

Electricity Specification 359

Issue 2 March 2024

6.6kV and 11kV Retrofit Circuit Breakers and Associated Housings



Amendment Summary

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1 Scope

This Specification and attached Schedules cover the general design specification of retrofit circuit breakers and associated housings for use on the 6.6kV or 11kV system of Electricity North West Limited, hereinafter referred to as Electricity North West.

2 Definitions

Approval	Sanction by the Electricity North West Plant Policy Manager that specified criteria have been satisfied.
Contract	The agreement between Electricity North West and the Contractor for the execution of the Works including therein all documents to which reference may properly be made in order to ascertain the rights and obligations of the parties under the said agreement.
Contractor	The person or person's firm or company, including personal representatives, successors and permitted assigns, whose tender has been accepted by Electricity North West.
ENA TS	Energy Networks Association Technical Specification.
Specification	The Specifications and Schedules (if any) agreed by the parties for the purpose of the Contract
Sub-Contractor	Any person (other than the Contractor) named in the Contract for any part of the Works or any person to whom any part of the Contract has been sub-let with the consent in writing of the Electricity North West Plant Policy Manager, and the legal representatives, successors and assigns of such person.
Supplier	Any person or person's firm or company who supplies goods to Electricity North West or to its contractor.
Tender	An offer in writing to execute work or supply goods at a fixed price.
Tenderer	The person or person's firm or company, including personal representatives, successors and permitted assigns, invited by Electricity North West to submit a tender.
Words	Words importing persons shall include firms and corporations; words importing the singular only, also

	include the plural, and vice versa where the context requires.
Work	All materials, labour and actions required to be provided or performed by the Contractor under the Contract.
Writing	Any manuscript, typewritten or printed statement under seal or hand as the case may be.

3 Standards

Switchgear shall comply with the stated ENA TS 41-36 except where varied by this Specification.

The Tenderer shall complete and return with their Tender the Schedules in [Appendix A](#) and all conformance declaration sheet in [Appendix B](#).

4 General Requirements for Approvals and Testing

4.1 Product not to be Changed

Compliance with this clause shall be in accordance with ES001.

4.2 Electricity North West Technical Approval

Compliance with this clause shall be in accordance with ES001.

4.3 Quality Assurance

Compliance with this clause shall be in accordance with ES001.

4.4 Formulation

Compliance with this clause shall be in accordance with ES001.

4.5 Identification Markings

Compliance with this clause shall be in accordance with ES001.

4.6 Minimum Life Expectancy

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

4.7 Product Conformity

Compliance with this clause shall be in accordance with ES001.

4.8 Confirmation of Conformance

The Tenderer shall complete the conformance declaration sheets in [Appendix B](#). Failure to complete these declaration sheets may result in an unacceptable bid.

Switchgear shall at the time of Tender have a valid Approval Notice or Notice of Conformity as issued by the Electricity Network Association Switchgear Assessment Panel. Copies of Approvals Certificates and Notices of Conformity shall accompany the Tender.

5 Requirements for Type and Routine Testing

Compliance with this clause shall be in accordance with ES001.

5.1 Requirement for Type Tests at Suppliers Premises

Compliance with this clause shall be in accordance with ES001.

5.2 Requirement for Routine Tests at the Supplier's Premises

Compliance with this clause shall be in accordance with ES001.

5.3 Requirement for On Site Tests.

These tests shall be carried out as a minimum on every individual unit or component supplied. The tests are detailed in [Section 10](#) and shall be completed by the Supplier.

The results of these tests shall be supplied to Electricity North West with each unit purchased and retained for inspection, at a period to be determined by the Electricity North West Plant Policy Manager.

6 General Design Features

The overall arrangements of the installation shall enable a straightforward operating regime. Each switching component, its operational state and means of control shall be clearly and instantly recognisable.

The completed installation shall provide reasonable levels of access for any maintenance work which may be required throughout the lifetime of the equipment. Access levels for any operation, inspection, or maintenance shall be acceptable to the Electricity North West Plant Policy Manager, and fixed aids such as platforms or ladders shall be provided as necessary in order to achieve this.

6.1 Handling of Gasses used and Decontamination Procedures

In certain situations, it will be necessary to access enclosures where sulphur hexafluoride (SF₆) or any alternative gasses such as C4FN and Natural Origin Gasses, have been used for insulation and/or arc extinction, e.g.

- Switchgear modification to correct manufacturing or material defect.
- Examination following failure.
- Examination following leak of SF₆ / Alternative Gasses.
- Maintenance.
- Disposal of switchgear at end of life.

Whilst Electricity North West has a procedure for safe decontamination of enclosures containing SF₆ it is not envisaged that Electricity North West will undertake such work except in an emergency. The original equipment manufacturer, its successor or a suitable contractor will be expected to assist as necessary in any such work and consequent actions. The Tenderer shall submit details with their Tender of any procedures required to comply with this statement for all Alternative Gasses used.

When the equipment reaches the end of its working life it will have to be decontaminated and disposed of safely. It is important that this is considered in the design of the equipment. Tenderers will be expected to show that there is available a detailed procedure by which each type of switchgear offered under this tender may be safely de-gassed and decontaminated prior to disposal at the end of its life. This applies to enclosures that have contained SF₆ as an insulator as well as those where SF₆ has been used as an arc interrupting medium. The Tenderer shall submit details with their Tender of any procedures required to comply with this statement for all Alternative Gasses used.

It is a requirement of this Specification that Tenderers have procedures and safe working practices in place to:

- Decontaminate the equipment and site as necessary and recover switchgear for examination/disposal as required.
- Decontaminate the equipment on site or some other location as required to carry out modifications.
- Decontaminate the equipment prior to disposal.

Tenderers shall provide the following information:

- Mass of SF₆ in kg for each type and variant of circuit breaker offered.
- Details of procedures for handling new and contaminated SF₆ / Alternative Gasses.
- Details of procedures for decontaminating failed SF₆ / Alternative Gasses equipment and the associated sites/substations.

- Details of procedures for decontaminating SF₆ / Alternative Gasses equipment prior to carrying out modifications.
- Details of the procedure by which each type of circuit breaker offered under this Tender may be safely de-gassed and decontaminated prior to disposal as the end of its life. This shall cover enclosures (a) where SF₆/ Alternative Gasses are used as an insulating medium and (b) where SF₆ / Alternative Gasses are used as an arc interrupting medium.

