure		
4	3.4	Circuit breaker opening		
4	4	Locking facilities		
4	4.1	Locking of Equipment		
4	4.2	Padlocking		
4	5	Auxiliary Switches and Contactors		
4	5.1	Quantity		
4	5.2	Exclusion of repeat relays		
4	6	Bushings		
4	7	Control and indication and alarms		
4	7.1	Local control		
4	7.2	ON/OFF and other indications		
4	8	Ratings		

Clause / Sub-clause		Requirement	Conformance Code	Remarks (Must be completed if Conformance Code is not Cs1)
4	8.1	Variation of power frequency withstand voltage with gas density		
4	9	Environment, operating conditions and duty		
4	9.1	Service conditions		
4	9.2	Noise		
4	9.3	Electromagnetic Compatability		
4	10	Auxiliary Supplies		
4	11	Finish Colour		
4	12	Operating Cubicle		
4	12.1	General		
4	12.2	Local/remote operation		
4	12.3	Ferruling		
4	12.4	Terminals and Terminal Blocks		
4	12.5	Internal Wiring		
4	12.6	External Wiring		
4	13	Special Tools		
4	14	Support Structure		
4	15	HV Terminals		
4	16	Current Transformers for Dead Tank Breakers		
4	16.1	Location of CTs		
4	16.2	Marking and positioning of CTs		
4	16.3	Requirements for CTs		
4	16.4	Dual Ratio CTs		
4	16.5	CT Ratings		
4	16.6	Magnetisation, core loss and secondary resistance curves		
5		Erection and Site Assembly		
5	1	Final Erection in Works		
5	2	First Filling of Gas		
5	3	Site Works		

Clause / Sub-clause		Requirement	Conformance Code	Remarks (Must be completed if Conformance Code is not Cs1)
5	4	Test Equipment		
6		Drawings		
7		Operational Life, Inspection, Maintenance and Training		
7	1	Operational Life		
7	2	Operating and Maintenance manuals		
7	3	Gas Handling Equipment		
7	4	Training		
8		Variations		

Additional Notes: