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Federal Electricity & Water Authority

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TECHNICAL SPECIFICATION
(132 kV INDOOR METAL-ENCLOSED SF6 GAS INSULATED SWITCHGEAR)

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1.0 TYPE OF 132KV SWITCHGEAR AND GENERAL REQUIREMENTS

The switchgear shall be of the SF6 gas insulated three phase or single phase encapsulated type, suitable for accommodation within a building and capable of continuous operation under the climatic conditions existing at the Site. Duplicate busbar switchgear shall be provided with busbar selector disconnectors as specified in the Schedules to facilitate the changeover of individual circuits from one busbar to the other with the circuit on load and a bus coupler closed.

The arrangement of the switchboard shall be such that all units face in the same direction. Particular emphasis is placed on the provision of adequate clearance between chambers to facilitate maintenance.

The design of the switchboard shall be such as to enable extensions to be added at either end with the minimum of disturbance to the installed equipment and without circuit outages or complete shutdown of the substation. The design shall allow high voltage testing of extended busbars portion and bay with the second busbar and all other feeders in service.

The equipment offered shall be adequately protected from all types of system voltage surges and any equipment necessary to satisfy this requirement over and above that specified shall be included.
Easy access shall be provided for all equipment, which needs regular checking and / or maintenance, by means of fixed type ladders, platforms or similar facilities. A mobile platform to reach any equipment, all manual operating handles, etc. shall be supplied within the overall quoted price of GIS.

The design shall include all facilities necessary to enable the performance of the specified site checks and tests to be carried out. The Contractor shall state the test facilities provided and indicate any attachments or special equipment provided for this purpose.

Circuit-breakers, disconnectors, earth switches, VTs, CTs cable termination chambers, all and any other chambers and components must be capable of withstanding a gas over pressure of 130% of normal operating pressure continuously.

All grounding system, special tools and tackles, SF6 gas for site filling, O & M manuals etc. required for erection, operation, testing and maintenance of GIS shall be supplied within the quoted price. The embedded plates and channels for the GIS foundations and maintaining floor tolerances shall be provided by GIS supplier. Anchoring bolts for fixing GIS and LCCs shall also be supplied by the GIS supplier.

2.0 CURRENT RATING

Every current-carrying part of the switchgear including current transformers, disconnecting switches, busbars, connections and joints shall be capable of carrying its specified rated normal current continuously under IEC rating and in no part shall the temperature rise exceed the values IEC specified in relevant Standards. The derated current rating to site ambient (50^{o} C) shall be declared in the technical schedules against above items.

Every part of the switchgear shall also withstand, without mechanical or thermal damage the instantaneous peak currents and rated short-time currents pertaining to the rated breaking capacity of the circuit breaker as per relevant single line diagram. Rated duration of short-

circuit shall be taken as one second. The primary rating of the current transformers shall not differ from that of the associated circuit breakers unless specified otherwise.

The design of sliding type current carrying connectors and joints shall be such that they meet the aforementioned conditions over the full permitted range of movement. Where such joints may be made or adjusted on Site, full details of alignment procedure, together with any necessary alignment tools or gauges shall be described in the maintenance manual and included in the supply of special tools.

3.0 CONNECTIONS TO OUTGOING CIRCUITS

Cable header suitable for connecting plug-in type cable termination shall be provided as specified for the outgoing circuits. When the circuits are connected via cables directly to the SF6 switchgear terminals the sealing ends shall be to the specification given in Clause 4.

Design of cable termination equipment must ensure that the following conditions are maintained throughout the life of the equipment.

(a) The insulating material, either gas or oil, from inside the cable does not escape and penetrate the switchgear enclosure.

(b) The SF6 gas does not enter the cable from the enclosure.

(c) The cable sealing end does not introduce moisture into the gas in the sealing end enclosure.

(d) The sealing end is capable of withstanding the cable test voltages and differential pressures without damage including overpressure of +130% of normal operating pressure.

(e) Manually operated disconnecting links shall be provided for facilitating cable testing without removing the termination from the switchgear end for each cable circuits and without degassing.

4.0 PLUG-IN TYPE CABLE TERMINATION

Cable header ends shall be suitable for terminating the cables specified directly into the GIS switchgear using 132kV plug-in type cable termination. The bushing part (socket) of plug-in-type termination system and accessories shall be supplied, installed and tested by the GIS manufacturer as part of GIS scope of supply. The dimensions and terminal arrangements, shall be submitted for approval by the Authority before manufacturing is commenced. Cable header ends shall be suitable for connecting 2 cables per phase with cross section of 630 mm^2 copper/XLPE 132 kV cable for all feeders. At present one cable shall be connected and the spare cable sealing ends shall be provided with dummy plugs within the quoted price. However, for IBT circuits, cable header shall be suitable for terminating 1 No., 1Cx630 sq.mm. Cu/XLPE cable per phase. For all circuits, GIS shall be complete with the bushing part (socket), connecting conductors, shields, accessories, etc.

Where required to reduce local heating when single-core cables are adopted, non-magnetic gland plates shall be provided or alternatively, non-magnetic inserts.

The cable termination fixing requirements shall be co-ordinated with cable termination manufacturer for fixing the cable termination. (Plug-in type)

The cable termination matching with the bushing part shall also be supplied as per B.O.Q.

Removable links shall be provided close to the GIS to enable cable sheath tests to be carried out.

All cable terminals shall be of adequate size to ensure no overheating takes place at rated current.

Insulators used in the manufacture of cable sealing ends shall be sound, free from defects and thoroughly verified so that the glaze or surface treatment is not depended upon for insulation.

The insulators and fittings shall be unaffected by the filling media or rapid temperature changes likely to arise when operating in the Site conditions.

5.0 BUSBAR AND CONNECTION GAS CHAMBERS

The switchgear units shall be divided into several gas-filled compartments, sealed from each other by gas- tight partitions so that any leakage may be quickly localised. The various gas zones shall be further sub-divided when necessary to restrict any internal arcing damage, and to enable gas-handling procedures to be completed with the minimum of delay. The partitions should confine any internal faults to a respective section of the switchgear. Enclosures shall be designed to minimise burn through in the event of internal arcing. The gas zone partitioning shall preferably be carried out either between busbar disconnectors and busbar or along the busbars, between each two circuits. The metal cladding enclosure for the switchgear shall be made from non-magnetic material, preferably aluminium alloy.

Busbar of each bay shall have separate gas compartment partitioned from adjacent bay. Each cable head shall be in separate gas compartment for circuits with two cable head. Gas barrier insulators shall be painted with yellow colour.

CTs shall be located in a separate gas compartment.

Busbars chambers shall be so arranged as to allow maintenance on one busbar, i.e. gas removal, and retain the other busbar and circuits in service.

The busbar phase conductor shall be copper or aluminium adequately supported by cast resin insulators or other approved material equally supported, at least at both ends of each section making provision for free axial movement of conductor.

Proposals for the partitioning of gas zones shall be clearly indicated on the drawings submitted with the tender. The length of circuit outgoing bus-duct belonging to one gas zone shall be limited to maximum 20m. Gas volumes and duration of gas handling procedures shall also be indicated in the technical schedules.