6.2 Internal Arc Tested Equipment

Units offered shall have completed internal arc testing in accordance with ENA TS 41-36 will be expected to be supported by test evidence, from a recognised Short Circuit Testing Station, of the ability of a unit to vent in a safe and predictable manner in the event of an internal arc occurring. Designs which vent into a trench are not acceptable.

Manufacturers shall also be expected to provide guidance information on the correct positioning of the unit within the substation enclosure so as not to invalidate the tests. This guidance shall include the following for each type of switchgear offered.

- The arrangements of the enclosure in which internal arc testing was carried out, highlighting differences from those specified in ENA TS 41-36 section 1.5.101.

Drawings showing the venting volumes required for fault ratings up to 21.9kA.

A drawing of the interface trunking that should be attached to the vent on the switchgear suitable for connection to Electricity North West standard trunking with external cross section of 342mm by 342mm.

The need for additional ducting is not desirable and Tenderers shall indicate the circumstances under which they consider venting would be necessary, so that such situations can be avoided.

A copy of this information shall be included with the Tender, but an additional copy shall be sent to the Electricity North West Plant Policy Manager.

7 General Clauses

7.1 Extent of Contract

This Specification lists Electricity North West' general requirements for indoor metalclad switchgear for use on the Electricity North West 6.6kV and 11kV system and is complementary to ENA TS 41-36 and clause numbers in brackets refer to that document.

Switchgear units for a particular installation will be listed in [Schedule A](#) in [Appendix A](#).

The Supplier shall be responsible for all site surveys necessary to adequately design the interface between the existing switchgear housing and the new circuit breaker, or the new housing to the existing switchgear.

The Supplier shall be responsible for correcting all defects found during testing and commissioning of the control, alarm and protective equipment.

Where erection is included in the contract, testing shall include power frequency high voltage testing and continuity (Ducter) tests. Electricity North West retains the right to witness these tests but may accept a copy of the test results, subject to prior Approval by the Electricity North West Plant Policy Manager.

7.2 Site and Delivery

The Contract Works shall be delivered by road and off-loaded by the Supplier during normal working hours to Electricity North West's Substation or depot at the address given on the Purchase Order. The Supplier shall provide method statements and risk assessments for all site works.

7.3 Time for Completion

The period of time required from the placing of an order until the Contractor's Works will be completely finished and delivered shall be stated in [Schedule C](#) of this or a particular enquiry.

7.4 Work to be Executed at Site

Where the contract includes erection by the Supplier all cutting away and making good of brickwork, etc., will be the responsibility of Electricity North West except small fixing holes for the switchgear which shall be the responsibility of the Supplier.

Care shall be taken to avoid damage to any floors, doors, or any other parts of the building. Any damage shall be made good to the satisfaction of the Electricity North West Plant Policy Manager.

7.5 Manufacturer

The whole of the plant shall be manufactured in the works of the Supplier or in the works of a sub-contractor approved by the Electricity North West Plant Policy Manager. The Tenderer shall state in [Schedule D](#) of this or a particular enquiry the names and work addresses of all such sub-contractors.

7.6 Drawings and Maintenance Instructions

General arrangement drawings shall be submitted with the Tender. These drawings shall include overall dimensions, headroom for erection and/or operation, withdrawal space where appropriate, and positions of main and multicore cables.

The Contractor shall submit drawings, as per [Schedules E](#) and [F](#), via email in an AutoCAD (.dwg) format and one paper print maximum size A1 of all diagrams and drawings to Electricity North West Policy and Standards section for approval.

A copy of all installation, operation and maintenance manuals shall be submitted with the Tender. These manuals shall, preferably, be on a email in an Adobe Acrobat format.

All equipment shall be in accordance with Electricity North West' current standard schematic drawings and multicore schedules, which shall be registered with the Contractor.

7.7 Spare Parts and Tools

All special tools required for the operation of the switchgear, including test devices, shall be included in the price.

All special tools necessary for the maintenance of the plant shall be included and fully detailed as part of this or a particular enquiry.

Spare parts which the Supplier recommends, including contacts, closing and tripping coils, etc. shall be enumerated as part of this or a particular enquiry and a separate price given for each item.

7.8 Inspection and Tests

7.8.1 Works Inspections

Routine inspections of the plant at the Supplier's Works will normally be carried out, but the Electricity North West Plant Policy Manager may, by prior agreement, waive such inspections. Inspection of the first Electricity North West circuit breaker or housing of a new design completed will be required at the Supplier's works before delivery. At least one unit shall be in full working order.

Not less than seven days' notice of all inspections and tests shall be given to the Electricity North West Plant Policy Manager in order that he or his representative may be present if he so desires.

All apparatus shall be routine tested at the manufacturer's works and at site in accordance with the appropriate standard. Test certificates for all tests shall be supplied in duplicate to the Electricity North West Plant Policy Manager.

7.8.2 Relay Testing

The relay and instruments shall be tested and calibrated to the appropriate standard at the Supplier's or Sub-contractor's works. The Electricity North West Protection Policy Manager will not normally witness these tests but reserves the right to do so by arrangement.

7.9 Disposal of Switchgear and/or its components

Tenderers shall provide details on how to dispose of the switchgear and/or its components to ensure compliance with the various waste management regulations [Environmental Protection Act 1990 (Part II); Special Waste Regulations 1996; Waste Management Licensing Regulations 1994; Control of Pollution (Amendment) Act 1989]

7.10 Manual Handling

Tenderers shall supply a Risk Assessment on the manual handling required for installation and operation of the switchgear.

7.11 Failure, Modes, Effect and Cause Analysis (FMECA)

Tenderers shall carry out a FMECA or equivalent study for each type of equipment offered. A copy of this study shall be provided with the Tender documents.

8 Technical Clauses – General Requirements

8.1 General Requirements

Electricity North West's basic requirements for provision of equipment under this ES shall be either:-

- A new retrofit circuit breaker for installation into an existing switchgear housing. Specific technical requirements are described in [Section 9](#) of this ES.

A new switchgear housing and circuit breaker truck to extend an existing switchboard. Specific technical requirements for housings are described in [Section 10](#) of this ES.

The specific requirements for a particular enquiry are indicated in [Schedule A](#). Additional details given in this section are normally aspects of good design, where they involve extra cost, this shall be priced separately.

All incidental items shall be included, whether specified in detail or not, as required to secure reliability, economy, safety, and convenience of operation. The whole of the equipment shall conform to the best modern practice and shall be to the reasonable satisfaction of the Electricity North West Plant Policy Manager.

Each unit shall be complete with all necessary details including busbar coupling arrangements, spacers, bolts, etc. Busbar end covers and any other parts necessary for completing an end unit shall be supplied as specified in the purchase orders.

Means shall be provided for the easy lubrication of all bearings and, where necessary, other portions or mechanisms or moving parts.

Components which may suffer deterioration in service shall be removable as complete assemblies for maintenance or replacement.

8.2 System Earthing

The switchgear is required for use on Electricity North West's three phase, 50 Hz, 6.6kV and 11kV general supply systems with the neutral earthed directly or through an impedance at the option of Electricity North West.

8.3 Common Ratings (Refer to Clause 1.4)

Rated Voltage	7.2kV or 12kV
Rated normal current	Circuit breakers 630A, 1250A, 2000A
	Busbars 1250A, 2000A
Rated short circuit current	21.9kA minimum

Rating plates shall show the actual ratings to which the equipment is certified not that of the system on which it will operate.

8.4 Standard CT Ratios

Standard CT ratios shall be used unless otherwise specified by Electricity North West.

Standard CT Ratio	Application
2000/5	Transformer incoming CB
2000/5, 1200/5	Bus section CB
600/5, 400/5	Feeder CB

9 Retrofit Circuit Breaker Specific Technical Requirements

9.1 Interface Design

The Supplier shall be responsible for the detailed design of the interface between the retrofit circuit breaker and the existing switchgear. The design shall:-

- Ensure correct fitting, movement and operation of the circuit breaker within the existing housing. Functionality and operation of existing interlock schemes and shutters shall remain unchanged.

Provide correct connection of secondary wiring between the circuit breaker and the existing switchgear, either by moving contacts or plug and socket.

Identify the auxiliary supplies voltage used in the existing switchboard and design the retrofit circuit breaker accordingly.

9.2 Rules for Interchangeability

Secondary wiring on physically interchangeable units shall be identical.

9.3 Operating Mechanism

9.3.1 Dependent Power (Refer to Clause 1.5.5)

If this type of mechanism is used then, a magnetic actuator is preferred.

9.3.2 Stored Energy (Refer to Clause 1.5.6)

If this type of mechanism is used then, stored energy operation by means of energy stored in a motor-charged spring with manual and electrical release is preferred.

9.4 Trip Circuit Supervision

The Supplier shall design the retrofit circuit breaker to integrate into the trip circuit supervision scheme of the existing switchgear. Electricity North West generally uses trip circuit supervision schemes specified in Scheme H7 of ENA Engineering Recommendation (ER) S15, or the ammeter type. The supplier may extend the existing scheme type or propose a suitable alternative.

9.5 Circuit Breaker Healthy Indication

Where the retrofit circuit breaker requires auxiliary supplies, the supplier shall design a suitable connection to the existing switchgear or batteries. This shall include local indication to show supply healthy, and provision of changeover contacts to allow remote monitoring.

9.6 Provision of Auto Trip Alarm

The Supplier's design shall include provision of an auto trip alarm, in a format suitable to be input into Electricity North West's Supervisory Control and Data Acquisition (SCADA) system.

9.7 Electrical Endurance (Refer to Clause 2.4.111)

The Manufacturer shall state the number of breaking operations the circuit breaker is capable of at different fault levels (i.e. 25%, 50%, 75% and 100% of rating) and the basis on which the information is given.

9.8 Isolating Features of Secondary Circuits (withdrawable circuit breakers)

Means shall be provided for coupling secondary circuits of the fixed portion to the withdrawn removable portion.

9.9 Gas (Refer to Clause 1.5.2)

Equipment in which gas is used as the interrupting medium shall be supplied with:-

- a pressure gauge or indicator
- a two-stage pressure switch

Where gas is used as the insulating medium only, equipment shall be supplied with:-

- a pressure gauge or indicator
- a single stage pressure switch

9.10 Auxiliary Supplies

Motor wound spring charging supplies to be nominal 110V dc.

9.11 Earthing Arrangements

The earthing arrangements for the retrofit circuit breaker shall replicate those of the existing switchboard. Existing arrangements will generally be transfer earthing, or accessory earthing. Full details of the proposed arrangement and earthing accessories shall be included in the Tender.

10 Switchgear Housing Specific Requirements

10.1 Cable Terminations (Refer to Clause 1.5.103.1.101)

Unfilled terminations are required. Unless previously approved, drawings of cable boxes complete with all relevant design information shall be provided for assessment. Cable box bushings shall comply with BS EN 50181 Table 1 Type C complete with stud suitable for use with separable connectors and shall be equipped with connections for initial and future cables.

It is preferred that the cable terminations run horizontally across the rear of the switchgear to allow the switchgear to hang over an existing trench.

Cable terminations shall be suitable for single phase 400mm² stranded copper conductor XLPE cables and have provision for a maximum of:-

- Two cables per phase on feeder units, and
- Four cables per phase on incomer units.

Jointing lugs, heat/cold shrink termination kits or separable connectors will be supplied by Electricity North West. Each bushing palm shall be supplied with a 30mm long x M12 brass screw, brass nut, two brass flat washers and one phosphor bronze lock washer. Gaskets are not required.

Provision shall be made for earthing individual copper screens. This shall take the form of a set of earth bars mounted on the base of the cable box. This internal cable box earthing shall be connected to the external true earth bar via bushings, which shall withstand a test voltage of 10kV dc.

Means shall be provided for fixing cable supports.

Unless previously approved drawings of cable boxes complete with all relevant design information shall be provided for assessment.

The expected type of cable to be installed and type of glands to be provided will be stated in the enquiry documents. The gland plate (non-ferrous) is preferred to be a minimum of 250mm from ground level.

10.2 Current Transformers (Refer to Clause 10.2)

10.2.1 General

Current transformers (cts) shall in general comply with the requirements of BS EN 60044-1, but where required they shall also comply with the additional requirements of ENA TS 35-17 for Class X(PX) Current Transformers. [Schedule B](#) details the particular performance characteristics required.

The primary windings shall be of the bar type wherever the choice exists.

