SPECIFICATION FOR 11 KV HIGH VOLTAGE OIL CIRCUIT BREAKER

CONTENTS

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1.0 SCOPE OF SPECIFICATION

This specification applies to the design, manufacture, inspection, testing, delivery to site, unloading, complete installation, wiring, connections, final testing and putting into commission, handing over in approved working order and maintenance during the defects liability period as stated in the conditions of contract.

This specification should be read in conjunction with the Tender Forms, Schedule of Rates and Prices and Drawings which bear reference to this specification.

2.0 STANDARDS

All equipment covered by this specification shall comply with the relevant British Standards current at the time of tendering and with the clauses of this specification. If any Tenderer offerers equipment which conform to standards other than those published by the British Standards Institution, full details of the differences between the proposed standard and the equivalent British Standard, in so far as they affect the design and performance of the equipment, shall be submitted with the Tender.

3.0 APPROVAL OF EQUIPMENT

All equipment offered by the Tenderer shall be approved by the Chief Electrical Inspector for use in Peninsular Malaysia. However, approval of equipment by the Chief Electrical Inspector shall not prejudice the right of the Superintending Officer to

reject the equipment.

4.0 **PARTICULARS & GUARANTEES**

Tenderers shall submit at the time of tendering detailed technical Particulars and Guarantees in respect of the equipment offered, which shall be binding. No departure from these Particulars and Guarantees will be permitted except with the written approval of the Superintending Officer. Notwithstanding any description, drawing, 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. Should any deviation other than those stated in the Schedule of Departures from specification submitted by the Tenderer be found on the equipment during or after the installation, the Superintending Officer shall have the right to reject the equipment and the Tenderer shall bear the full cost of replacing new equipment complying with the specification and recommissioning of the installation.

The Electrical Contractor shall guarantee the plant and equipment to be supplied under this Tender against faulty design, materials and workmanship at the manufacturer's works for the period stated in the conditions of contract commencing from the date of handing over in approved working order of the complete installation under the contract.

5.0 **RATING OF SWITCHGEAR**

5.1 Each oil circuit breaker equipment shall be suitable for

continuous service on a 11 KV, 3 phase, 50 Hz, neutral earthed system.

5.2 The fixed and moving portions of each oil circuit breaker equipment shall be insulated for 11 KV throughout. The fixed portion shall have a short-time (3 seconds) current rating of at least 13.1 KA R.M.S. and shall be suitable for accommodating an oil circuit breaker having a rated breaking capacity of not less than 350 MVA at 11 KV as defined in BS 116. The making capacity, short-time current rating and operating duty of each circuit breaker and the performance of all associated trip capacity of 350 MVA at 11 KV, An A.S.T.A. or other approved Type Test Certificate shall be submitted with the Tender.

6.0 **TYPE OF SWITCHGEAR**

The oil circuit breaker equipment shall be of the single busbar, metal clad, indoor, extensible type with vertical isolation and horizontal drawout features and having air-insulated busbar and current transformer chambers. It shall be fitted with one of the operating mechanisms specified in Clause 9.8 and provided with integral feeder and busbar earthing facilities.

The oil circuit breaker 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. It shall also be possible to couple difference number of circuit breakers with oil-switch and/or switch-fuse units.

7.0 **STANDARD EQUIPMENT**

The standard equipment covered by this specification are:-

a. for feeder circuits:

Type A1 - with non-directional overcurrent and earth-fault

protection using I.D.M.T. 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 I.D.M.T. relay.

b. for transformer circuits:

Type B1 - with non-directional overcurrent and earth-fault protection using I.D.M.T. relay.

c. for bus-section:

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

8.0 **BUSBARS**

Unless otherwise specified the busbars of all circuit breakers and circuit connections to busbars and feeder cable boxes shall be rated at 400 Amps. continuous Busbars shall be the totally enclosed air-insulated type. They shall be made of high-conductivity bard-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-to-panel basis at the busbar orifice tee-off connectors.

9.0 **CIRCUIT BREAKER EQUIPMENT**

9.1 **STATIONARY PORTION**

The stationary cubicle portion of the circuit breaker 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, relay, cable and metering chambers. There shall be no vertical partitioning of the air-insulated busbar chamber.

Each cubicle shall be fitted with a flap to relieve any pressure which might build up due to an internal fault.

Provision shall be made at the rear of the panel to run a continuous earth bar to earth the frames of all panels of a switchboard.