Total time for gas evacuation and filling of the largest chamber shall not exceed 10 hours.

The equipment and connections within each compartment shall be so arranged as to allow ready removal and replacement of any section with minimum isolation and disturbance of adjacent pressurised sections.

This feature should also permit the erection and testing of extension units alongside equipment already in service with the minimum of outage time being required for final connections. All external gas pipe work shall be connected via vacuum, non-return

couplings of proven design, which will enable joints to be broken and remade without loss of gas.

Suitable arrangements shall be provided for the thermal expansion and contraction of the busbars and busbar chambers without detriment to the current carrying capacity or gas volume.

Devices shall be provided for each section of switchgear as appropriate to allow for pressure relief to the switchgear room. All relief devices shall be located such that operation of the devices shall not endanger personnel working on the equipment or in the vicinity of the equipment. Where necessary the devices shall be fitted with cowls to deflect any gases or fragmented parts away from locations where personnel may be expected to be present.

GIS enclosures shall be clearly marked with SLD mimic diagram to identify gas compartment zones, disconnectors, circuit breakers, earthing switches, current transformers, voltage transformers and other primary devices contained therein. The method proposed shall be subject to the approval of the Authority. The colour of mimic shall be as per Vol. II, Section 6.0. Partitioning of gas zones on the GIS shall be clearly marked with “YELLOW” paint on the GIS enclosure.

Each separate gas zone must be provided with its own device for monitoring continuously the gas density, which must be temperature compensated. These devices shall be arranged to give individual compartment indication and initiation of remote alarms. The gas density monitors shall be grouped in not more than two locations per bay and shall be positioned to enable easy reading from the floor level. All gas density monitors, including the one for outdoor bus duct zones, shall be accommodated in the switchgear room, unless otherwise approved by the Authority.

All gas monitors shall be fitted with minimum 2 contacts for stage 1 & stage 2 alarms whereas for circuit breaker stage-1 alarm and stage-2 lockout.

Means shall also be provided to facilitate the regular maintenance checking of moisture content. Each gas-filled chamber shall be fitted with static filters to absorb any moisture, which may be present. In addition filters for removal of SF6 decomposition products shall be provided in those compartments in which arcing or corona discharge can take place.

In chambers equipped for 132kV cable sealing ends a manual disconnecting link must be provided to allow easy isolation between the cable sealing end and the main connections. It must be possible to open this link without removal/refitting of the main connections and any other main equipment installed in the enclosure. Necessary interlock shall be provided for safety of operation.

In order to compensate for any small variations in floor level, each compartment shall be fitted with means of adjustment (jacking screws or similar). Such adjustments shall be fully described in the maintenance manuals provided by the manufacturer.

Gas barriers shall be gas tight and of sufficient strength and factor of safety to withstand short circuit forces and the maximum pressure differential that can occur under internal fault conditions. The gas barrier withstand pressure shall be more than that of bursting disc. It shall be possible to vacuum any chamber with adjacent chambers having full pressure.

6.0 CIRCUIT-BREAKERS

Circuit breakers shall be puffer or Self-Generating Gas Pressure type and shall use the SF6 gas conforming to IEC or other approved standard as the insulating medium as well as for arc quenching.

Circuit breakers shall be single break type.

The circuit breakers shall be suitable for an operating sequence of O - 0.3 sec – CO – 3 min - CO. Circuit breakers shall comply with IEC standard 62271-100 and shall have valid type test report based on the above standard conducted on an independent test lab or witnessed by independent observers. Evidence of type test report as per the standard shall be submitted alongwith offer. The capacitive current switching, line charging and cable charging current, restrike performance, mechanical & electrical endurance, making and breaking current etc. shall be as per IEC 62271-100. The circuit breakers shall have first pole to clear factor of 1.5. The transient recovering voltage performance shall be as per IEC. All circuit breakers whether cable or OHL shall be suitable for auto reclose duty.

The offered circuit breakers alongwith operating mechanism shall preferably be type tested for mechanical endurance class M2.

If the bidder does not have circuit breakers of class M2 in the production range, alternately class M1 may also be offered.

If the circuit breakers are not type tested as per the IEC 62271-100, the new type tests shall be conducted preferably in an independent test laboratory. If tests are performed on manufacturer's premises, the tests shall be witnessed by independent observers. The above tests shall be conducted without any cost implication to FEWA.

A lockout feature shall be incorporated to prevent operation of the circuit-breaker whenever the gas pressure falls to a value below which it would be incapable of performing in accordance with its rated duty. Gas monitors shall be temperature compensated.

An alarm feature shall also be incorporated to give indication of falling gas pressure prior to the lockout of the circuit breaker.

Suitable facilities shall be included for gas sampling and for draining and replenishing the gas volume for maintenance. Absorption of moisture and the decomposition products of arcing or discharge in the gas shall be achieved by integral filters.

The switch room arrangement shall allow for full mobility of the gas handling plant along the switch room.

Offers of circuit breakers shall include proof that a satisfactory period of commercial service experience of not less than three years in climatic conditions similar to the UAE has been obtained with the type and rating put forward; failure to provide this proof may result in rejection of the tender.

7.0 CIRCUIT-BREAKER OPERATING MECHANISM

The circuit-breaker operating mechanism shall be of motor charged spring operated. Operation will normally be from a remote or supervisory position but facilities shall be provided for operation locally by electrical release and by direct manual release from stored

energy devices when the circuit breaker is isolated for maintenance. It shall be possible to padlock each local control function in the open position. Operation counters of non-resetable type shall be fitted to all circuit-breaker mechanisms.

The mechanism and its control scheme shall be such that, in the event of an electrical tripping pulse being applied to the circuit-breaker during the closing stroke, or of the mechanism failing to latch in the closed position, the circuit-breaker shall open fully and in such a manner as to be capable of interrupting its rated breaking current. Mechanical indicator shall be provided for CB “ON” and CB “OFF” position.

The mechanism and its control scheme shall be such that the mechanism shall not make repeated attempts to close the circuit- breaker when the control switch is held in the CLOSE position in the event of failure to latch on the first closing attempt or in the event of a trip signal being given to the circuit-breaker.

The electrical closing and tripping devices, including direct acting solenoid coils and solenoid operated valves, shall be capable of operation over the ambient temperature range when the voltage at their terminals is any value within the voltage range stipulated in IEC 62271-100 and in addition over the range of all operating conditions of the batteries and chargers.

The circuit breakers shall be provided with two trip coils.

The operating mechanism shall be suitable for a rated operating sequence of O-0.3 sec-CO-3 min-CO.

7.1 Spring Charged Operating Mechanisms

Spring operated mechanisms with proved satisfactory service experience shall be arranged for motor charging but means shall also be provided for charging by hand.

When fully charged the spring mechanism shall have sufficient stored energy to permit the operating sequence O-CO/2CO to be performed following the loss of supply to the charging motor.

A mechanical indicating device shall be provided to indicate the state of the spring. The indication shall be visible with the doors of the mechanism cabinet closed. An auxiliary switch shall give the remote indication of "spring discharged".

The mechanism shall be charged automatically, for further operation, as soon as the circuit breaker has completed a closing operation. The time required to power charge the spring shall not exceed 30 seconds.

The spring shall be fully charged before it can be released to close the circuit breaker. It shall not be possible for the breaker to close whilst the spring is being charged.

Spring closing mechanisms shall be designed such that it is not possible for a fully charged spring to be released inadvertently due to external shock or vibration caused by the breaker opening under short circuit conditions or any other cause.

The mechanisms shall be provided with means for charging the spring by hand. During this process no electrical or mechanical operation of the mechanism shall endanger the operator or damage the equipment.

An indicating device shall be provided at the local control panel and the main control room and also over the supervisory system to indicate a spring failing to be charged by a preset time after circuit breaker closing.

Means shall be provided for discharging the spring when the circuit breaker is in the open position without the circuit breaker attempting to close.

8.0 DISCONNECTING AND EARTHING SWITCHES

Disconnecting and earthing switches shall be arranged to permit safe maintenance of any section of the equipment when the remainder is alive. Disconnecting switches shall be arranged for operation while the equipment is alive, but will not be required to break current other than the charging currents of open busbars and connections (circuit breaker bushings) or load currents shared by parallel disconnectors under the conditions of this Specification.

Disconnectors of earth switches shall comply with the requirement of IEC 62271-102.

Disconnectors shall preferably be housed in compartments partitioned from circuit breakers.

Line disconnectors gas zones must be separated from the cable sealing ends or outdoor bushing gas zone.

Switch mechanisms shall be so designed that the disconnector cannot be opened by forces due to currents passing through it and shall be self-locking in both the "open" and "closed" positions. The mechanism shall open and close all three phases simultaneously.

Power operated drives shall be provided which shall be suitable for local, remote and supervisory control (supervisory control of earth switches is not required) and should be fitted with a removable emergency manual operation facility. It should be possible to lock-off the manual and local facility and padlock the mechanism in the open and closed positions with the motor automatically disengaged.

Local mechanical position indicators shall be provided on disconnecting and earthing switches and shall be visible from ground level.

For safe earthing of the busbars and feeders, high-speed fault making spring driven earth switches shall be provided. The contacts of these earth switches shall have the same fault making capability as that of the circuit breaker. With earthing switches of the high speed fault making type it shall be impossible to complete a slow close operation.

Each section of busbar, which can be electrically isolated from other sections of busbar by means of disconnectors or circuit breakers shall incorporate high speed earthing switches as specified above. The mechanisms of the high speed earthing switches shall be spring operated. It shall be possible to charge the spring by d.c. motor and manually. During the manual charging of the spring, motor operation shall be prevented. The spring shall not be charged when the earthing switch is in open position, but the charging of the spring shall be initiated as a sequence of the closing operation.

Slow speed maintenance earthing switches shall be operated locally only with the mechanism driven with a d.c. motor and manually. During the manual operation the supply circuit of the d.c. motor shall be automatically disconnected. Interlocks shall be provided to prevent unintentional use of this earthing equipment.

Earthing switches shall be arranged such that, with a minimum use of tools and special fittings, they may be used to facilitate such tests as CT primary injection, timing, voltage drop and resistance measurement without the necessity to open gas-filled compartments. The current rating and insulation level of the injection contact assemblies shall be adequate for the required testing parameters. Detailed means of performing these tests shall be provided. All earthing switches shall have insulation terminals to enable CT primary injection, timing test, cable fault detection, etc. without shut down of busbars or adjacent bays. The earth switch insulation terminal shall have a continuous voltage rating of 10kV and current rating of at least 1250A for 15 minutes.

9.0 INTERLOCKING

An interlocking scheme shall be provided which takes into account the following basic requirements.

(a) To safeguard maintenance personnel who may be working on one section of the equipment with other sections live.

(b) To prevent incorrect switching sequences which could lead to a hazardous situation to plant, equipment and personnel.

(c) To prevent earthing of live circuits.

(d) To prevent simultaneous operation of two or more devices of the same bay.

The interlocking scheme shall be electrical for all operational interlocks and preferably of the mechanical/key type for maintenance safety interlocks but shall be effective when the equipment is being controlled from driving mechanisms local control cabinet, remote control panels or system control centre.

All mechanical interlocks shall be applied at the point at which hand power is used so that stress cannot be applied to parts remote from that point.

All electrical interlocks shall so function as to interrupt the operating supply and a system of interlocks shall be provided which shall cover the emergency hand operation of apparatus which is normally power operated. Failure of supply or connections to any electrical interlock shall not produce or permit faulty operation. Electrical bolt interlocks shall be energised only when the operating handle of the mechanism is brought to the working position. Visible indication shall be provided to show whether the mechanism is locked or free. Means, normally padlocked, shall be provided whereby the bolt can be operated in the emergency of a failure of interlock supplies.

Where key interlocking is employed tripping of the circuit breaker shall not occur if any attempt is made to remove the trapped key from the mechanism. Any local emergency tripping device shall be kept separate and distinct from the key interlocking.

All disconnecting devices shall be interlocked with associated circuit-breakers and disconnectors in the same station so that it shall not be possible to make or break current on a disconnecting device unless a parallel circuit in that station is already closed.

In double busbar stations the provision for on-load changeover of busbars is required. The busbar disconnecting devices shall be so interlocked with the appropriate busbar coupling and sectioning equipments that sections or sets of busbars cannot be paralleled by means of the busbar disconnecting devices unless a parallel circuit is already closed through the

circuit-breakers of the appropriate busbar coupling and sectioning equipment. In all other circumstances, the busbar disconnecting devices of equipment other than busbar sectioning and coupling equipment shall be so interlocked that their respective circuit breakers can only be coupled to one set of busbars at a time. It shall not be possible to parallel sections of busbars except through the circuit breakers of the busbar coupling and sectioning equipment. The bus coupler CB tripping shall be inhibited during on-load bus transfer and trip circuit faulty alarm shall be initiated in such situation.

10.0 AUXILIARY SWITCHES AND CONTACTORS

Auxiliary switches shall be provided on all circuit breakers and disconnectors for local and remote & SCADA indication, control and interlocking. Repeat relays of special robust design may be used where necessary. Busbar protection should have direct driven auxiliary contacts for CT circuits. With each circuit-breaker, disconnecting device, and earthing device, there shall be supplied all necessary auxiliary switches, contactors and mechanisms for indication, protection, metering, control, interlocking, supervisory and other services. All such auxiliary switches shall be enclosed in dust free housing. Not less than ten spare auxiliary switch ways shall be provided with each circuit breaker, disconnector and earth switches. All auxiliary switches shall be wired up to a terminal board in the local control cubicle of the switchgear whether they are in use or not in the first instance and shall be arranged in the same sequence on all equipment.

Each busbar disconnector shall be supplied with three Nos. early make late break type, direct driven auxiliary contacts to be used for busbar protection CT circuits.

Switches shall be provided to interrupt the supply of current to the tripping mechanisms of the circuit breakers directly after the operation of the latter has been completed. All such switches and mechanisms shall be mounted in approved accessible positions clear of the operating mechanism and shall be adequately protected. The contacts of all auxiliary switches shall be strong and shall have a positive wiping action when closing. Direct acting auxiliary switch contacts shall be used in conjunction with busbar protection schemes.

If sufficient aux. contacts are not available, the contacts shall be multiplied by using suitable latching relays (bistable relays) so that the failure of DC supply shall not cause a mal-operation or undefined position of circuit breakers, disconnectors or earth switches.

If any discrepancy between the aux. contacts and latching relay contacts, this shall be monitored and alarmed locally and for remote indication.

All repeat relays are subject to approval of FEWA.

11.0 CURRENT TRANSFORMERS

Current transformers shall be of the toroidal core type preferably encapsulated in epoxy resin.

The current transformers shall contain no hygroscopic materials, which could affect the moisture contents of the SF6 gas in the CT chamber.

The rated short-time thermal current shall not be less than the through fault capacity of the associated circuit breakers.

The characteristics of current transformers shall be submitted to the Authority for approval together with details of the protection, instrumentation or measuring equipment with which each current transformer is to be used. Each current transformer shall be capable of providing the necessary output to operate the related devices satisfactorily at the lead burdens involved.

Each current transformer shall have a continuous extended current rating of at least l.2 times the rated current.

The characteristics and capacities of current transformers used for protection circuits shall be calculated by the relay manufacturer who shall prove by calculation, the suitability of the CT's being provided in conjunction with the relay manufacturers requirements for the relays and equipment offered.

Where multi-ratio secondary windings are specified a label shall be provided at the secondary terminals of the current transformer indicating clearly the connections required for each ratio. These connections and the ratio in use shall also be shown on the diagram of connections. All connections from secondary windings shall be brought out and taken by means of separate insulated leads to a terminal blocks specially designed for the CT circuits, mounted in the Local Control Cubicle. The secondary windings shall be earthed at one point through a removable link, which shall be in the relay panels for protection and in the control panel for instrumentation.

CT terminal blocks located in the local control cabinets shall have shorting/ disconnecting links to allow testing with the circuit in service and on load.

It shall be possible to carry out primary injection testing of the CTs including magnetising curve testing, when the switchgear is fully assembled, or retesting of the CTs during the service life of the switchgear without interruption of supply to adjacent circuits.

The secondary windings of each set of current transformers shall be capable of being open circuited for one minute with the primary winding carrying the rated current.

Unless otherwise approved, all current transformers shall be installed with the P1 terminals adjacent to the busbars. The polarity of the primary and secondary windings of each transformer shall be clearly indicated at the respective terminals and in addition labels shall be fitted in a readily accessible position to indicate the ratio, class and duty of each transformer.

The current transformer particulars as specified in latest IEC 60044-1 shall be given on an accessible plate mounted external to the current transformer.

Unless otherwise approved, current transformers shall be accommodated in a separate gas chamber adjacent to the circuit breaker.

12.0 VOLTAGE TRANSFORMERS

Voltage transformers shall be of electromagnetic type and of metal-enclosed design, which shall be compatible with the switchgear. They shall contain no hygroscopic insulating material, which could affect the moisture contents of the SF6 gas in the VT chamber. The bus voltage transformers shall be provided with motor operated disconnectors for disconnecting the VT for maintenance, testing etc. Line voltage transformers shall be supplied with manual disconnectors.

The voltage transformers shall be capable of discharging the capacitance of line, cables and switchgear, which may remain connected to them during switching operations. The Contractor shall declare any limitations of the equipment for this duty.

Voltage transformer secondary and tertiary circuits shall be provided with miniature circuit breakers or fuses as close to each voltage transformer as possible and shall be labelled with winding and phase indication. For single-phase voltage transformers separate earth links for each secondary shall be provided and each neutral lead shall be connected together at a single earth point in the local control cubicle. Earthing of the VT HV winding shall be through a link separate from the LV winding.

A fixed ladder or other arrangement shall be provided for each voltage transformer to enable an easy access to the voltage transformer and to the VT MCB/fuse box.

The ratio and phase angle errors of voltage transformers shall not exceed the permissible limits prescribed in the relevant Standard and shall be capable of meeting the following additional requirements from 5% rated primary voltage to 90% rated primary voltage:

Voltage error - not exceeding + 3%

Phase angle error - not exceeding + l20 minutes.

The voltage transformer shall have a voltage factor withstand rating of 1.2 continuous 1.9 times for 8 hours without saturation.

Voltage transformers shall be capable of carrying continuously without injurious heating 50% burden above their rated burden.

Damping resistors shall be supplied for VT open delta windings. The manufacturer shall submit the calculations of such damping resistors for FEWA approval.

The neutral side of all voltage transformers shall be earthed.

It shall not be possible for the voltage transformer secondary circuits to be connected in parallel, except through interposing voltage transformers associated with synchronisation scheme to prevent any possibility back energisation through synchronising circuits.

Mechanical shock indicators shall be fitted to the VT to indicate how the VT was handled during transit. Maximum allowed shock level should be specified by the manufacturer. In case that the shock indicator shows the shock record which is higher than the maximum allowed level, voltage transformer shall be returned to the factory for inspection and retesting, with all associated costs borne by the contractor. Opening of VT chambers shall not be allowed at site, unless otherwise approved by the Authority. The other requirements of VT shall be as per IEC 60044-2.

13.0 SF6 IMMERSED INSULATION

Busbars and items of switchgear shall be supported in the enclosures by insulators of materials compatible with SF6 gas and the products of gas decomposition.

Gas barrier insulators and bushings, including gas-oil and gas-air bushings shall comply with the specified conditions for sealing of enclosures. The Authority shall be advised of design pressures used and may require test evidence to substantiate performance under extremes of differential pressure and temperature.

The surfaces of insulation in contact with SF6 shall not be glazed or otherwise treated with silica compounds or other materials, which may deteriorate in the presence of decomposed gas or arcing products. Alternative glazing or surface treatment, which is compatible with SF6 and its by-products, may be acceptable subject to proved durability.

The insulators should be free at all times of partial discharges at all voltage levels within the working range and shall be tested for voids and partial discharges during manufacture.

SF6 immersed insulation shall otherwise comply with the relevant clauses for insulators and bushings.

The equipment shall be designed such that no heating elements will be required for satisfactory operation within the range of ambient temperatures and pressure encountered under service conditions.

The minimum dew point temperature in unheated SF6 gas filled equipment shall not exceed minus 20°C at the working pressure, measured at least 24 hours after the gas filling.

14.0 HV CABLE AND GIS TESTING FACILITY

A set of single and three-phase cable test bushings and the facility for connection to the switchgear shall be provided which will permit the full a.c. testing of all both-end cable connected circuits or the GIS. It shall be possible to connect the test bushings without dismantling other equipment and permit testing three single-core cables at the same time or separately. Adequate precautions shall be taken to ensure that any section of busbars insulated by SF6 gas is not subjected to any cable testing voltage unless able to withstand such voltages.