Magnetising curves of all cts shall be submitted for approval, to Electricity North West Policy and Standards Section, unless previously approved by Electricity North West as a standard. The Manufacturer shall carry out mag curve tests on all installed cts as part of the routine factory tests.

The thermal and mechanical rating of the cts shall not be less than that corresponding to the rating of the switchgear to which they are connected.

Cts shall be rated to carry the maximum primary rated current of the associated circuit breaker. Where dual ratio cts are specified the ct shall be rated to carry the maximum primary current on the lowest turns ratio tap. This shall not preclude the maximum current being carried on the highest turns ratio tap.

The rating plate for all cts shall clearly show the serial number, primary and secondary rated current, turns ratio (if different from the rated current), output and accuracy class. **In addition**, the rated continuous thermal current of the ct **shall be clearly marked** on the ct rating plate. Additionally, the rating plates of Class X cts shall include the details specified in Section 7 of ENA TS 35-17

The Manufacturer will provide copies of all test data for the cts, this to include the type, routine and any special test reports that have been carried out in accordance with BS EN 60044-1 or ENA TS 35-17 for Class X cts.

Cts for incoming transformer restricted earth fault protection shall have characteristics similar to those detailed below. The characteristics of the neutral ct shall match as closely as practicable those of the phase cts: -

1:400 turns ratio

$V_{kp} > (66R_{ct} + 50) V$

$I_{mag} < 60mA @ V_{kp}$

$R_{ct} < 2\Omega$

Where:

V_{kp} = knee point voltage

I_{mag} = magnetisation current

R_{ct} = resistance of ct

Where cts are required for metering purposes the performance, testing and certification shall be in accordance with Electricity North West Electricity Specification (ES) 501.

At substations with remote operation and control panels, an interposing ct is required for remote ammeters for feeder circuits only, of Class 3 accuracy to BS7626 capable of operation with the secondary winding open-circuited without affecting the operation of the protective gear connected in series with the 5A winding.

Main CT ratio	Interposing CT ratio
200/5	5A/25 mA
400/5	5A/50 mA
600/5	5A/75 mA

10.2.2 Accommodation and Earthing

Except for the Standby Earth Fault Protection ct the protective and instrument ct secondary connections shall be earthed (each group separately) at the switchgear, in an easily accessible position and preferably by means of a bolted link.

Where there is more than one set of protective cts, those operating the balanced or unit protection shall be placed nearest to the busbars. Busbar protection cts shall be physically positioned such that they are always in the left-hand section of the busbar unit when viewed from the rear. Metering cts shall be connected in the outer phases. The exact location of each ct shall be submitted for the approval of the Electricity North West Plant Policy Manager. An earthed metal screen shall be provided between the primary conductor and the secondary winding.

10.3 Voltage Transformers (vt) (Refer to Clause 10.3)

The following additional requirements shall be met:-

- Two sets of low voltage fuses are required.
- Rated voltage factor 1.9. Rated time 30 seconds.
- Burden no less than 50VA per phase
- Accuracy class 1.0 3P

Earth connections shall be reasonably accessible to provide for insulation testing. Access is only required when the voltage transformer is isolated. Preferably some means of preventing re-energisation without completing the earth connection is required.

Electricity North West shall give preference to Switchgear where it is possible to isolate the vt at ground level without the use of tools.

The arrangement of fuses, links and earthing shall be in accordance with the appropriate Electricity North West diagrams. Secondary fuse bases and carriers shall be sea green (BS381C No 217) in colour and fitted with a 16-amp HRC fuse-link of a type approved by Electricity North West's Policy and Standards section.

Where the relay used for directional protection requires an vt with an open delta tertiary winding to be provided, the vt shall be either, of 3 phase 5 limb construction , or 3 separate 1 phase vts. This requirement shall be specified by Electricity North West at the time of ordering with an:-

- Accuracy Class 1.0 3P
- Burden 50VA

Where voltage transformers are required for metering purposes the performance, testing and certification shall be in accordance with Electricity North West ES501.

10.4 Small Wiring and Ancillary Equipment (Refer to Clause 1.5.4)

The following additional requirements are to be met:-

10.4.1 Auxiliary Switches

All auxiliary switches, whether they are in use or not, shall be wired up to a suitable terminal board on the fixed part of the switchgear such that they can easily be connected to multicore cables.

The use of auxiliary relays to substitute for inability to supply and connect sufficient auxiliary switches is strongly deprecated and is subject to approval by the Electricity North West Plant Policy Manager in each individual case.

10.4.2 Standard provision of auxiliary switches in primary substations.

The minimum number of auxiliary switches required is:-

Open when CB open	7
Closed when CB open	7
Open when closing spring charged	2
Closed when closing spring charged	2

Two changeover auxiliary switches may be called for which change position as a circuit breaker attains or departs from the service or earth locations on withdrawable equipment, or selectors attain or depart from the service or earth position on non-withdrawable equipment.

All incoming transformer and bus section units shall be provided with four spare auxiliary switches (two open, two closed).

10.4.3 Small Wiring

Refer to Section 4.6 in Electricity North West ES337. The colour of small wiring shall be white.

10.5 Circuit Diagrams

Appropriate Electricity North West standard diagrams are detailed in each section of [Schedule B](#).

11. Items Additional to ENA Technical Specification 41-36

11.1 Relays

This document shall be read in conjunction with Electricity North West ES396 in order that the protection philosophy and functionality may be fully understood. This is particularly relevant to the transformer incomers as the current protection, alarm and communication requirements are fully specified.

11.1.1 General

All relays shall be approved by Electricity North West. Electricity North West reserves the right to nominate the type and manufacturer of any relay. All Approved relays are detailed in ES281.

All relays shall be supplied with blank identification labels.

Induction disc relays shall preferably not be mounted on doors or removable panel covers. Where this is unavoidable guard relays shall be fitted to prevent inadvertent relay operation when doors are opened or closed.

11.1.2 Sensitive Earth Fault Relays

On feeder circuits, Sensitive Earth Fault relays, when specified, shall have a sensitivity range which includes 2% or 3% with a definite time delay variable up to 10 seconds. The relay will be connected in the residual circuit of the overcurrent and earth fault CTs which shall be capable of driving the burden. The Sensitive Earth Fault protection may be provided within the overcurrent and earth fault relay if it is capable of providing all the required functionality.

This relay shall be capable of being switched IN or OUT by Telecontrol.

11.1.3 Relays for Directional Protection

Directional overcurrent relays shall have a characteristic angle which includes 45° lead.

Directional earth fault relays shall have a characteristic angle which includes 0°.

11.1.4 Unit Protection Relays

For certain types guard relays may be required.

11.1.5 Feeder Earth Fault Alarm Relays

If a separate Feeder Earth Fault Alarm is required, then the relays shall be connected in the residual circuit of the overcurrent and earth fault CT and provide an output contact for the duration of the fault current. In addition to this earth fault alarm there shall be a delayed reset indicator (LED or flag) on each feeder unit to give on-site indication. This delayed reset indication shall have a duration of up to six hours but shall not be less than three hours and shall be capable of manual reset on site.

11.2 Secondary Wiring Disconnection

Where the switchgear is demountable the appropriate secondary wiring shall be capable of disconnection by means of suitable plugs and sockets of a design approved by Electricity North West. Means shall be provided to ensure and maintain full contact wipe.

11.3 Auto-reclosing

Auto reclosing, where specified on feeder circuits, will be achieved by use of the Telecontrol Delayed Auto Reclosing (TDAR) functionality. There is no requirement for a separate relay that incorporates auto-reclosing functionality.

11.4 Trip Circuit Supervision

11.4.1 Scheme Required

The Supplier shall design the housing and circuit breaker to integrate into the trip circuit supervision scheme of the existing switchgear. Electricity North West generally uses trip circuit supervision schemes specified in Scheme H7 of ENA Engineering Recommendation (ER) S15, or the ammeter type. The supplier may extend the existing scheme type or propose a suitable alternative.

11.4.2 Label

Where the secondary circuit connections are taken through flexible trunking an additional label shall be fitted:-

WARNING

REMOVAL OR REPLACEMENT OF THE PLUG BOX
MAY OPERATE THE TRIP CIRCUIT FAIL ALARM

Where secondary circuit connections are opened when the circuit breaker is isolated the label shall read:-

WARNING

ISOLATION FROM OR RESTORATION TO THE SERVICE LOCATION MAY OPERATE THE TRIP
CIRCUIT FAIL ALARM

11.5 Control Scheme

The overall control, trip and alarm facilities are shown on the Electricity North West diagrams quoted in each section of [Schedule B](#).

The auxiliary supply for static relays shall be provided by a separate fuse and link retained by a bolted bar inscribed :-

WARNING

REMOVING THE RELAY POWER SUPPLY FUSE OR LINK MAY ERASE PART OF THE RELAY
MEMORY.

11.6 Selector Switches

Selector switch handle shapes shall comply with ENA TS 50-18 and be fitted with stud type connections. Loose connecting screws or pinch type terminals are not acceptable.

11.7 Circuit Breaker Interlocks

If key interlocks are to be used within the switchgear, interlocking shall be provided by a means of:

- Castell type FS (or equivalents) for mechanical locking and
- A combination of Lowe and Fletcher type H31 electrical and Castell type FS (or equivalents) mechanical key and locks for electrical locking.

11.8 Multicore Cables

No multicore cabling is included in this contract. The multicore cables which will be installed by Electricity North West will normally be plastic insulated, but rubber or paper insulated, lead sheathed and armoured as well as aluminium sheathed cables may also be used on occasions.

Electricity North West will not normally use multicore/multi-pair cables with less than four or more than nineteen cores/pairs. In general, the multicores required will be selected from those detailed in ENA TS 09-6.

The Contractor shall provide undrilled removable gland plates to accommodate the multicore cables. The identification of the cores, terminating and connecting them to suitable terminal boards shall be excluded from the Contract.

11.9 Foundation Arrangements

Foundation arrangements will permit the withdrawal of circuit breaker trucks.

The Tenderer shall detail in full with their Tender how much of the Switchgear can overhang an existing trench without causing a structural instability or adverse effect on the Switchgear.

11.10 Platforms and Ladders

Where required platforms and ladders shall be provided to give safe and easy access to all parts of the equipment, for operation, inspection, and cleaning. The platforms shall, unless otherwise approved, be of the gridway type, and the ladders of glass fibre rungs.

Ladders used for normal operation on the switchgear shall comply with the requirements of Health and Safety Guidance Note GS.31. Ladders required only for access for testing may be vertical, if approved.

Portable ladders shall be of glass fibre to BS1129.

Provision shall be made for the use of fall arrest devices when it is necessary to work on top of the switchgear.

11.11 Lifting and Handling Facilities

11.11.1 General

The design shall be such that any withdrawable portion can be reasonably manoeuvred by one man. The wheels shall be such that running on a concrete floor will not cause damage.

11.11.2 Additional Equipment - Withdrawable Circuit Breakers

Where required a power operated device shall be provided such that a circuit breaker may be raised or lowered. This may take the form of a portable device common to the whole switchboard.

Such a device shall be stable in operation, with the minimum of exposed moving parts, and with a supply of either 110 volts ac single phase or 30 volts dc, to be stated in [Schedule B](#). All 30 volts and 110 volts supplies will be provided by Electricity North West.

A safety device shall be provided to prevent damage due to over winding.

11.11.3 Voltage Transformers

Voltage Transformer assemblies shall be provided with suitable lifting attachments.

11.11.4 Transport

Any additional parts required for bracing during transport shall be painted in a distinctive colour and if necessary, clearly lettered "Do not remove until housing firmly fixed to foundation".

11.12 Telecontrol

At primary substations all switchgear will be provided with equipment to interface with Electricity North West telecontrol. This equipment should preferably be mounted in a position accessible through the hinged door of the instrument panel.

Telecontrol close and trip relays shall be required on each circuit with an additional relay where sensitive earth fault functionality is specified. The Purchaser shall supply and connect telecontrol cables in the multicore box.

The Contractor shall supply relays and matching bases in accordance with Electricity North West ES337 Section 4.9. (Note Mag blowout contacts are normally required for trip/close functionality except where switchgear is fitted with a magnetic actuator operated mechanism).

All relays and position switches for Telecontrol shall be wired to a terminal block suitably placed for the termination of multicore cables. The location of the terminal block is to be agreed by the Electricity North West Plant Policy Manager.

