

**SPECIFICATION FOR 11 kV CIRCUIT BREAKER EQUIPMENT**

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## **SPECIFICATION FOR 11 kV CIRCUIT BREAKER EQUIPMENT**

### **1.0 GENERAL**

This section of the specification describes and specifies requirements of the supply, installation, testing, commissioning, handing over in approved working order and maintenance during the Defects Liability Period of the 11 kV circuit breaker equipment all in accordance with the specification, supplementary notes, Bill of Quantities, Conditions of Contract, Drawings, etc.

### **2.0 STANDARDS AND APPROVAL**

The switchgear equipment shall comply with the latest relevant British Standard Specification or IEC Recommendations and shall be of the type approved by JKR.

If the Tenderer offers equipment which conforms to standards/recomendations other than those published by the British Standards Institution or the IEC, full details of the difference between the proposed standard and the equivalent British Standard or IEC Recommendation, in so far as they affect the design and performance of the equipment, shall be submitted with the Tender.

### **3.0 TECHNICAL PARTICULARS AND GUARANTEES**

Tenderers shall submit at the time of tendering detailed Technical Particulars and Guarantees in respect of the equipmnet offered, which shall be binding. No departure from these Technical Particulars and Guarantees will be permitted except with the written approval of the S.O.'s Representative. Not withstanding any description, drawings, illustrations or pamphlets which may be submitted with the Tender, all details other than those stated by the Tenderer in the Schedule of Departures from Specification, at the time of tendering, will be deemed to be in full conformity with the Specification.

The Electrical Contractor shall guarantee the equipment to be supplied under this Contract agaainst faulty design, materials

and workmanship at the manufacturer's works within the Defects Liability Period.

#### 4.0 SWITCHGEAR EQUIPMENT

The switchgear equipment shall be suitable for service on an electrical power system of 11kV, 3-phase, 50 Hz. They shall be fully tropicalised and suitable for continuous operation at an ambient temperature up to 40 Degree Celsius, relative humidity up to 100% and at altitude up to 1000 metres above sea level. The equipment shall be of the single busbar, metalclad, floor mounting, indoor type with horizontal isolation and horizontal drawout features having air insulated busbar, current transformer and voltage transformer chambers. The equipment shall be fully extensible both to the left and right such that it is possible to couple individual units of circuit breaker together to form switchboard of different number of circuit breakers.

The equipment shall have fully interlocked fool proof operation system, provided with pressure relief flap and designed to prevent accidental contact with live parts such that the equipment will provide the highest degree of protection for personnel and totally safe for operation. The equipment shall also be designed to prevent ingress of vermin and to minimise the ingress of dust and dirt. Materials which may be liable to attack by termites and other insects should not be used. The switchgear equipment covered by this specification shall be suitable for:-

##### A. Feeder Circuit:

Type A1 - with non-directional overcurrent and earth fault protection using IDMT relay.

Type A2 - with differential pilot wire protection using Translay relay, without back up protection.

Type A3 - with differential pilot wire protection using Translay relay with back up overcurrent and earth fault protection using IDMT relay.

**B. Transformer Circuit:**

Type B1 - with non-directional overcurrent and earth fault protection using IDMT relay.

**C. Bus Section:**

Type C1 - non-automatic, i.e. no protection relays involved.

**4.1 TYPES OF SWITCHGEAR**

This specification covers the following types of switchgears:-

- (a) Vacuum Circuit Breaker.
- (b) SF6 Circuit Breaker.

The type of switchgear required shall be as specified in the Bill of Quantities and/or Drawings.

**4.2 RATING OF SWITCHGEAR.**

The switchgear equipment shall be suitable for continuous operation on a 11 kV, 3-phase, 50 Hz, neutral earthed electrical system with fault level up to 350 KVA. The impulse withstand level, on 1.2/50 micro second, shall not be less than 75 kV peak.

The various components of the switchgear equipment shall have the following rating:-

**(i) Fix Portion**

- (a) Rated voltage : 12 kV.
- (b) Continuous normal current rating : 630A.
- (c) Short time rating : 18.4 kA r.m.s at 11 kV

**(ii) Circuit Breaker**

- (a) Rated voltage : 12 kV.
- (b) Continuous normal current rating : 630A.
- (c) Making Capacity : 46.9 kA peak at 11 KV
- (d) Breaking Capacity : 18.4 kA r.m.s. at 11 kV
- (e) Short time rating : 18.4 kA r.m.s at 11 kV

(iii) **Earth Switch**

- (a) Rated voltage : 12 kV.
- (b) Making Capacity : 46.9 kA peak at 11kV
- (c) Short time rating : 18.4 kA r.m.s at 11 kV

(iv) **Circuit Breaker**

- (a) Rated voltage : 12 kV.
- (b) Continuous normal current rating : 630A.
- (c) Short time rating : 18.4 kA r.m.s at 11 kV

An ASTA or KEMA or PHELA type test certificate shall be submitted with the Tender.

**4.3 BUSBARS**

Busbars shall be totally enclosed air insulated type. They shall be made of high conductivity hard drawn copper bars shrouded with a tight fitting PVC sleeving or epoxy resin.

Except for those associated with the bus section panels, all busbars for circuit breaker shall be of a standard unit length with provision for mounting on a panel basis at the busbar orifice tee off connectors.

**4.4 STATIONARY PORTION**

The stationary cubicle portion of the switchgear equipment shall comprise a fabricated steel structure with sheet steel cladding of rigid construction and shall withstand repeatedly without distortion shocks caused by closing and opening impacts under all conditions.

Each cubicle shall be fully compartmentalised into circuit breaker, busbar, cable, relay and metering chambers. There shall be no vertical partitioning in the air insulated busbar chamber. Each cubicle shall be fitted with a flap to relieve any pressure which might built up due to an internal fault.

The fixed isolating contacts shall be insulated and shrouded by resin mouldings. Provision shall be made at the rear of the panel to run a continuous earth bar to earth frames of all panels of a switchboard.

**4.5 SAFETY SHUTTERS**

Main plugging contact apertures shall be fitted with fully automatic metal safety shutters arranged to close the apertures and access to live parts when the circuit breaker truck is withdrawn and to open when the circuit breaker is being plugged in. The shutters shall form reasonably dust, drip, fire and insect proof covers over the apertures and shall be arranged in two sets, one to cover the busbar spout apertures and the other to cover the circuit spout apertures, normally opening and closing simultaneously. Means shall be provided to uncouple each set from the mechanism and to lock in the closed position with padlocks. The safety shutters shall be so designed as to facilitate the insertion of test plugs, when necessary.

Busbar and circuit shutters shall be painted and boldly labelled 'BUSBAR' and 'CIRCUIT' respectively.

#### 4.6 **HEATERS**

In view of the extreme tropical and humid climatic conditions under which the equipment are required to operate, suitable low temperature anti-condensation heater rated at 240 V a.c. shall be provided in each circuit breaker panel together with a protective fuse as necessary. The heater shall be so mounted as to prevent moisture condensation within the busbar chamber, current transformer chamber, busbar and feeder spouts etc., and yet not cause any undue overheating of the cables, cable termination, busbars, current transformers etc. Wiring from nearby LV board to the switchgear panel for the heater shall be carried out by the Electrical Contractor.

#### 4.7 **CIRCUIT BREAKER TRUCK**

The moving truck portion of the circuit breaker equipment shall be of steel construction, rigid and designed to resist tension and to withstand the shocks under fault conditions. It shall accommodate the circuit breaker, operating mechanism, auxillary switches, main and auxillary plugging contacts etc.

The truck shall be equiped with suitable wheels for movement on normal floor surfaces and are also to act as guides in conjunction with suitable allignment rails, pins and sockets to ensure correct and accurate engagement of the plug and socket contacts.

The circuit breaker truck shall be able to be pushed in until it comes to a stop, with the moving isolating contacts still sufficiently far from the fixed contact to avoid discharge. The last few centimetres of travel to contact touch and on to fully plugged in position shall be controlled by a detachable handle or other means. A suitable form of manually operated drawout isolation shall be provided with mechanical interlocks to prevent the circuit breaker from being moved into or out of the fully plugged in position with the circuit breaker in the closed position and to prevent closing of the circuit breaker unless it is in the fully plug in or fully isolated positions.

Means shall be provided for locking the truck in the fully plugged in position with padlocks.

Means shall also be provided for the efficient earthing of the truck portion to the stationary cubicle when the truck is fully plugged in.

#### 4.8 **MECHANICAL INTERLOCK**

A fully complement of mechanical interlocks shall be provided to prevent the following:-

- (a) The circuit breaker being withdrawn from or inserted into the isolating contacts when it is closed (attempted isolation shall not trip a closed circuit breaker).
- (b) The circuit breaker being closed unless correctly located in the service or isolated positions or unless the circuit breaker is fully withdrawn from the stationary portion of the switchgear equipment.
- (c) The moving portion being withdrawn or replaced unless the circuit breaker is fully isolated and in the appropriate position for withdrawal or replacement.
- (d) The circuit breaker being closed in the service position without completing the auxillary circuits between the fixed and moving positions.
- (e) The auxillary circuits plug and socket been uncoupled when the circuit breaker is in the service position.



- (f) The earthing switch being closed when the circuit breaker is in the service position or between the service and isolated position.
- (g) The circuit breaker being inserted into the service positions with the earthing switch closed.
- (h) Access to the HV fuse orifices of the voltage transformer unless the voltage transformer is isolated.

All manually operated mechanical interlocks shall be clearly labelled to indicate their respective functions. Means shall be provided for padlocking to effect the above mechanical interlocking systems.

#### 4.9 **CIRCUIT BREAKER**

The circuit breaker shall be of either:-

- (a) SF6 type with the interrupter contacts housed in a sealed module filled with sulphur hexafluoride (SF6) gas.
- or
- (b) Vacuum type with the interrupter contacts housed in a sealed vacuum cylinder.

The SF6 circuit breaker shall use SF6 gas as an insulating, arc cooling and extinguishing medium. The enclosure module shall be of cast epoxy resin and able to withstand internal pressure caused by switching. A pressure relief device shall be fitted to allow safe discharge of gas in case of abnormal pressure raise. The module shall be designed with minimum number of seal and with the gas pressure within the chamber slightly higher than the atmospheric pressure so as to minimize the risk of leakage. Each SF6 circuit breaker shall be fitted with a pressure sensor which will caused the circuit breaker to trip when the gas pressure in the chamber falls below a level recommended by the manufacturer. A visual inidication shall be provided when the SF6 circuit breaker trip on low gas pressure. However, the SF6 circuit breaker shall be able to operate safely under normal condition even at atmospheric pressure.

The interrupter of the vacuum circuit breaker shall consist of a sealed cylindrical insulating glass/ceramic enclosure containing the fixed and moving contacts, condensation metal shields and metal bellows. The alloy materials used for the

interrupter contact surfaces shall represent the best choice from an arc stability point of view and when combined with the system or magnetis arc control, produces low arc energy and minimum contact wear. The interrupter shall be mounted in epoxy resin monobloc or monoblocs and on a movable truck to form a robust assembly.

Each circuit breaker shall be provided with a suitable mechanically operated 'OPEN' 'CLOSED' (alternatively 'OFF' and 'ON') indicating device, conspicuously positioned and clearly visible. The indicating device shall be positively driven in both directions so as to show whether the circuit breaker is open or closed in the service or isolated positions.

The circuit breaker main plugging contacts shall be self aligning type and shall be mounted on cast resin bushings incorporating stress controlled condenser layer. The secondary connection between the fixed and moving portion shall preferably be made of self-aligning plugs and sockets.

All circuit breaker of identical rating shall be fully interchangeable with one another.

#### 4.10 **OPERATING MECHANISM**

Circuit breaker mechanism shall be the trip free type and shall be robust enough to withstand the forces produced under such conditions. Unless otherwise specified, each circuit breaker shall be fitted with a spring operated, power closing mechanism for closing the circuit breaker by means of energy which has previously been stored in by hand charged, with direct mechanical release and having the following requirements:-

- (a) It shall not be possible under any circumstances for the circuit breaker to close while the spring is being charged.
- (b) It shall be necessary for the spring to be fully charged before it can be released to close the circuit breaker.
- (c) The circuit breaker shall always open at normal speed even if the mechanism fails to latch on closing.
- (d) It shall be possible to charge the spring when the circuit breaker is closed, thus allowing the circuit breaker to be reclosed immediately it opens. While the spring is thus charged, it shall be possible to release the spring either mechanically or electrically without

opening the circuit breaker.

- (e) A visual mechanical indicating device shall be provided to indicate include the state of the spring.

Manual tripping shall be effected by a push button. An operation counter shall be provided to register the number of switching operation.

#### 4.11 **AUXILARY CONTACTS**

All auxillary contacts shall be positively driven in both directions. They shall be mounted so as be readily accessible for maintenance and shall be designed to facilitate inspection, cleaning and adjustment.

Unless otherwise specified each breaker shall be fitted with a minimum of four auxillary contacts, two normally open and two normally closed. All auxillary contacts shall be wired to appropriate terminal boards, whether or not these are used in the first instance.

#### 4.12 **SECONDARY ISOLATING CONTACTS**

The secondary wiring shall be carried from the mechanism, via a flexible tube, through secondary isolating contacts, into the bottom of the instrument chamber. The isolating sockets shall be contained in moulded blocks fastened to the bottom of the instrument chamber. The isolating plugs shall be contained in a detachable plug box tray fastened to the mechanism. With the breaker in its isolated position, it shall be possible to plug the plug tray into the sockets at the bottom of the instrument chamber, thus allowing checking of secondary circuits without having the circuit breaker in service.

#### 4.13 **EARTHING DEVICE**

Unless otherwise specified, an integral earthing switch of the quick make type shall be provided for earthing the circuit side of the switchgear equipment.

The earthing switch shall be located in the cable compartment and shall be operated from the front of the switchgear cubicle. This earthing switch shall be able to close against the rated short circuit current and shall have only two

positions, open or closed. Means shall be provided to enable the earthing switch to be locked in both positions with padlocks. The position of integral switch shall be clearly visible from the front of the switchgear cubicle.

Mechanical interlocks shall be provided to prevent:-

- (a) Closing the earthing switch when the circuit breaker is in the stationary portion of the switchgear equipment.
- (b) Inserting the circuit breaker into or withdrawing the circuit breaker from the stationary portion of the switchgear equipment when the earthing switch is closed.

In case the switchgear equipment offered cannot comply with the above requirements, the tenderer may, at the time of tendering, submit alternative offer. In which case, the tenderer shall clearly indicate the deviations and provide full technical particulars of the alternative offer.

#### 4.14 **CURRENT TRANSFORMERS**

Current transformers shall comply with the requirements of BS 3938 or IEC 185 and shall have short circuit ratings not less than that of the associated switchgear. They shall be capable of carrying the rated primary current for a period of one minute with the secondary open circuited as specified in BS 3938.

The rating of current transformers shall be as stated in the Drawings. Unless otherwise specified, the output and class of accuracy for protection current transformers shall be 15 VA, Class 10P10 for metering current transformers shall be 15 VA Class 0.5.

Each current transformers shall be provided with an identifying label giving its type reference, ratio, output, class accuracy, voltage rating and serial number. The label shall be fixed to current transformer in such a position so that the details of the label can be easily visible.

The secondary windings of current transformers shall be wired to suitable terminal boards and earthed at one point in the circuit.

Switchgear equipment for circuits type A1, A2 and B1 shall be fitted with one protection current transformer per phase, and in addition to the protective relay element, the yellow phase current transformer shall also cater for the panel ammeter instrumentation. In the case of switchgear equipment for circuits type A3, two separate current transformers shall be

provided in each phase, one for Translay pilot wire feeder protection and the other for back up overcurrent and earth fault protection and also for panel ammeter instrumentation in the yellow phase.

In addition to the protection current transformers mentioned above, a current transformers shall be provided on each of the two outer phases of each incoming feeders for KWH and KVARH metering. The Electrical Contractor shall supply and install the metering panel for HV metering by TNB/Supply Authority. The panel shall be fabricated to suit TNB/Supply Authority's requirements.

Cabling from the switchgear panel to the metering panel and other associated accessories as required shall also be supplied and installed by the Electrical Contractor.

#### 4.15 **VOLTAGE TRANSFORMERS**

Voltage transformers, if specified in the Drawings, shall be of 3-phase, 3 limb, star-star, disconnectable type having a ratio of 11,000/110 volts complying with BS 3941 or IEC 186. They shall be of cast epoxy resin filled type suitable for installation in the switchgear equipment.

The connection between the main circuit and voltage transformer shall be capable of carrying the rated short time current of the switchgear equipment.

The primary windings shall be connected through suitable HRC fuses to the circuit side of the transformers remote from the busbars or, when specified otherwise, to the busbars.

The secondary windings shall be connected through fuses to the appropriate circuits and labelled to indicate their respective functions and phase colours.

The voltage transformers shall be capable of being padlocked in the isolated position. Safety shutters normally closed and positively driven by the voltage transformers isolating switch shall open to enable the fuses to be replaced when the transformers are in isolated position and shall shield the access to the voltage transformers HV fuses as soon as the isolating switch is closed.

When voltage transformers is specified to be connected to the busbar side, the voltage transformers assembly shall be clearly

and conspicuously sign painted on the outside with the inscription 'BUSBAR VT'.

Unless otherwise specified the voltage transformers shall be 100 VA class 1.0 .

#### 4.16 **INSTRUMENT AND METERS**

All electrical measurement/indication instrument and meters shall comply with BS 89 and shall be of accuracy class 1.5, unless otherwise specified.

Each switchgear panel, except bus section panel, shall be equipped with an ammeter complete with maximum demand indicator and connected to the protection current transformer in the yellow phase.

Additionally, when any panel is fitted with a volatage transformer, it shall also be equipped with a voltmeter.

All ammeters and voltmeters shall be of flush mounted type. They shall be of moving iron spring acontrolled pattern with deadbeat type movement and provided with a readily accessible zero adjustment.

Instrument dials in general shall be white with black markings and shall reversible in the case of double sealed instruments. The seals shall be of such materials that no peelings or dicolouration will take place with age. Voltmeters shall be scaled 0 - 15 kV. Ammeters shall be scale commensurate with the current transformers ratio as specified.

All other instruments shall be provided in accordance with the Drawings.

#### 4.17 **PROTECTIVE RELAYS.**

Relays shall be draw out types complying with BS142 or equivalent with approved characteristics and shall be flush mounted in drawout type dust proof cases.

Relay contacts shall be of the self resetting type and shall be adequately rated. They shall make firmly witout bounce and the whole of the relay mechanism shall , as far as possible, be unaffected by vibration or external magnetic fields.

Relays shall be provided with coloured flag indicators of the hand reset pattern capable of being reset without opening the case. In the case of multi-element relays, separate flag indicators shall be provided for each element, appropriately phase coloured.

Relays with provision for manual operation from outside the case, other than for resetting the flag indicators, will not be accepted. They shall be provided with clearly inscribed labels describing their application and rating.

To minimise the effect of electrolysis, relay coils shall be so connected that the coils are not continuously energised from the positive pole of the d.c, auxillary supply.

Each non-directional overcurrent and earth fault protective relay shall have a rated current of 5A and shall comprise of three induction disc, inverse definite minimum time lag in a common case. The overcurrent elements shall be provided with adjustable settings for both operating current and time, the adjustment being possible on load.

The range of current settings for overcurrent elements shall be from 50 to 200% of rated full load with tapings at 25% intervals and the time setting adjustment shall be 0 to 3 seconds at 10 times the normal operating current. The earth fault elements shall comply with the foregoing but shall have a range of current settings from 10 to 40% with tapings at 5% intervals.

In the case of switchgear equipment for circuits Type, The approved pilot wire feeder differential protection relay shall be 5A single element relay type arranged to give phase fault and earth fault protection.

In addition to the relays being acceptable to the S.O.'s Representative, the Electrical Contractor shall also ensure that they are approved by TNB for the installation under this Contract.

#### 4.18 **SMALL WIRING**

All small wiring shall be effected with single core black coloured PVC insulated 7/0.67 mm plain annealed copper conductor cables to BS 6231.

Wires connected to stud type terminals shall be terminated with claw washers, one for each individual wire. No wire may be teed or jointed between terminal points. All wires shall have numbered ferrules at both ends in accordance with the wiring and connection diagrams. The ferrules shall be of insulating material and the characters shall be indelibly marked in black. Additional ferrules marked "TRIP" or "T" shall be fitted to the wires interconnecting the relay trip contacts and the shunt trip coils. All metallic cases of

instruments, relays etc. mounted on the panels, shall be connected by means of green PVC insulated plain annealed copper cables of not less than 4 sq. mm. section to the nearest earth bar. Where auxiliary wiring cleats are used to support insulated wires, these shall be of the insulated compression type.

#### 4.19 **TERMINAL BOARDS**

All terminal boards shall be mounted in accessible positions with provision for making the connections at the front of the terminal boards without exposing any live metal at the back. Where stud type terminal board are provided, the studs shall be fitted with washers, nuts and locknuts or lockwashers. Insulated barriers shall be fitted between adjacent terminal studs. 415/240V terminals shall be segregated from other terminals and shall be fitted with non-inflammable transparent plastic covers to prevent accidental contact. These shall have warning labels with red lettering mounted thereon in a conspicuous position. Where pinch type terminations are used, these shall be of the approved type such as 'Klippon' terminals.

#### 4.20 **FUSES AND ISOLATING LINKS**

A fuse and a link in the positive and negative poles respectively shall be provided on each unit to isolate the tripping circuit from the d.c. bus wires. These shall be of an approved type, the carriers and bases being coloured in accordance with the following code:

COLOUR				FUNCTION
Black	.....	.....	.....	5A fuse
Light Green	.....	.....	.....	15A fuse
White	.....	.....	.....	Isolating link.

All fuses and isolating links shall be appropriately labelled to indicate their respective functions.

#### 4.21 **AUXILIARY CABLE BOX**

Switchgear panels fitted with differential pilot wire feeder protection shall be equipped with a small auxiliary cable box together with a compression type gland at the rear end of the panels suitable for the termination of a 7 core PVC/PVC/SWA/PVC pilot cable leading to the corresponding relay at the TNB's/Supply Authority's end of the feeder. Likewise, equipment fitted with metering current and voltage



transformer shall also be fitted with a small auxilliary cable box with a compression type gland for connecting the current and voltage secondary leads to the remote metering equipment, using a 7 core PVC/PVC/SWA/PVC cable.

#### 4.22 **CABLE TERMINATION**

The cable termination shall be of dry type suitable for 11 KV 3 core PILCDSTAS cable to BS 6480 of conductor size up to 300 sq. mm. The termination shall be normally be for cable entering vertically from below. However, due to site conditions, a bottom angled entry or a vertical top entry may be required. In such case, the Electrical Contractor shall supply the appropriate termination accessories at no extra cost.

#### 5.0 **BATTERY AND BATTERY CHARGER.**

One 30V d.c. Ni-Cd battery tripping unit of sufficient AH capacity (5 hour rate) to trip minimum three circuit breakers at the same time shall be supplied and installed in each substation room by the Electrical Contractor. It shall be self-contained, floor standing steel cabinet type with automatic 2 rate (boost and trickle) charging feature and complete with isolator, d.c. milliammeter, d.c. ammeter, d.c. voltmeter, indicator light for 'Mains on', 'Trickle Charge', 'A.C. Failure' etc. Charge fail visual and audio alarm, alarm cancellation, reset facilities and protective fuses shall also be provided. Input voltage to the charger shall be 240V a.c. single phase via a 13A 3 pin switched socket outlet. Catalogue and technical details of the battery and calculation to prove the adequacy of the capacity of the battery shall be submitted together with the Tender.

#### 6.0 **EARTHING**

All metal parts of the switchgear equipment shall be interconnected and connected to the main earth bar running along the switchboard. The earth bars shall be of not less than 25 mm x 6 mm flat harddrawn copper. The earth bar shall be bolted to the main frame and located so as to provide convenient facilities for earthing cable sheaths and for use with earthing device. Means shall be provided for coupling earths bars of adjacent units. The joints shall be tinned and bolted. A similar earth bar shall run around the four walls of the switchroom at a height of 300 mm from the finished floor level. The earth bars shall be painted with an approved green enamel.

Earth electrodes shall be of copper jacketed steel core rods with 16 mm diameter and supplied in 2.4 m length and shall have provision for screw coupling with another standard length. The copper jacket shall be of minimum thickness 0.25 mm and shall be metallurgically bonded to the steel case to ensure that the copper jacket and steel core are not separable. The earth resistance of the HV switchboard earthing shall not exceed 1 Ohm. Where the desired earth resistance value cannot be achieved after the first set of earth electrodes have been driven, sufficient number of sets of earth electrodes shall be installed outside the resistance area until required value is reached. Each set of earth electrodes shall be provided with brass connecting clamp and approved type of precast heavy duty concrete inspection chamber with removable cover.

The earthing point shall be identified by permanent label legibly marked with the words "HV switchboard Earth" permanently fixed at the point of connection of every earthing conductor to an earth electrode.

#### 7.0 **PADLOCKS**

The Electrical Contractor shall supply two 40 mm padlocks of 'Yale' make or equivalent for every switchgear panel. All padlocks in the same substation shall be supplied with keys alike.

#### 8.0 **LABELLING**

Labels of size not less than 50 mm x 150 mm shall be fitted on the front of all switchgears by means of non-corrodable screws or any other method approved by the S.O.'s Representative. The labels shall be of black laminated plastic with engraved white lettering with details such as rating, over current setting, earth fault setting to which it is connected etc. The exact wording of the labels shall be agreed with the S.O.'s Representative.

#### 9.0 **PAINTING**

The switchgear equipment shall have one coat of primer, one undercoat and a final finishing coat of paint applied at the manufacturer's works. The final coat shall be of an oil resisting enamel paint.

#### 10.0 **INSPECTION, TESTING AND COMMISSIONING**

## 10.1 INSPECTION

The whole of the plant and equipment to be provided under the Tender may be subjected to inspection and test by the S.O.'s Representative in the factory prior to installation. The approval by the S.O.'s Representative of the results of any such inspection or test shall not prejudice the right of the Superintending Officer to reject the plant if it fails to comply with the specification when erected or to give complete satisfaction in service within the Defects Liability Period. The costs of all tests including the provision of the necessary test equipment shall be deemed to be included in the Tender Price.

Adequate notice shall be given when the plant is ready for inspection or test and every facility shall be provided by the Electrical Contractor to enable the S.O.'s Representative to carry out the necessary inspection and tests.

## 10.2 TESTING

On completion of the installation work on site, the Electrical Contractor shall, at his own expense, arrange for all necessary tests to be carried out on the equipment by either TNB or a Service Engineer approved by the Jabatan Bekalan Elektrik as part of the tests required of him for the whole installation under this Contract. The tests to be carried out shall be as prescribed in the relevant British Standards Code of Practice for High Voltage Switchgear, The IEE wiring Regulation 15th Edition, the Electricity (Board Supplies) Rules 1949 and other tests deemed necessary by the S.O.'s Representative. In the event the installation fails to pass any of these tests, The Electrical Contractor shall take such measures as are necessary to remedy the defects and the installation shall not be considered as completed until all such tests have been passed.

The tests to be carried out by the Electrical Contractor shall consist of the following tests as the minimum requirements:-

- (a) 200 V insulation resistance tests on the circuit breaker equipment, current transformers, voltage transformers etc.
- (b) 24 KV a.c. pressure test for 1.0 minute on the circuit breaker equipment and voltage transformers.
- (c) Magnetisation curve and ratio checks on current transformers.
- (d) Testing and setting of all relays.

- (e) Any other tests as recommended by the manufacturer and the supplier.

The S.O.'s Representative reserves the right to be present at all tests and the Electrical Contractor shall give at least one week notice in writing to the S.O.'s Representative for this purpose. In any case no test shall be carried out without prior approval of the S.O.'s representative. Copies of all the test certificates shall be submitted to the S.O.'s Representative within one week after the completion of the testing.

### 10.3 COMMISSIONING

On successful testing of the complete installation, the Electrical Contractor shall arrange to commission the equipment in the presence of the S.O.'s Representative on a date to be decided by the S.O.'s Representative.

### 11.0 REJECTION OF PLANT

Any item of plant or component which fails to comply with the requirements of the specification in any respect whatsoever at any stage of manufacture, test or erection or on completion at site within the Defects Liability Period of the contract may be rejected by the Superintending Officer either in whole or in part as he considers necessary. After adjustment or modification if so directed by the Superintending Officer, The Electrical Contractor shall submit the item for further inspection and/or tests. Plant or components with defects of such nature that, in the opinion of the Superintending Officer, the requirements of this specification cannot be fulfilled by adjustment or modification shall be replaced by the Electrical Contractor at his own expense and to the satisfaction of the Superintending Officer.

### 12.0 OTHER ITEMS TO BE SUBMITTED WITH THE TENDER

#### 12.1 MANUFACTURER'S CATALOGUE AND DRAWINGS

Manufacturer's catalogues and drawing giving detailed information on the general arrangement of the switchgear equipment, overall dimensions, general construction, position of cables, grouting bolts, loading on foundation, minimum clearance to rear end wall, trenching details, technical specification and other useful details shall be submitted together with the Tender.