The test bushing, test conductors and associated auxiliary equipments shall be supplied by the GIS manufacturer as per the scope of work.

15.0 SEALING OF ENCLOSURES

To prevent ingress of moisture or leakage of gas during the service life of the equipment, the sealing materials used at all joints and interfaces shall satisfy the following requirements:-

(a) Not affected by SF6 gas

(b) Non-hygroscopic, containing no silicon

(c) Non-ageing and non-shrinking

(d) Retain resilience for long periods under stress

(e) Stable under all temperature conditions

Seals including those at compartment partitions shall continue to function correctly throughout the temperature and pressure ranges in service and the pressure differentials, including vacuum and test pressures, during erection, maintenance and subsequent revisions.

New seals shall be used after dismantling any of the sealed connection.

Expansion bellows and diaphragms and pressure relief devices shall be designed to be free of leakage under the same conditions as stated for seals.

Where the use of cast aluminium is envisaged, the Contractor shall submit to the Authority evidence of tests carried out for porosity and extended pressure testing to show the quality of the castings used.

16.0 GAS LOSSES

The Manufacturer should guarantee the equipment for a gas loss of not more than 1.0% per annum in any single gas compartment. In case of extensive and repeated gas leaks at any time during the warranty period, the Authority will have the right to request the contractor to replace the part of the assembly, which causes the leakage. All costs associated with such works shall be borne by the contractor.

17.0 LOCAL CONTROL CUBICLE

Each circuit-breaker bay shall be provided with a separate, free standing local control cabinet containing local control switches and a mimic diagram for the operation and status indication of the circuit-breaker and all associated disconnectors and earth switches together with selector switches to prevent local, remote/supervisory controls being in operation simultaneously. Integral LCCs are not acceptable.

Local manual release facilities shall be provided for closing and tripping the circuit breaker. The operation of both releases shall be subject to lockout if insufficient stored energy is available. Local manual releases shall be provided with locking off facilities.

Sufficient electrical terminals shall be provided for the termination and inter-connection of all cabling associated with remote and supervisory control, alarms, indications, protection and local ring main supplies. The low voltage control cables, terminations and accessories required for cabling between 132kV GIS and local control panel (LCC) shall be provided by the manufacturer.

The AC, DC wiring, CTs, VTs, etc. shall be wired in separate cables from GIS to LCC. Also, the early make late break contacts of Busbar disconnectors shall be wired in separate cables. The wiring inside LCC shall also be segregated as AC, DC, Bus wiring, CTs of each core, VTs, Synchronising, etc. Shrouds shall be provided for AC wiring, heater, lighting circuits etc.

The control switches, local/remote selector switch, mimic diagram, etc. shall be mounted behind the lockable glass panelled front door. Alternately a swing mounting frame inside the LCC and glass door in the front is also acceptable. The arrangement of glass panel, mounting of components etc. for the LCC is subject to the approval of FEWA during detail design stage.

Lockable control switches with spade type handles shall be provided for earth switches and disconnectors, whereas with pistol grip type handles for circuit breakers. All control switches shall be lockable and effective only when local mode is selected. A semaphore indicator is required for each device (CB/DS/ES etc.) as part of mimic diagram and each semaphore indicator shall be labelled with the device SCADA No. and identification (Eg : Q0, E3010 etc.). The colour of LCC mimic diagram shall be as per Vol. II Section 6.

If a DS or ES is not in the fully open or closed position “control circuit faulty” alarm shall be initiated and electrical operation of all the devices shall be locked.

A red colour emergency trip push button shall be provided for each LCC and shall be protected with suitable cover/flap. Voltmeter shall be provided for each LCC with a selector switch (7 positions) wherever VTs are available.

CTs, VTs, Transformer, etc. shall be properly integrated in the mimic diagram.

The colour of LCC shall be RAL 7032, internal colour shall be semi gloss white. The sheet steel thickness shall be minimum 2.5 mm. The LCC shall be supplied with gland plates separated as two halves. The anchoring bolts etc. for installing the LCCs shall be supplied. Each LCC shall have a copper earth bar of not less than 185 sq.mm. cross section. Provision shall be provided for drawing pockets and ventilation arrangement. The degree of protection of enclosure shall be at least IP52.

The terminal block for each application ie, CT circuits of each function, VTs, control, status and alarms, Scada circuits, AC supplies, DC supplies, bus wires etc. shall be properly segregated and labelled to suit the application and is subject to FEWA approval during engineering stage.

The CT terminal blocks shall have shorting, isolation and injection test facilities whereas VT terminals shall have isolation and injection test facilities ie, two separate types complying the above requirement shall only be applied for CTs and VTs. VT terminal blocks shall not have any provision for shorting. Ferrule Nos. shall be provided for all wiring as per the specifications of small wiring and termination. The control switches to be provided for local operation of CBs, disconnectors, earth switches etc. shall be lockable, spring return to neutral position type ie, 3 positions 'close - neutral - open'. However the local/remote selector switch shall be supplied with two positions type, lockable, key free in remote position only. LCC shall have door limit switches and panel illumination. Also a heater controlled by humidistat and heater on/off switch, 'heater on' indication lamp etc. shall be provided. A separate lamp test push button (black colour) for testing all the indication lamps shall be provided. All CT/VT and AC circuit wiring of the LCC shall be with minimum 2.5 sq.mm colour coded wires whereas other DC wiring shall be 1.5 sq.mm grey colour wires. The wires shall have voltage grade of 0.6/1kV. Also the specification for electrical small wiring and terminations enclosed in Vol. IV, Sec. 1 are applicable for all wiring in GIS, LCC etc.

Where control cabling between the local control cabinet and the switchgear are connected by plug and socket boxes, the plugs and sockets within the same bay shall not be interchangeable.

18.0 EARTHING SYSTEM

All metal parts other than those forming part of any electrical circuit shall be earthed to the earthing system. Any necessary terminals on any part of the equipment required for this purpose shall be provided.

Earthing conductor cross section shall be in accordance with the overall substation earthing system calculation. However, the following provisions shall be provided at GIS & LCC :

For GIS earthing - Provision for minimum 300 sq.mm. Cu cable

For LCC earthing - Provision for minimum 185 sq.mm Cu cable

For each GIS bay atleast two such terminals shall be provided.

19.0 LOCKING DEVICES

Locking devices shall be provided for securing each control switch in the "neutral" position, each control selector switch in all positions and for securing each disconnector and earthing switch operating handle in either the "open" or "closed" position. Padlocks, keys, master keys etc. shall also be supplied.

20.0 ANTI-CONDENSATION HEATERS

Anti-condensation heaters of an approved type shall be provided inside each cubicle. They shall be shrouded and located so as not to cause injury to personnel or damage to equipment. The heaters shall have humidistatic control and shall be arranged to cut off when the cubicle internal temperature exceeds between 30-35°C. and suitable humidity. A heater circuit switch shall be provided on each LCC panel with an indicating lamp to show whether the supply is on or off. Heaters shall also be supplied for operating mechanism boxes of CB, DS/ES etc.

21.0 GAS HANDLING EQUIPMENT

Mobile gas handling unit, the size of which shall allow full mobility within the switch room, shall be included for the complete sampling, testing, filtering, drying, extraction and refilling of SF6 gas. This unit shall be self-contained and comprise of a wheeled trolley housing all necessary compressors, vacuum pumps, gauges, piping and controls etc., together with a gas storage tank of min 250 ltr volume. The unit shall be capable of evacuating air from the switchgear compartments and replenishing them with gas at the end of a maintenance period. Facilities shall also allow for circulation of the gas from a compartment through filters in order to extract moisture pressure.

The gas handling unit handling and storage capacity shall be suitably sized as to enable gas evacuation and filling of the largest chamber to be carried out in not more than 6 hours.

All necessary pipe work, flexible hoses, (minimum two of each type) couplings and valves, shall be included to enable interconnection between the switchgear compartments, gas trolley and storage tanks and one cylinder filled with SF6 gas of minimum 40kg shall be supplied from major producers of SF6 gas. In addition, the SF6 gas required for site top up shall also be supplied within the quoted price.

One approved portable SF6 gas leakage detector, an oxygen analyser and a moisture meter shall be provided as per scope of work. This equipment shall be new, not used during the erection and commissioning of the switchgear. The equipment shall be delivered and handed over to the Authority along with other major equipments after testing and commissioning of 132kV GIS. The quantity required shall be as per scope of work. The calibration date of any of the above devices shall not be older than 6 months on the date of the handing over.

22.0 INSTALLATION

The installation/commissioning of the GIS is to be supervised by original manufacturer. Providing the manufacturers specialist for the above shall be contractors responsibility and in accordance with general requirement specification (Volume II Section 1) scope of work etc.

Minimum two months before the inspection of the equipments at works, three sets of installation manuals per each substation shall be submitted by the Contractor.

Minimum required conditions for the switchgear erection commencement should be detailed in the manual. Also the requirements for storing the equipment at site shall also be included in the manual.

Special attention shall be specified for completion of civil works inside the room prior to the erection commencement and to provide exceptionally clean conditions in the room all the time during the erection works.

QA check list procedure shall also be submitted along with the installation manual by the equipment manufacturer.

23.0 REMOVAL/INSERTION OF LINKS FOR HV CABLE TESTS AND PRIMARY INJECTION

The manufacturer's erection specialist shall be responsible for the degassing, removal of the cable chamber, VT's and links at the remote ends, and regassing to facilitate HV Cable Tests and Primary Injection if required by FEWA as per scope of work. Once the tests are complete the degassing, insertion of the links and regassing shall be completed thus allowing normal operation of the switchgear. This shall include replacement of gaskets as necessary.

24.0 TESTS

24.1 Type Tests

Type tests shall have been carried out on the switchgear components in accordance with the relevant IEC standards preferably by an independent test laboratory.

The performance of the components of the switchgear shall be substantiated by test data relevant to the particular designs offered. The type test certificates issued by Test Laboratories for the type of equipment offered or similar design shall be tabulated in the schedule enclosed with the tender.

Evidence of valid type tests shall be submitted with the Tender and shall include dielectric tests, temperature rise tests, short-time current tests and mechanical endurance tests together with evidence of tests to verify the making and breaking capacity of the included switching devices and other primary components. All other test certificates as per relevant IEC standard shall also be included.

Evidence of Type Tests should be provided, including the hydraulic system, for ambient temperature of 50oC and 100% humidity.

No additional costs will be allowed for type testing to meet specified requirements and should deficiencies in existing type test evidence occur then the cost of such additional or repeat tests as may be required by the Authority shall be deemed to be included in Contract Price, including the costs for witnessing the inspection/testing. FEWA reserves the right to ask for repetition of those type tests conducted in the manufacturers works (if such tests are not witnessed by independent observer from internationally accredited test lab) in presence of FEWA representatives and all the cost towards testing and witnessing by FEWA is deemed to be included in the tender price.

Clause reference of type tests and routine tests are listed below. Any other tests specified by the referred standard (current and future issues) but not listed shall be applicable as well.

24.1(a) Complete Bay

IEC 62271-203

Clause	
6.2	Dielectric tests
6.3	Radio interference voltage (r.i.v) test
6.4	Measurement of the resistance of circuits
6.5	Temperature-rise tests
6.6	Short time and peak withstand current tests
6.7	Verification of the protection
6.8	Gas lightness test
6.9	Electro-magnetic compatibility tests (EMC)
6.10	Additional tests as aux. & control circuit
6.101	Verification of making and breaking capacity
6.102	Mechanical and environmental test
6.103	Proof tests for enclosures
6.104	Pressure test on partitions
6.105	Test under conditions of arcing due to an internal fault
6.106	Insulator test
6.107	Corrosion tests on earthing connections

24.1(b) Circuit Breaker

IEC 62271-100

Clause	
6.2	Dielectric tests
6.3	Radio interference voltage tests (r.i.v)
6.4	Measurement of the resistance of the main circuit
6.5	Temperature-rise tests
6.6	Short-time and peak withstand current tests
6.7	Verification of the degree of protection
6.8	Tightness tests
6.9	Electromagnetic compatibility (EMC) tests
6.101	Mechanical and environmental tests
6.102	Miscellaneous provisions for making and breaking tests
6.103	Test circuits for short circuit making and breaking tests
6.104	Short-circuit test quantities
6.105	Short-circuit test procedure
6.106	Basic short-circuit test-duties
6.107	Critical current tests
6.108	Single-phase and double-earthfault tests
6.109	Short line fault tests
6.110	Out-of-phase making and breaking tests
6.111	Capacitive current switching tests

Additionally, the circuit breaker shall comply with 1EC 61233 in regard of inductive load switching.

24.l(c) Disconnector & Earth Switch

IEC 62271-102

6.2 Dielectric tests
6.3 Radio interference voltage (r.i.v) test.
6.4 Measurement of the resistance of the main circuit
6.5 Temperature-rise tests
6.6 Short-time and peak withstand current tests
6.7 Verification of protection
6.8 Tightness test
6.9 Electromagnetic compatibility (EMC) tests
6.101 Tests to prove the short-circuit making performance of earthing switches
6.102 Operating and mechanical endurance tests
6.105 Test to verify functioning of position indication
6.106 Bus transfer current switching test.
6.107 Induced current switching tests of earth switches.
6.108 Bus charging switching test of disconnectors.

24.1(d) Current Transformer

IEC 60044-1, BS 3938, IEC 6044-6

Type tests for Measuring Current Transformers & Protective Current transformers shall be done as per above specified standards.

24.1(e) Voltage Transformers

IEC 60186 & 60044-2

Type Tests for all Voltage transformers shall be done as per above specified standards.

24.2 Routine Tests

The routine tests on GIS, LCCs and accessories shall be carried out as per the latest edition of relevant IEC standard. The complete routine test report including GIS, LCCs, CTs, VTs, cables from GIS to LCC etc. arranged section wise for each bay shall be submitted to FEWA approval.

The GIS, LCCs and accessories are subject to routine witness test and inspection at manufacturer's works in presence of FEWA inspectors. All the GIS bays, LCCs and accessories shall be offered for routine witness tests and inspection in presence of FEWA representatives. All typical LCCs (OHL, cable, IBT, BC, BS etc.) shall be connected to GIS for routine witness test. During inspection by FEWA representatives at manufacturer's works, the quantity of GIS, LCCs, etc. which are ready and offered for inspection with their internal routine test report shall only be considered as inspected by FEWA. The balance items not ready during the inspection shall be subject to further inspection by FEWA. Total quantity as per BOQ may also be offered for routine witness test in different lots subject to approval of FEWA but minimum complete quantity of each substation shall be included in each lot of inspection.

The manufacturer shall submit the routine test procedure of complete GIS, CTs, VTs, LCCs, etc. at least 3 months before the inspection, for FEWA approval.

Also 2 sets of inspection packages (which shall include approved set of drawings, test procedure, copies of relevant standards, day wise test programme etc.) shall be submitted atleast one month before each inspection.

The following routine tests shall be conducted. In addition, any other tests referred by the standard but not listed below shall also be applicable.

24.2(a) Complete Bay

IEC 62271-203

Clause	
7.1	Dielectric tests on the main circuit
7.2	Tests on auxiliary and control circuits
7.3	Measurement of the resistance of the main circuit
7.4	Tightness test
7.5	Design and visual check
7.101	Pressure tests of enclosures
7.102	Mechanical operation tests
7.103	Tests on auxiliary circuits, equipment and interlocks in the control mechanism
7.104	Pressure test on partitions
--	Visual inspection and design check, schemes and interlocks check, LCC tests, gas pressure switch test, etc as required by FEWA.
--	Name plates check measurement of insulation resistance, earth continuity check .

24.2(b) Circuit Breaker

IEC 62271-100

Clause	
7.1	Dielectric tests on the main circuit
7.2	Dielectric withstand tests on control and auxiliary circuits
7.3	Measurement of the resistance of the main circuit.
7.4	Tightness Test
7.5	Design and visual checks.
7.101	Mechanical operating tests (including resistance and current measurement of Closing and trip coils and checking anti-pumping function, timing etc).
--	Measurement of operating time/timing diagram.

24.2(c) Disconnectors & Earth Switch

IEC 62771-102

Clause	
7.1	Dielectric tests on the main circuit
7.2	Dielectric tests on control and auxiliary circuits
7.3	Measurement of the resistance of the main circuit
7.4	Tightness test
7.5	Design and visual checks
7.101	Mechanical operation tests (including verification of early make late break feature of busbar disconnector aux. contacts).
--	Timing test, coil check etc.

24.2(d) CTs

Routine Tests to all current transformers shall be done as per IEC-6044-1, IEC 6044-6, BS3938 etc. In addition the following Tests are mandatory.

- Measurement of Secondary winding resistance
- Measurement of magnetizing current characteristics of all CTs
- Determination of Turns ratio Error for class PX CTs
- Verification of knee-point voltage for Class PX CTs
- Determination of remonance factor and transient performance of TPY CTs.
- Polarity test
- Measurement of insulation resistance
- Power frequency test on secondary winding
- Determination of errors (Accuracy test)
- Interterm over voltage test
- Appearance

24.2(e) Voltage Transformers

IEC 60044-2 / IEC 60186

Routine Tests applicable to Voltage Transformers as per specified standards.

- Visual inspection
- Gas tightness test
- Verification of terminal marking
- Winding resistance
- Power frequency withstand on primary
- Power frequency withstand on primary between sections and secondary
- Determination of errors
- Insulation resistance
- Operating test and power frequency voltage test on disconnecting device
- Dielectric test on auxiliary and control circuit
- Insulation resistance auxiliary and control circuit

Acceptance tests during inspection by FEWA's engineer in the works of CT, VT manufacturer shall comprise all the routine tests specified for the items. Reading for magnetic characteristics for all ratios of all class CTs shall be taken. Typical CTs & VTs shall be tested for witness inspection before assembling on GIS. FEWA shall decide the number but minimum 10% will be inspected.

24.2(f) Insulators

Routine tests to –

- IEC 60233 (BS 4963) for hollow porcelains
- IEC 60137 for bushings
- IEC 60168 and 60273 for high voltage post insulators
- IEC 60383 and 60305 for cap and pin string insulators.

The performance of the components of the switchgear shall be substantiated by test data relevant to the particular designs offered.

Evidence of type tests shall be submitted with the Tender.

24.2(g) Local Control Cubicle:

Major components of LCCs are to be tested and calibrated. Functional tests of LCCs to be carried out during factory acceptance tests.

- Mechanical and visual inspection
- Control wiring check
- Measurement of insulation resistance
- Dielectric test
- Control circuit test, interlocks etc.
- Coil check test
- Sequence test
- Measurement of paint thickness, earthing etc.

24.3 Site Tests:

The GIS manufacturer shall furnish the details of site test procedure, method statement, site test format etc. for the GIS, CTs and VTs, LCCs etc. with clear diagrams at least one month before delivery of GIS.

25.0 RATINGS

Switchgear and substation equipment shall be suitable for continuous operation on a 3-phase 50 Hz system of 132kV nominal voltage (Um = 145kV) as per "Design Criteria" and under the climatic conditions specified. The 132kV system is solidly earthed.

a) <u>Circuit Breaker</u>

Reference Standard	IEC 62271-100
Unless otherwise approved by FEWA, offered circuit breakers shall have the following rating :-	
Electrical endurance class	E1

Mechanical endurance class	M2
Restrike performance class	C2
Voltage	145 kV
Normal current, Bus coupler, Bus section (at 50^{o}C site rating)	2500 A
Normal current IBT Bays (at 50^{0} C site rating)	1600 A
Normal current, feeders (at 50^{0} C site rating)	1600 A
Frequency	50 Hz
Lighting impulse withstand voltage	650 kV
Power frequency withstand voltage (1 min)	275 kV
Short-circuit making current at 145 kV	100 kA
Short-circuit breaking current at 145 kV	40 kA
First-pole-to-clear factor	1.5
Operating sequence	O-0.3S-CO-3 min-CO
Duration of short circuit	1 s
Out-of-phase breaking current (factor 2.5)	10 kA
Line charging breaking current	50 A
Cable charging breaking current	160 A
Single capacitor bank breaking current	400 A
Back to back capacitor back breaking current	400 A
Shunt Reactor Switching duty	20 MV Ar
Supply voltage :	
Closing device	110 V d.c.
Opening device	110 V d.c.

b) <u>Disconnectors</u>

Reference standard	IEC 62271-102,61128
Voltage	145 kV
Lightning impulse withstand voltage	
phase to earth and between poles	650 kV
across isolating distance	750 kV
Power frequency withstand voltage (1 min)	
phase to earth and between poles	275 kV
across isolating distance	315 kV
Frequency	50 Hz
Normal current, Bus coupler, Bus section (at 50^{0} C site rating)	2500 A
Normal current IBT bays (at 50^{0} C site rating)	1600 A

Normal current, feeders (at 50^{o}C site rating)	1600 A
Short-time withstand current	40 kA
Peak withstand current	100 kA
Duration of short circuit	1 s
Supply voltage	
Closing device	110 V d.c.
Opening device	110 V d.c.
Mechanical endurance	M0/M1

c) Earthing switches

Reference standard	IEC 62271-102 & 61129
Voltage	145 kV
Lightning impulse withstand voltage	650 kV
Power frequency withstand voltage (1 min)	275 kV
Frequency	50 Hz
Short-time withstand current	40 kA
Peak withstand current	100 kA
Duration of short circuit	1 s
Supply voltage	
Closing device	110 V d.c.
Opening device	110 V d.c.

d) Fast acting earth switch

Reference standard	IEC 62271-102 & 61129
Voltage	145 kV
Lightning impulse withstand voltage	650 kV
Power frequency withstand voltage(1 min)	275 kV
Frequency	50 Hz
Short-time withstand current	40 kA
Short-circuit making current at 145kV	100 kA
Duration of short circuit	1 s
Supply voltage	
Closing device	110 V d.c.
Opening device	110 V d.c
Electrical endurance	E 1

e) Current Transformer CT

Reference standard	IEC 60044-1, BS3938, IEC 60044-6

Voltage	145 kV
Frequency	50 Hz
Lightning impulse withstand voltage	650 kV
Power frequency withstand voltage (1 min)	275 kV
Primary current	As per single line diagram
Secondary current	1 A
Output	** VA
Short-time withstand current	40 kA
Peak withstand current	100 kA
Duration of short circuit	1 s
Accuracy class	As per single line diagram and protection requirement

f) Voltage transformer

Reference standard	IEC 60186 & 60044-2
Voltage	145 kV
Frequency	50 Hz
Lightning impulse withstand voltage	650 kV
Power frequency withstand voltage (1 min)	275 kV
Accuracy Class	cl.0.5/3 P
Over voltage factor	120% continuous/190 % for 8 Hrs
Voltage ratio	$\frac{132}{\sqrt{3}}/\frac{0.11}{\sqrt{3}}$kV
Output	**

* Current rating as given in the single line diagram.
** Based on the approved CT/VT calculations.

g) Busbars

Voltage	145 kV
Frequency	50 Hz
Rated current (at 50^0 C site rating)	2500 A
Lighting impulse withstand voltage	650 kV
Power frequency withstand voltage (1 min)	275 kV
Rated short time current (1 Sec.)	40 kA

26.0 APPLICABLE STANDARDS

Except where modified by this specification, the switchgear/accessories shall be designed, manufactured, tested and commissioned in accordance with following latest IEC Standards and other publications quoted in these Standard:

IEC 62271 -100	High voltage alternating current circuit breakers.
IEC 62271 -102	Alternating Current disconnectors and earthing switches.
IEC 60694	Common clauses for high voltage switchgear and control gear standards
IEC 62271-203	Gas Insulated metal-enclosed switchgear for rated voltages of 52kV and above.
IEC 60376	Specification and acceptance of new sulphur hexafluoride.
IEC 61128	Alternating current disconnectos bus-transfer current switching by disconnectors
IEC 61129	Alternating current earthing switches - Induced current switching
IEC 60265	High voltage switches.
IEC 60137	Bushings for alternating voltages above 1000V.
IEC 60233	Tests for hollow insulators for use in electrical equipment.
IEC 60099-4	Metal - Oxide surge arresters without gaps for a.c. systems.
IEC 60044-1	Instrument transformers, Part-1 : Current Transformers
IEC 60044-2	Instrument Transformers, Part-2 : Voltage Transformers
IEC 60044-6	Instrument Transformers, Part-6 : Current Transformers
IEC 60186	Voltage transformers.
BS 3938	Current Transformers
IEC 61259	Requirements for switching of bus charging current by G1S disconnectors.
IEC 61233	High Voltage Alternating current circuit Breakers – Inductive Load Switching.
IEC 60059	IEC Standard Current Rating
IEC 61633	High Voltage Alternating Current Circuit Breakers-Guide for Short Circuit and Switching Test - Procedure for Metal Enclosed and Dead tank Circuit Breakers.
IEC 61634	High Voltage Switchgear and Control gear use and handling of SF6 in High voltage Switchgear and Control gear
IEC 62215	Guide for Asymmetrical Short Circuit Breaking Test Duty T10
IEC 60529	Degree of protection of enclosures

27.0 NAME PLATE / RATING PLATE / CIRCUIT LABELS

All devices including CB, DS, ES, CT, VT, busbars etc. shall be supplied with proper name plate and rating plate. All information as per the latest edition of relevant IEC and BS standards as applicable shall be included. Any additional information as per FEWA specific requirement shall also be included. All nameplate drawings shall be submitted to FEWA approval.

The switchgear and LCC shall be adequately labeled at the front and rear of the fixed portion of equipment in English. Provision shall also be provided for Arabic labels.

The label shall include Bay No., Scada number and Circuit name as per the approved SLD. The engraved circuit labels shall have black labels on white background.

Circuit labels shall not be fitted on detachable doors or covers.

28.0 TECHNICAL DATA SHEETS & GUARANTEED PARTICULARS:

The technical guaranteed data shall be completely filled in and to be submitted alongwith tender. The statement such as “To be advised later”, “To be given after contract award”, or “equivalent” etc. are not acceptable.

29.0 CIVIL CO-ORDINATION:

The GIS manufacturer shall submit the following details during design approval stage.

1. Foundation plan, floor opening, etc. of GIS.
2. GIS layout drawing indicating all clearances.
3. The required capacity of EOT crane.
4. Static and dynamic load of GIS.
5. Heat dissipation of 132kV GIS, LCCs etc. to finalize ventilation design.
6. AC/DC load requirement (standing and maximum).
7. HVAC test set up of 132kV Cables.

30.0 TECHNICAL DOCUMENTS TO BE INCLUDED WITH TENDER OFFER:

In addition to the items listed above, the following documents shall also be included in the tender submission;

1. Single line diagram.
2. Gas section diagram
3. Lay out of GIS.
4. All schedules duly filled in
5. List of deviations from specification, if applicable (as per relevant schedule)
6. Evidence of type test report
7. Detailed catalogue, literature of proposed GIS, its service record in Middle East/GCC etc.
8. Any other documents indicated elsewhere in the specification

31.0 CO-ORDINATED SCHEME

The GIS and LCC schematic diagram shall be properly co-ordinated and interfaced with relay panels, control panels, busbar protection, MV side of IBTs etc. The contractor shall submit co-ordinated GIS and LCC schematic diagram including the interface terminal numbers, drawing number, sheet reference etc. of relay panel, control panel, busbar protection, LVAC, DCDB etc. Such schematic diagrams shall be submitted for each bay separately.

The co-ordinated schematic diagram of each bay shall contain all relevant schemes (switchgear and LCC, control panel, relay panel etc.) bunched together in a single folder with proper cross references.