Each circuit including the bus-section/s where protection is fitted, shall be equipped for remote indication of current by using a wedding ring ct, provided and wired by the switchgear manufacturer. Requirements for the aforementioned interposing CTs are specified in Electricity North West ES336 section 2.1. Incoming transformer units shall have an additional CT. Mounting may be by an insulated strap to the secondary wiring cable loom. The secondary wiring connection C11 shall be passed through the ct(s) the requisite number of times to provide 10 ampere-turns at rated secondary current.

11.13 Additional Requirements

11.13.1 Busbar Trunking

Electricity North West has a requirement for Busbar Trunking to allow for replacement of existing assets either side of an existing structural blast wall. All Tenderers shall submit with their Tender details of the available Busbar Trunking including the type test certificates and drawings. Where the Busbar Trunking is not fully Type Tested calculations on Short Circuit Forces, Stresses, Temperature Rise and Copper Conductivity shall be submitted to the Electricity North West Plant Policy Manager for assessment and Approval.

11.13.2 Dummy Panels.

Electricity North West has a requirement for 200mm, 300mm and 500mm Dummy Panels. All Tenderers shall submit full details including type test certificates and drawings of the Dummy Panels.

There may be occasions where Electricity North West requires the manufacturer to design, type test and provide bespoke dummy panel lengths. This will be subject on a site-specific basis and subject to Approval by Electricity North West Plant Policy Manager.

12. Requirements for On-Site Testing

The Switchgear Supplier shall carry out the following site tests:-

12.1 Resistance Tests of Main Circuit

Micro-ohm meter tests shall be carried out on all busbars, main connections, and across the circuit breaker and disconnecter contacts.

Which shall include:-

- (a) Micro-ohm meter tests between all primary test access points and their associated HV cable termination box connection.
- (b) Micro-ohm meter tests between all common earthing connections between the Circuit Breaker housings.

12.2 Switchgear Operation, Mechanical Interlock Checks and Function Tests

The following basic operational checks on switchgear shall be carried out by the Supplier:-

- (a) The mechanical functionality of the switchgear shall be checked.
- (b) The operation of all electrical and mechanical interlocks on the switchgear shall be checked to ensure that they operate correctly in both permissive and preventative mode.
- (c) Functionality of switchgear operation counters shall be checked.
- (d) Each panel shall be operated electrically for all sources of initiation (trip/close) to ascertain that its function is correct to the wiring diagram / schematic.
- (e) Any remote features shall only be checked to the multicore box terminals.

- (f) Bus-wiring and Schemes involving the interrelationship of a group of panels of any one switchboard shall be checked between each other for correct operation (i.e. auto-changeover).
- (g) Functionality of earthing arrangements shall be checked

12.3 Check of Panels and Connections

A physical examination of each panel shall be made to ensure that all wiring, positioning of equipment, fuse ratings and labels are in accordance with the wiring diagram and general arrangement drawings and that all relay ratings are appropriate.

All electrical connections shall be proved for mechanical integrity, e.g. terminal tightness, shrouding etc. The panels, relays and control modules shall be visually inspected to ensure freedom from debris and mechanical damage.

The following shall also be checked by the Supplier:-

- (a) Wiring identification including ferruling.
- (b) Electrical Location and Polarity of fuses, links and auxiliary components.
- (c) Component values, e.g. resistor values.
- (d) Terminations fit for purpose, e.g. current rating, spring loaded where applicable.

12.4 Phasing Out Tests

All construction work shall be phased out by Electricity North West staff, as required in accordance with the Electricity North West Distribution Safety Rules and CP606.

All Suppliers' phasing out devices, such as IVIS, VDS, or neon indicators, shall be tested by the switchgear Supplier before use as part of the on-site testing.

12.5 HV Tests

The following High Voltage (HV) Tests shall be completed on site by the Supplier:-

- (a) Each group of busbars shall have an HV pressure test completed between each phase and to earth.
- (b) All circuit breakers shall have an HV pressure test completed between phases, across the contacts and to earth.
- (c) All ct chambers shall have an HV pressure test completed between phases, across the contacts and to earth.
- (d) IR checks of the primary circuit shall be completed before and after any HV tests. A 5kV test device shall be used,
- (e) All results will be recorded on the manufacturers approved documents and submitted to Electricity North West.

- (f) Parts of the equipment that have external primary connections made off shall not be included in the HV test.

12.5.1. HV Tests of any IVIS, VDS or VPIS type voltage/phase indication devices.

Tests by the Supplier shall include:-

- (a) The strike voltage of the device.
- (b) The secondary terminal voltage of the device at system associated system voltage level.
- (c) The proving of phasing between each device and between adjacent CBs (switchgear bays) using the testing/phasing device supplied by the manufacturer.

12.5.2 HV Tests of any Voltage Transformers:

Tests by the Supplier shall include:-

- (a) Primary / Secondary Ratio check of the device at the associated system voltage level.
- (b) Tertiary Winding Ratio check of the device at the associated system voltage level.

12.5.3 Current Transformer (CT) Magnetisation Curve Tests.

The Suppliers CT Magnetisation Curve Bench and Factory Test Results shall be supplied to Electricity North West as part of the On-Site Tests.

13. Documents Referenced

DOCUMENTS REFERENCED	
Environmental Protection Act 1990	
Special Waste Regulations 1996	
Waste Management Licensing Regulations 1994	
BS EN 50181	Specification Plug-in type bushings above 1kV up to 52kV and from 250A to 5,50kA for equipment other than liquid filled transformers.
BS EN 60044-1	Instrument Transformers

BS7215	Specification of Separable Insulated Cable Connector Systems above 11kV and up to 36kV
BS1129	Specification for Portable Timber Ladders, Steps, Trestles and Lightweight Stagings
BS7626	Specification for Current Transformers
BS381C	Specification for Colours for Identification, Coding and Special Purposes
ENA ER S15	Standard Schematic Diagrams
ENA TS 09-6	Auxiliary Multicore and Multipair Cables
ENA TS 35-17	Class X Current Transformers
ENA TS 41-26	Distribution Switchgear for Service up to 36kV (cable connected)
ENA TS 41-36	Distribution Switchgear for Service up to 36kV (cable and overhead conductor connected)
ENA TS 50-18	Design and Application of Ancillary Electrical Equipment
ES001	Electricity North West Limited Main Specifications.
ES336	Interposing Transformers for Telecontrol Current and Voltage Measurement
ES337	Specification for 19" Rack Control and Relay Panels for Use in BSP and Primary Substations
ES396	Protection in Primary Substations
ES501	Metering Current and Voltage Transformers