9.2 **DRAWOUT ISOLATION**

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 racked-in position with the circuit breaker in the closed position and to prevent closing of the circuit, breaker unless it is in the fully racked-in or fully isolated positions.

9.3 **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 withdrawal 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. Padlocks shall be supplied by Tenderer as per Yale 1/2 inch or equivalent.

Busbar shutters shall be painted `Signal Red' (colour 537 in BS 381C) and boldly labelled `BUSBARS' in white letters, whilst circuit shutters shall be painted `Lemon' (colour 355 in BS 381C) and boldly labelled `CIRCUIT'.

9.4 **HEATERS**

In view of the extreme tropical and humid climatic conditions under which the equipment are required to operate, a suitable low temperature anti-condensation heater rated at 240 volts 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 chambers, current transformer chambers, busbar and feeder spouts etc., and yet not cause any undue overheating of the main cable, cable box, main feeder and busbar connections, current transformers etc. Wiring from nearby L.T. switchboard to the circuit breaker panel for the heater shall be carried out by the Tenderer.

If the circuit breaker equipment offered by any Tenderer does not incorporate an anti-condensation heater, he shall at the time of tendering offer adequate evidence to establish that the equipment offered is entirely suitable for operation in Peninsular Malaysia, based on long term experiences gained from other installations in Peninsular Malaysia. In any case, the acceptance of circuit breaker equipment without anti-condensation heaters shall be subject to the Superintending Officer's approval.

9.5 **CIRCUIT BREAKER TRUCK**

The moving truck portion of the circuit breaker equipment shall be of steel construction, rigid and designed ti resist tension

and to withstand the shocks under fault conditions. It shall accommodate the circuit breaker, operating mechanism, auxiliary switches, main and auxiliary plugging contracts etc.

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

Means shall be provided for locking the truck in the fully racked-in position with padlocks. Padlocks shall be supplied by Tenderer as per yale 1/2 inch or equivalent.

Means shall also be provided for the efficient earthing of the truck portion to the stationary cubicle when the truck is fully racked in. In the service position, the circuit breaker top plate shall be adequately and not fortuitously earthed.

9.6 **MECHANICAL INTERLOCKS**

A full 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 closing of the circuit breaker, unless correctly

located in the service, earth or isolated positions, or unless the circuit breaker is fully withdrawn from the stationary panel of the equipment.

c. The moving portion being withdrawal or replaced unless the circuit breaker is fully isolated and in the appropriate position for withdrawal or replacement.

d. The circuit breaker being plugged-in without its tank in position.

e The circuit breaker being closed in the service position without completing the auxiliary circuits between the fixed and moving portions.

f. The removal of the top cover of the voltage transformer tank unless the transformer is isolated.

All manually operated mechanical interlocks shall be clearly labelled to signify their respective functions.

9.7. **CIRCUIT BREAKER**

The circuit breaker shall be of the 3 phase dead tank type suitable for continuous normal current rating of 400 Amps. All circuit breakers of identical rating shall be fully

interchangeable with one another.

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

A suitable form of arc control shall be incorporated in the design of the circuit breaker and contacts shall be renewable and self-aligning to ensure full contract without undue maintenance.

The circuit breaker main plugging contracts shall be mounted on synthetic resin bonded paper or cast resin bushings incorporating stress-controlling condenser layers. The secondary connections between the fixed and moving portions shall preferably be made by self-aligning plugs and sockets.

A suitable vent shall be provided in the top plate of each circuit breaker for the safe escape of gas. The vent shall be provided with an efficient oil trap.

Cast iron shall not be used for circuit breaker tanks and top plates. The level up to which oil is to be filled in the circuit breaker tank shall be marked internally and labelled `OIL LEVEL'.

9.8 **OPERATING MECHANISM**

Circuit breaker mechanisms shall be of the trip-free type and shall be robust enough ti withstand the forces produced under such conditions. Each circuit breaker shall be fitted with and operating mechanism for closing the circuit breaker by any one of the following methods:

a. a spring operated manual closing mechanism for independent manual closing.

b. a spring operated power closing mechanism for closing the circuit breaker by means of energy which has previously been stored in by hand charged spring with direct mechanical release and in addition, when specified in the Schedule of Rates and Prices and/or the Drawings with electrical release.

c. when specified in the Schedule of Rates and Prices and/or the Drawings a solenoid closing mechanism for remote and local electrical closed and trip, with remote/local selection at the unit, if necessary.

Except in the case of breakers fitted with solenoid/motor drive closing device, which shall be rated at 110 volts D.C. and unless specified otherwise in the Schedule of Rates and Prices and/or the Drawings the shunt trip coils and closing spring release coils where applicable shall be rated at 30 volts D.C.

Operating mechanisms shall be provided with locking facilities such that, in any position, the circuit breaker can be prevented from being closed when it is open and from being manually tripped when it is closed.

Each requirement shall be met by fitting a single padlock and shall not entail the fitting of any loose components prior to the insertion of the padlock. It shall not be possible to readily gain accesses to the tripping toggle or any part of the mechanism which would defeat the locking of the manual tripping. It shall not be possible to lock mechanically the trip mechanism so as ti render the electrical tripping inoperative except when the circuit side or the busbar side of the equipment is earthed through the circuit breaker. All padlocks to be used on the oil circuit breaker, oil-switch units and switch-fuse units in the same substation shall be supplied by the Electrical Contractor complete with similar number of keys alike.

The closing operation of circuit breakers fitted with spring operated manual closing mechanisms shall take place by hand preferably in a single downward operation in which energy stored in the initial part of the operation is later used to complete the closing operation at a speed independent of the operator. It shall not be possible for the mechanism to be left in such a condition that the energy which has been stored during the initial part of an incomplete closing operation remains in the spring when the circuit breaker is open. Manual tripping shall be effected by a push button which can be padlocked.

For circuit breakers fitted with spring operated power closing mechanisms, the following are additional requirements:

a. it shall not be possible under any circumstances (except during slow closing described in the next paragraph) 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 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 the state of the spring and inscribed `SPRING CHARGED' when the mechanism is in the condition to close the circuit breaker and `spring free' when it is in any other condition, in accordance with the requirements of BS 116.

All forms of operating mechanisms shall be of trip-free type. The connection between the actuating level and the circuit breaker contact bars shall be such that, under all conditions, the driven is positive in both directions and the mechanism and moving contracts operate in unison. Facilities for slow closing facility when the circuit breaker is engaged in the service or earth positions, unless each slow closing operation necessitates a manipulation quite separate and distinct from the normal operation of manual spring operated closing, spring charging and/or release.

One operating level for performing the slow closing and opening of the circuit breaker shall be provided in each sub-station room unless otherwise specified.

9.9 **AUXILIARY SWITCHES**

All auxiliary switches shall be positively driven in both directions. They shall be mounted so as to 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 auxiliary switches; two normally open and two normally closed. All auxiliary switches shall be wired to appropriate terminal boards, whether or not these are used in the first instance.

9.10 **SECONDARY ISOLATING CONTACTS**

The secondary wiring shall be carried from the mechanism, via a flexible tube, through secondary isolating contract, 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 breaker in service.

The secondary isolating sockets shall be arranged in three groups so that the isolating plugs make contact when the circuit breaker is raised in the "BUSBAR EARTH","NORMAL SERVICE" and "CIRCUIT EARTH" positions. Sockets for tripping circuits shall not be provided in the "EARTH" positions, thereby making the circuit breaker non-automatic in these positions. Sockets for closing circuits shall be provided in the "EARTH" position.

9.11 **EARTHING DEVICE**

Each circuit breaker equipment shall be arranged so as to permit earthing the circuit side or the busbar side of the equipment through the circuit breaker without the use of loose attachments.

Three positions namely "BUSBAR EARTH", "NORMAL SERVICE" and "CIRCUIT EARTH" shall be clearly labelled on the housing floor to indicate the position in which the breaker is located. A selector device shall be provided in the housing to ensure positive location of the circuit breaker in these positions. The selector shall ensure that the carriage when inserted into the housing stops in the selected position and also prevent any

attempt to elevate the breaker in other than the selected position.

It shall be possible to padlock the selector in positions other than either earth position.

9.12 **CURRENT TRANSFORMERS**

Current transformers shall comply with the requirements of BS 3938 and shall have short circuit ratings not less than that if 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 Clause 5.5 of BS 3938. Where the open circuit voltage would exceed 3.5 KV, suitable protection is to be provided at the secondary terminals to limit the induced voltage.

The rations of current transformers shall be as stated in the Drawings. Unless otherwise specified, the output and class accuracy of current transformers shall be 15-S-10. Metering current transformers shall be of 15 VA., Class AM, BM or CM as specified.

Each current transformer shall be provided with an identifying label giving its type reference, ratio, output, class accuracy, voltage rating and serial number.

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

Circuit breaker equipment types A1, A2 and B1 shall be fitted with one protection current transformer per phase, and in addition to the protective relay element, the centre phase current transformer shall also cater for the panel ammeter instrumentation. In the case of type A3 circuit breaker equipment, 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 centre phase.

In addition to the protection current transformers mentioned above, a current transformer 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 instal the metering panel for H.T. metering by TNB The panel shall be fabricated to suit TNB requirements.

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

9.13 **VOLTAGE TRANSFORMERS**

Voltage transformers, when specified in the Drawings shall be of the 3 phase, 3 limb, star-star, withdrawable, feeder connected type having a ratio of 11,000/110 volts, 100 VA output per phase or as specified Class B accuracy. They shall be of the cast epoxy resin filled type suitable for mounting on the circuit breaker carriage and shall fully comply with the requirements of BS 3941.

The primary windings shall be connected through suitable high rupturing capacity fuses to the circuit side of the current transformers remote from the busbars so as to be included in the zone of the equipment controlled by the circuit breaker or, when specified otherwise, to the busbars. The connections from the main circuit to the point of isolation of the voltage transformer shall be capable of carrying the rated short-time current of the circuit breaker equipment. They shall also be capable of carrying a continuous current of 200 Amps. or more in order that primary injection tests on protective gear may be carried out.

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

The fixed spouts of the primary isolating contacts shall be covered by a set of safety shutters capable of being padlocked

so as to prevent access to the stationary primary isolating contracts. The shutters shall open and close automatically by positive drive actuated by the movement (i.e. insertion or withdrawal) of the voltage transformer assembly. When the voltage transformer is required to be connected to the circuit side, the shutters shall be painted `Lemon' colour 355 to BS 381C and when specified to be connected to the busbar side, shall be painted `Signal Red' colour 537 to BS 381C. Additionally, when specified to be connected to the busbar side, the voltage transformer assembly shall be clearly and conspicuously sign painted on the outside with the inscription `BUSBAR VT'.

Means shall be provided to ensure that the tank of the voltage transformer is adequately connected to the main earth bar before its primary connections are made.

9.14 **INSTRUMENTS**

Each circuit breaker panel, except bus section panel, shall be equipped with an ammeter connected to the protection current transformer in the centre phase. Additionally, when any panel is fitted with a voltage transformer, it shall also be equipped with a voltmeter.

All ammeters and voltmeters shall be of the round dial pattern having a nominal 100 mm. case and preferably flush mounted. They shall be of the moving iron spring controlled 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 be reversible in the case of double sealed instruments. The seals shall be of such materials that no peeling or discolouration will take place with age. Ammeters shall be scaled commensurate with the current transformer ratios or as specified and voltmeters 0 - 15 KV.

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

9.15 **RELAYS**

Relays shall be of approved types complying with BS 142 or equivalent with approved characteristics and shall be flush mounted in draw-out type dust proof cases. Relay cases shall be finished in bright black enamel.

Relay contacts shall be of the self-resetting type and shall be adequately rated. They shall make firmly without 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 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. auxiliary supply.

Each non-directional overcurrent and earth-fault protection relay shall have a rated current of 5 Amps and shall comprise three induction disc, inverse time 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 tappings 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 tappings at 5% intervals.

In the case of types A2 and A3 circuit breaker equipment, the approved pilot wire feeder differential protection relay shall be 5 Amp. single element relay type arranged to give phase fault and earth-fault protection.

In additional to the relays being acceptable to the Superintending Officer, the Tenderer shall also ensure that they are approved by TNB for the installation under this contract.

9.16 **SMALL WIRING**

All small wiring shall be effected with single core black coloured PVC insulated 7/0.67 mm. plain annealed copper conductor cables of 600 volts grade (Type B) to BS 6231:1969. Wires connected to stud type terminals shall be terminated with Ross-Courtney type claw washers, one for each individual wire. No wires may be teed or jointed between terminal points. All wires shall have numbered ferrules at both ends in accordance with the standard wiring and connection diagrams. The ferrules shall be fitted to the wires interconnecting the relay trip contacts and the shunt trip coils. All metallic cases of instruments, relays

et. mounted on the panels, shall be connected by means of bare copper 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 limited compression type.

9.17 **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 boards are provided, the studs shall be fitted with washers, nuts and locknuts or lock washers. Insulated barriers shall be fitted between adjacent terminal studs. 240 volts 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.

9.18 **FUSES & 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	5 amp fuse
Light Green	15 amp fuse
White	Link

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

9.19 **AUXILIARY CABLE BOX**

Circuit breaker 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 end of the feeder. Likewise, equipment fitted with metering current and voltage transformers shall also be fitted with a small auxiliary 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.

10.0 **BATTERY**

One 30 D.C. Ni-Cd battery tripping unit of sufficient AH to trip minimum 3 circuit breakers at the same time shall be supplied and installed in each substation room by the Tenderer. It shall be self-contained, floor standing steel cubicle type with automatic two-rate (boost and trickle) charging feature and complete with ammeter, voltmeter, indicator lights, charge fail visual and audio alarm, alarm cancellation and reset facilities, protective fuses etc. Input voltage to the charger shall be 240 A.C. single phase via a 13 A 3 pin switched socket outlet.

11.0 **CABLE BOXES**

All main cable dividing and sealing boxes and the associated brass wiping glands, cable sockets and armour clamps shall be suitable for 3-core P.I.L.D.S.T.A.S. 6350/11000 volts cable to BS 6480 for conductor sizes up to and including 300 sq. mm. The boxes shall be suitable for bituminous compound filling and shall be split along the centre line of the cable or otherwise constructed to permit the horizontal removal of the cable. They shall be provided with large filling orifices and suitable expansion space. The mounting of the boxes and glands shall be suitable for normal vertical entry of cable from below as well as top vertical entry when dictated by site conditions.

Access to the cable boxes for terminating the cable shall be from the rear end of the stationary panels unless otherwise specified.

12.0 **EARTHING**

Each circuit breaker shall be provided with a main earth bar of not less than 25 mm x 5 mm. hard drawn high conductivity copper strip or equivalent section. The earth bar shall be bolted to the main frame and located to provide convenient facilities for earthing cable sheaths and for use with earthing devices. Means shall be provided for coupling the earth bars of adjacent units. The joints shall be tinned and bolted.

13.0 **CIRCUIT LABELS**

Each circuit breaker shall be provided with a circuit label, preferably of laminated material (the inner and outer laminations being of contrasting colours, e.g. white/black) mounted on the front of the fixed portion, of a size not less than 150 mm x 50 mm.

The labels shall be suitable for being engraved upon such that the colour of the characters engraved shall have adequate contrast against the colour of the unengraved portion of the label to render the engraved inscription clearly visible from a reasonable viewing distance. Wordings on the labels shall be agreed upon with the Superintending Officer.

In addition to the normal circuit identification labels, each circuit breaker panel shall also be provided with a label of similar material indicating the various current settings of the circuit breaker concerned.

14.0 **TROPICALISATION AND VERMIN PROOFING**

All circuit breaker equipment covered by this specification shall be fully tropicalised to make them suitable for continuous operation in the fully tropicalised to make them suitable for continuous operation in the extremely humid and tropical climatic conditions experienced in Malaysia.

The equipment shall also be designed to prevent ingress of vermin, accidental contract with live parts, 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.

15.0 **PAINTING**

Each circuit breaker equipment shall receive one coat of primary, one undercoat and finishing coat of paint at the manufacturer's works. The final coat applied shall be an oil resisting enamel of either light grey colour No. 631 or dark grey colour No. 632 per BS 381C, but not both colours. The internal surfaces of all oil tanks (including voltage transformer housing, where applicable) shall be finished with a final coat of oil resisting enamel.

16.0 **INSULATING OIL & COMPOUND**

The first filling of insulating oil and cable box compound shall be supplied and filled by the Electrical Contractor.

17.0 **PORTABLE TEST PLUGS**

One set of portable 3-phase test plugs for insertion into the busbars side or circuit side isolating contacts of circuit breaker equipment shall be provided for each substation.

18.0 **TOOLS & APPLIANCES**

This Tender shall include the supply of the following tools and appliances whether they are specified in the Schedule of Rates & Prices or not. The Tenderer is also required to give a full list with details when submitting his Tender:-

a. Sets as required of any special tools, gauges and handling appliances required for the normal maintenance of oil circuit breaker.

b. Sets as required of any special tools, gauges etc., required for the assembly, checking or adjustment (but not for normal maintenance) of the oil circuit breaker.

19.0 **SPARES**

The Tenderer shall submit with his Tender separate Schedule of Spares recommended by him. 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 purpose of maintenance. The prices for these 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. These prices shall be valid for acceptance during contract period (extended if applicable) of the project.

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

20.0 **INSPECTION & TESTING**

20.1 **GENERAL REQUIREMENTS**

The who of the plant and equipment to be provided under the Tender may be subject to inspect on and test by the Superintending Officer or his representatives prior to installation. The approval by the Superintending Officer or his representatives of the results of any such inspection or test shall bot 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 coasts 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 Superintending Officer or his representatives to carry out the necessary inspection and tests.

20.2 **SITE TESTS**

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 TNB approved testing authority as part of the tests required of him for the whole installation under this contract.

On successful testing of the complete installation, the Electrical Contractor shall arrange to commission the equipment in the presence of the Superintending Officer.

20.3 **TEST CERTIFICATES**

Four (4) sets of all principal test records, test certificates, and performance curves shall be supplied for all tests carried out in accordance with the provisions of his specification. These test records, certificates and performance curves will be supplied for all tests, whether or not they have been witnessed by the Superintending Officer or his representatives. The information given on such test certificates and curves shall be sufficient to identity the material or equipment to which the certificate refers and shall also bear the contract reference and heading given in Clause 22 of his specification either in whole or in part as he considers necessary. After adjustment or modification if so directed by the Superintending Officer or his representatives, the Electrical Contractor shall submit the item for further inspection and/or tests. Plant or components with defects

of such nature that 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.

20.4 **REJECTION OF PLANT**

Any item of plant or component which fails to comply with the requirement of this specification in any respect whatsoever at any stage of manufacture, test, erection or on completion at site within the defects liability period may be rejected by the Superintending Officer.

21.0 **PACKING**

Each item of equipment is to be packed properly and protected for shipment or transport from the place of manufacture to the site.

22.0 **TENDER DRAWINGS**

The following is a list drawings which shall be submitted with the Tender:-

a. Dimensioned drawings of general arrangement of all types of circuit breaker equipment (with and without voltage transformer) showing positions of main and auxiliary cables, grouting bolts, static and shock loadings on foundation, minimum clearance to tear end wall, minimum floor to ceiling height of switchroom. This drawing shall also show the layout of the various equipment on the front instrument/relay panel.

b. Section drawings of all types of circuit breaker panels showing general details of construction, including position of anti-condensation heater.

Should any dimension of the building shown on the Drawing be found to be unsuitable for the gears offered, the Tenderer should point these out in his Tender and recommend the necessary changes.

23.0 **WORKING DRAWINGS**

Within 3 weeks after award of the Tender, the Electrical contractor shall submit to the Superintending Officer for his approval dimensioned general arrangement and section drawings and schematic/wiring diagrams of the equipment ordered. These drawings are to be submitted in quadruplicate. The drawings submitted are to be modified if necessary as requested by the Superintending Officer and re-submitted for final approval.

24.0 **RECORD DRAWINGS**

Within a month after practical completion of the project, the Electrical Contractor shall submit to the Superintending Officer one set of true to scale negatives (155/165 gm/sq.m.) and four sets of prints of each of the approved working drawings with modifications as carried out during erection and other drawings deemed necessary by the Superintending Officer for record and maintenance purposes.

All drawings submitted by the Electrical Contractor shall have the following particulars at the lower right hand corner, in addition to the manufacturer's name, date, scale, drawing number and title:-

PUBLIC WORKS DEPARTMENT
ELECTRICAL BRANCH
PENINSULAR MALAYSIA.

Contract No.....
Tender No.....

25.0 **INSTALLATION, OPERATION & MAINTENANCE INSTRUCTIONS**

As soon as the general arrangement and details of the equipment to be supplied have been finalised and before the delivery of the equipment, the Electrical Contractor shall submit to the Superintending Officer 4 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, manufacturers' standard brochures will be acceptable provided that they refer particularly to the equipment to be supplied and are free from extraneous matter.

The instructions 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 lubricant etc. All manuals submitted shall be properly bound with hard-covers and titles to the satisfaction of the Superintending Officer.

The cost of these manuals shall be deemed to be included in the Tender Price.

After commissioning of the plant the Electrical Contractor shall, if specified, provide the service of one competent person to operate and maintain the plant together with the Government's personnel who are put in charge of the daily operation and maintenance of the plant for a period specified in the Schedule of Rates & Prices. This period may be extended if required by the Superintending Officer. During this period the Electrical Contractor shall endeavour to train up the personnel to ensure that the latter are well equipped for the proper operation of the plant after the specified period.

AS/ftm..