**12.2 RECOMMENDED SPARES**

The Tenderer shall submit with his Tender separate Schedule of Spares recommended by the supplier of the equipment. This Schedule should contain the price and delivery period of each item of the spares recommended. The Tenderer shall also recommend the quantity of each item to be stored for the purpose of maintenance. The prices of these spares shall not be included in the total Tender Price and the purchase of all or any of the spares listed shall be at the option of the Superintending Officer. The prices quoted shall be valid for acceptance during Contract Period (extended if applicable) of the project.

All the spare parts shall be original and fully interchangeable with the corresponding part used in the main items of the equipment and with each other without having to resort to machining or additional fittings at site. All spares shall be finished, protected, packed and labelled in suitable manner to prevent deterioration during prolonged storage in tropical climate.

**13.0 WORKING DRAWINGS, INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS.**

**13.1 WORKING DRAWINGS**

Within two weeks after award of the Tender or such shorter period as may be required by the S.O.'s Representative, the Electrical Contractor shall submit to the S.O.'s Representative for his approval four sets of the details of the layout of the switchgear equipment in the switchroom provided. The drawings submitted are to be modified if necessary as requested by the S.O.'s Representative and resubmitted for final approval. It is to be understood, however, that approval of the drawing will not exonerate the Electrical Contractor from any responsibility in connection with the work.

**13.2 INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS**

As soon as the general arrangement and details of the equipment to be supplied have been finalised at and before the delivery of the equipment, the Electrical Contractor shall submit to the S.O.'s Representative two copies of detailed

installation, operation and maintenance instructions in respect of the equipment to be supplied. The instructions shall cover the main as well as any associated equipment. For this purpose, manufacturer's standard brochures will be acceptable provided that they refer particularly to the equipment to be supplied and are free from extraneous matter.

The instruction shall include essential details, drawings and sketches of the equipment installation, operation and maintenance techniques, make mention of special materials where used and include schedules of recommended lubricants etc. Each of the above two sets of manuals submitted shall be in a stiff cover ring file and with tittles to the satisfaction of the S.O.'s Representative. The cost of these manuals shall be deemed to be included in the Tender Price.

#### 14.0 **SWITCHROOM**

Approved type of rubber mat shall be provided in front of the switchgear panels. The rubber mat shall extend to the full length of the switchgear panels and shall be of thickness not less than 5 mm and width 1000 mm.

'BAHAYA' sign, 'DILARANG MASUK' sign, sign indicating 'Substation No: ' and shock treatment chart shall be installed to the requiremn of the Jabatan Bekalan Elektrik and to the satisfaction of the S.O.'s Representative. 'DILARANG MEROKOK' sign shall also be installed.

All trenches in the switchrooms shall be filled up with clean sand to a level above cable ducts.

As fitted layout plans, shematic wiring diagrams, and plans showing cable routes and positions of earthing point with reference to easily recognised buildings and structures shall be suitably framed up in the switchroom. These plans and diagrams shall be in addition to the four sets of prints required to be submitted to the S.O.'s Representative after completion of the project as stated in clause 16.0 below.

One 9 kg. dry powder fire extinguisher for A/B/C class of fire and complete with discharge hose, nozzle and wall bracket shall be supplied and installed in every switchroom.

#### 15.0 **SERVICE AND MAINTENANCE**

During the Defects Liability Period, The Electrical Contractor shall be responsible for trhe service and maintenance work for

the complete installation. All works shall be carried out by competent personnel. All labour, material, tools and parts necessary to rectify the defects due to manufacturing/installation faults shall be supplied/executed at the Electrical Contractor's cost.

The service and maintenance to be performed shall include but not be limited to the following:-

- (a) Replacing or making good all components of the switchgear equipment, fuses, wiring, battery, battery charger etc.
- (b) Replacing or making good all loose and burnt cables and terminations, all mechanical support and linkage, earth electrodes, earth electrode chambers and covers, conduits, trunking etc.
- (c) Making good any damage to roads, buildings drains, cables, pipes, concrete areas, paved areas etc. which had not been properly made good arising out of his work.
- (d) All other works as deemed necessary by the S.O.'s Representative.

All works shall be carried out as soon as the Electrical Contractor has been informed by the S.O.'s Representative or the Occupant and shall be completed within a reasonable time except under emergency situation as stipulated in the Electrical Works Additional General Conditions. If the Electrical Contractor fail to comply with the above requirement, the S.O.'s Representative reserves the right to engage another party to carry out the works, in which case, the Electrical Contractor shall be responsible for all the expenses incurred.

#### **16.0 AS INSTALLED DRAWINGS, MANUALS AND TOOLS**

The drawings, manuals, tools etc. as mentioned below shall be provided whether or not they are separately itemised in the Bill of Quantities of the Tender Document. The cost of all these drawings, manuals, tools etc is deemed to be included in the Tender Price.

#### **16.1 AS INSTALLED DRAWINGS**

Within three calendar months after the practical completion of the project, one set of true to scale negatives (155/165 gm/sq.cm ISO A0 or A1 size) and four sets of prints for each of the following drawings shall be submitted.

- (a) Site plan.
- (b) Schematic Wiring Diagrams and Electrical Layout Plans.
- (c) Layout Plans of cable routes and earthing points with reference to easily recognisable buildings and structures.

These drawings shall be properly stencilled and shall have at the lower right hand corner the Electrical Contractor's name and address, date of commissioning, scale, drawing number (the drawing number to be obtained from S.O.'s Representative), title and the following particulars:-

**JABATAN KERJA RAYA**  
**CAWANGAN ELEKTRIK**  
**CONTRACT NO:**  
**TENDER NO:**

If the drawings submitted are not acceptable by the S.O.'s Representative, the Electrical Contractor shall amend and re-submit the drawings within two weeks from the date of return of the drawings.

## 16.2 **MANUALS**

Four sets of the following manuals and documents of the switchgear equipment, battery and battery charger shall be supplied:

- (a) Installation manual.
- (b) Operation manual.
- (c) Service and Maintenance Manual.
- (d) Parts List.
- (e) Product data and catalogues.
- (f) Test Certificates.

The installation, operation, service and maintenance manuals shall be the same as those described in clause 13.2. Each of the four sets of drawings described in clause 16.1 and manuals, parts list etc. described above shall be in a stiff cover ring file.

## 16.3 **TOOLS**

One set of portable 3 phase test plugs for insertion into the busbars side or circuit side isolating contacts of the



circuit breaker equipment, or other similar test accessories, shall be provided for each substation. The test plugs or test accessories shall be insulated to withstand 25 KV d.c. to earth for 15 minutes and shall be capable of carrying at least 200 A continuously.

One set of standard tools and any special tools, gauges, handling appliance etc. as recommended by the manufacturer for the assembly, operation, checking adjustment and normal maintenance of the switchgear equipment, battery, battery charger etc. shall also be provided for each substation.

17.0 TECHNICAL PARTICULARS AND GUARANTEES FOR 11 Kv SWITCHGEAR EQUIPMENT.  
(To be filled by the Tenderer)

S)))))))))))))0))))))Q  
1.0 General \*  
\*

(a)	Name of Manufacturer	*
		*
(b)	Name of Supplier	*
		*
(c)	Model/Type Reference No.	*
		*
(d)	Type Testing Authority	*
		*
(e)	Test Certificate Report/ Reference	*
		*
(f)	Rated Voltage (kV)	*
		*
(g)	Rated Continuous Normal Current (A)	*
		*
		*
(h)	Rated Frequency(Hz)	*
		*
(i)	Number of Phase	*
		*
(j)	Impulse Withstand Voltage On 1.2/50 micro second (kVp)	*
		*
		*
(k)	One-minute Power Frequency Withstand Voltage (kV r.m.s)	*
		*
		*
		*
2.0	<b>Circuit Breaker</b>	*
		*
(a)	Rated Continuous Normal Current (A)	*
		*
		*
(b)	Breaking Capacity (MVA and KA)	*
		*
		*
(c)	Making Capacity (MVA and KA)	*
		*
		*
(d)	Short Time Current Rating. 3 seconds at 11 kV. (kA r.m.s)	*
		*
		*
		*
(e)	Number of Seals in the SF6 Module/Vacuum Bottle	*
		*
		*
(f)	Relative Pressure (Bar) of the SF6 Gas/Vacuum	*
		*
		*

3.0	<b>Busbars</b>	*
		*
(a)	Material	*
		*
(b)	Rated Continuous Normal Current (A)	*
		*
(c)	Short Time Current Rating. 3 seconds at 11 kV. (kA r.m.s)	*
		*
		*
4.0	<b>Earth Switches</b>	*
		*
(a)	Rated Normal Current (A)	*
		*
(b)	Making Capacity (kAp)	*
		*
(c)	Short Time Current Rating. 3 seconds at 11 kV. (kA r.m.s)	*
		*
		*
5.0	<b>D.C. Tripping System</b>	*
		*
(a)	Name of Battery Manufacturer	*
		*
(b)	Type of Battery	*
		*
(c)	Model No of Battery	*
		*
(d)	Capacity of Battery at 5 hour Rate (AH)	*
		*
(e)	Rated Voltage per Cell	*
		*
		*
(f)	Rated Battery Voltage (Rated Voltage per Cell x Number of Cells	*
		*
		*
(g)	Name of Battery Charger Manufacturer	*
		*
(h)	Type of Battery Charger	*
		*
(i)	Make of Battery Charger	*
(j)	Rated Current of Battery Charger	*
		*
		*
(k)	Rated Output Voltage	*
		*

- (l) Boost Charge Current \*
- (m) Trickle Charge Current \*
- (n) Energy required for each tripping (In ampere and at 30 V d.c) \*

\* 6.0 Schedule of Departures from Specification:-

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S))Q

\* Tenderer should enter details at time of tendering. If no details are entered, the equipment shall deemed to fully comply with the requirements of the Specification.

Signature : .....  
Name of Tenderer : .....  
Chop of Tenderer : .....  
.....

\* \* \* \* \*