14 Keywords

6.6kV; 11kV; CT; Indoor; Switchgear; Protection; VT

Appendix A – Requirements and General Particulars

1. [Schedule A](#) lists Electricity North West ' requirements for multi-circuit 6.6kV and 11kV retrofit circuit breakers and associated housings at primary and distribution substations.
2. [Schedules B, C, E and F](#) will be completed for each substation required.
3. The equipment listed includes provision for supervisory control.
4. The Electricity North West system is normally earthed at the supply point through two neutral earthing resistors, each rated at 1000A, but provision is made for the installation of a third incoming transformer and its associated neutral resistor.
5. For the purpose of this specification, the availability of a nominal 110 Volt battery and a 240 Volt single-phase ac supply may be assumed as standard. The supplies to the switchgear will be at the bus-section unit and provided under a separate contract.
6. Where channel foundations are supplied, these shall cater for the ultimate capacity of the switchhouse, which will be stated on the general particulars of the enquiry.
7. Where the secondary connections are broken when the circuit breaker is isolated, jumper connections shall be provided for completing these connections to permit testing.
8. The address to which the equipment shall be delivered will be given on the purchase order.
9. In addition to or in place of any other indications:
 - Phase colour indication (L1, L2 and L3) shall be provided.
 - Manual trip and close buttons shall be labelled “trip” and “close”.
 - SF₆ gas pressure gauges shall be labelled for the section of busbar or circuit breaker to which they relate.
10. Non-isolatable switchgear shall be supplied with a means for phasing out approved by the Electricity North West Plant Policy Manager.
11. Test shutters/covers shall be fully interlocked. Fully interlocked means that
 - The shutters/covers cannot be opened/removed unless the circuit is earthed, and
 - When the shutters/covers are opened/removed the circuit cannot be re-energised
 - It shall be possible to remove the earth for circuit testing.

When the test access is NOT at the front of the switchgear a physical indication adjacent to the shutters/covers shall be provided to show that the circuit is earthed, and a mechanical/ electromechanical interlock or linkage shall be provided which enables an operator to be sure that the correct access has been opened. A physical indication shall also be provided on the front of the switchgear to show that the test access is open. If either of these indicating devices are lamps, a lamp test facility shall also be provided.

When using lamps consideration shall be given to the drain on power supplies and the proposed scheme shall be submitted for Approval by the Policy and Standards Manager.

SCHEDULE A - GENERAL REQUIREMENTS

1.	Substation name		
2.	System Voltage	kV	
3.	Short circuit rating (minimum)	kA	
4.	Number of units		
5.	Operating mechanism		Refer to Clause 9.3
6.	Shunt trip coil		110V dc
7.	Spring release coil		110V dc
8.	Busbar rating	A	
9.	(a) Number of feeder units		
	(b) Current rating	A	
10.	(a) Number of incoming transformer or incoming feeder/transformer units		
	(b) Current rating	A	
11.	(a) Number of bus-section units		
	(b) Current rating	A	
12.	(a) Number of skeleton units		
	(b) Current rating	A	
13.	(a) Number of Dummy Panels		
	(b) Current rating		
	(c) Width of Dummy Panel		200mm* / 300mm* / 500mm* / Bespoke*
14.	(a) Number of Plinths Required		
	(b) Height of Plinth Required		200mm* / 500mm*
15.	(a) Number of Busbar Trunking Required		
	(b) Current rating		
16.	Foundations to accommodate expected number of units		
17.	Date for delivery to site		
18.	Date for completion of erection		
19.	Date for commissioning		

*Delete as required. Bespoke length to be specified. Subject to Approval.

**SCHEDULE B - PROJECT SPECIFIC INFORMATION - to be completed by
Electricity North West for each order.**

Substation	
Panel No	
Circuit Title	

Switchgear	
To Specification	Electricity North West ES359
Type	
Busbar Rated Normal Current	
Circuit Rated Normal Current	
Mechanism	Refer to Clause 8.6
Spring Charging Motor	
Multicore Terminations	In multicore box at rear of switch unit

Protection		
<u>Current Transformers</u>		
<u>Purpose</u>	<u>Ratio</u>	<u>Class</u>

<u>Relays</u> All relays to be approved by Electricity North West	
1 - OC/EF	
1 - Sensitive Earth Fault with additional telecontrol facilities (Unless integral with OC/EF relay)	
1 - Earth Fault Alarm (unless integral with OC/EF relay)	
Trip circuit supervision	

Control Wiring

Wiring on switch unit to be to following Electricity North West standard schematic diagrams:

AC Circuits		900420/010
DC Circuits	Vacuum	900420/008

Auxiliary switches as Clause 8.10.2 in ES313.

Cabling

Cable boxes	Air
No and size of cables	
Cable glands to be provided	Yes/No

SCHEDULE E - RETROFIT CIRCUIT BREAKER AND ASSOCIATED HOUSING DOCUMENT SCHEDULE

Drawings	With Tender	Preliminary. Number of Weeks after Order.	Final. Number of Weeks after Order.
Switchboard General Arrangement – Project Specific Dimensioned board layout including details of the operating mechanisms and front mimic diagrams.	Typical.	-	12
Civil Interface Drawing – Project Specific Fully dimensioned plan and side elevation of switchgear showing – <i>Alignment profiles and floor openings</i> <i>Fixing points and details</i> <i>Weights and loads</i> <i>Floor tolerances</i> <i>Minimum clearances</i>	Typical	-	12
Panel Internal and External General Arrangement / Layout. <i>Showing –</i> <i>Relay types, sizes and locations</i> <i>Door cut outs</i> <i>Terminal blocks</i> <i>Resistors and Metrosils</i> <i>Switches</i> <i>Indicating lamps</i>	Transformer Incomer to be provided with Tender.	-	12
AC and DC Schematics / Circuit Diagrams.	Transformer Incomer to be provided with Tender.	12	16
Wiring Diagrams <i>With enough information to allow point to point wiring checks to be carried out.</i>	Typical	12	16
Buswiring Diagram.	Typical	-	16
CT Mag Curves	-	-	20
Erection & Commissioning and Operation & Maintenance Manuals	Typical	-	20

General Notes

- 1) The above list is not exhaustive; the contractor (switchgear manufacturer) shall provide all drawings and information that is required to fully understand the switchboard design.
- 2) The above dates include 2 weeks for Electricity North West to comment on and approve drawings.
- 3) Common cubicle numbering system to be used on all drawings. Refer to Electricity North West' key line diagram for cubicle numbers.

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, although in exceptional circumstances 1 to 33 may be acceptable, subject to prior agreement.
- (b) Drawings shall be monochrome black line on white paper, at least ISO A3 and not exceeding ISO A0 in size, with a clear margin on each edge of at least 25 mm. Multi-page drawing booklets are not acceptable.
- (c) Drawings shall be submitted for approval by the Purchaser on paper in duplicate (2 sets of A3 or full size as required.). They shall also be accompanied by equivalent AutoCad .dwg format (rev 14) files on E-Mail as appropriate.
- (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.
- (e) The drawings shall contain the Electricity North West' title block which will be provided at the contract stage.

SCHEDULE F - RETROFIT CIRCUIT BREAKER ONLY DOCUMENT SCHEDULE

Drawings	With Tender	Preliminary. Number of Weeks after Order.	Final. Number of Weeks after Order.
Retrofit CB Truck General Arrangement – Project Specific Dimensioned board layout including details of the operating mechanisms and front mimic diagrams.	Typical.	4	12
Retrofit CB Truck AC and DC Schematics / Circuit Diagrams.	Transformer Incomer to be provided with Tender.	4	12
Retrofit CB Truck Wiring Diagrams <i>With enough information to allow point to point wiring checks to be carried out.</i>	Typical	4	12
Retrofit CB Truck Erection & Commissioning and Operation & Maintenance Manuals	Typical	-	12

General Notes

- 1) The above list is not exhaustive; the contractor (switchgear manufacturer) shall provide all drawings and information that is required to fully understand the switchboard design.
- 2) The above dates include 2 weeks for Electricity North West to comment on and approve drawings.
- 3) Common cubicle numbering system to be used on all drawings. Refer to Electricity North West' key line diagram for cubicle numbers.

Appendix B – Conformance Declaration

SECTION-BY-SECTION CONFORMANCE WITH SPECIFICATION

The Tenderer shall declare conformance or otherwise for each product/service or range of products/services, section-by-section, using the following 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:

Name:

Company:

Signature:

SECTION-BY-SECTION CONFORMANCE

Section	Section Topic	Conformance Declaration Code	Remarks * (must be completed if code is not C1)
3	Standards		
4.1	Product not to be Changed		
4.2	Electricity North West Technical Approval		
4.3	Quality Assurance		
4.4	Formulation		
4.5	Identification Markings		
4.6	Minimum Life Expectancy		
4.7	Product Conformity		
4.8	Confirmation of Conformance		
5.1	Requirements for Type Tests at the Supplier's Premises		
5.2	Requirement for Routine Tests at the Supplier's Premises		
5.3	Requirements for On-Site Tests		
6	General Design Features		
6.1	Handling of Gasses Used and Decontamination Procedures		
6.2	Internal Arc Tested Equipment		
7.1	Extent of Contract		

Section	Section Topic	Conformance Declaration Code	Remarks * (must be completed if code is not C1)
7.2	Site and Delivery		
7.3	Time for Completion		
7.4	Work to be Executed at Site		
7.5	Manufacturer		
7.6	Drawings and Maintenance Instructions		
7.7	Spare Parts and Tools		
7.8.1	Works Inspections		
7.8.2	Relay Testing		
7.9	Disposal of Switchgear and/or its components		
7.10	Manual Handling		
7.11	Failure, Modes, Effect and Cause Analysis		
8.1	General Requirements		
8.2	System Earthing		
8.3	Common Ratings		
8.4	Standard CT Ratios		
9.1	Interface Design		
9.2	Rules for Interchangeability		
9.3.1	Dependent Power		
9.3.2	Stored Energy		

Section	Section Topic	Conformance Declaration Code	Remarks * (must be completed if code is not C1)
9.4	Trip Circuit Supervision		
9.5	Circuit Breaker Healthy Indication		
9.6	Provision of Auto Trip Alarm		
9.7	Electrical Endurance		
9.8	Isolating Features for Secondary Circuits (withdrawable circuit breakers)		
9.9	Gas		
9.10	Auxiliary Supplies		
9.11	Earthing		
10.1	Cable Terminations		
10.2.1	Current Transformers – General		
10.2.2	Accommodation and Earthing		
10.3	Voltage Transformers		
10.4.1	Auxiliary Switches		
10.4.2	Standard Provision of Auxiliary Switches in Primary Substations		
10.4.3	Small Wiring		
10.5	Circuit Diagrams		
11.1.1	Relays – General		

Section	Section Topic	Conformance Declaration Code	Remarks * (must be completed if code is not C1)
11.1.2	Sensitive Earth Fault Relays		
11.1.3	Relays for Directional Protection		
11.1.4	Unit Protection Relays		
11.1.5	Feeder Earth Fault Relays		
11.2	Secondary Wiring Disconnection		
11.3	Auto-reclosing		
11.4.1	Trip Circuit Supervision – Scheme Required		
11.4.2	Trip Circuit Supervision – Label		
11.5	Control Scheme		
11.6	Selector Switches		
11.7	Circuit Breaker Interlocks		
11.8	Multicore Cables		
11.9	Foundation Arrangements		
11.10	Platforms and Ladders		
11.11.1	Lifting and Handling Facilities – General		
11.11.2	Additional Equipment – Withdrawable Circuit Breakers		
11.11.3	Voltage Transformers		
11.11.4	Transport		

Section	Section Topic	Conformance Declaration Code	Remarks * (must be completed if code is not C1)
11.12	Telecontrol		
11.13.1	Busbar Trunking		
11.13.2	Dummy Panels		
Appendix A	Requirements and General Particulars		
Schedule A	General Requirements		
Schedule C	Time for Completion		
Schedule D	List of Sub-Contractors		
Schedule E	Retrofit Circuit Breaker and Associated Housing Document Schedule		
Schedule F	Retrofit Circuit Breaker Only Document Schedule		

* Applicable specifications shall be stated in the Remarks column where alternatives are quoted within a section. The Remarks column shall also be used to indicate cases where the products or services exceed the quoted specifications.

Additional Notes: