

TECHNICAL SPECIFICATIONS

1.00 GENERAL SCOPE OF WORK

The scope of work shall cover internal and external electrical works for **Animal House for IIM at Jammu**. The scope of work covers major electrical equipments as per BOQ. Also, supply, installation, testing and commissioning of electrical works of the project including the following main items/systems:

- i. H.T. Sub-station including VCB panel, Transformers, HT cables etc
- ii. Main LT , Capacitor panels (APFC), MV Panels.
- iii. DG sets including AMF panels etc.
- iv. MCB Distribution Boards.
- v. Internal electrification through concealed MS conduit and provide light points, fan points, socket outlets etc. including supplying, installation, testing and commissioning of light fixtures, fans etc.
- vi. Conduiting and wiring for telephone points including Main Telephone Distribution Boards (Tag Blocks), telephone outlets etc. complete with telephone cabling from tag blocks to telephone outlets including EPABX, telephone instruments etc..
- vii. Addressable Fire Detection & Alarm System consisting of Main Fire Control & Indicator Panel, Smoke & Heat Detectors, Manual Call Points Hooter etc. including conduiting/wiring & cabling complete.
- viii. Conduiting and wiring for Cable TV system
- ix. Conduiting for computer networking and LAN.
- xi. UPS System.
- xi. CCTV, video conferencing.
- xii. Lightning protection system consisting of lightning arrestor, finial, horizontal and vertical strips, test joints, earth electrodes etc.
- xiii. Lifts
- xiv. LT Cabling.

- xv Earthing, safety equipments and misc items required for electrical installation complete in all respect.
- xvi Out door lighting
- xvii Testing and commissioning of all electrical installations
- xviii Any other items/ works required for the completion of electrical works.
- xix Enhancement/Sanctioning Electrical Load from State Electricity Board.
- xx Submission of GA drawings of electrical equipments and getting approvals from Client/ Owner before manufacturing/fabrication.
- xxi Obtaining approvals from Chief Electrical Inspectors, Local Electricity Supply Authority, Telecom Department, and any other statutory authorities for the complete scope.
- xxii Approval from CCE Nagpur for Diesel tank and pollution control for DG set.
- . Contractor shall submit equipment drawing from manufacturer along with the layout etc. and working drawings for approval from HSCC Electrical Engineer before manufacture / commencement of work at site.
- xxiii Contractor has to submit the working drawing of internal electrification based on our tender drawings for the approval of HSCC Electrical Engineer before commencement of work.
- xxiv Contractor has to take the approval of DB schedule/drawing of each DB from HSCC.
- xxvi Incase, details of any electrical item/ system are left out, then kindly refer the CPWD specifications & approval from Engineer.

2.0 REGULATIONS AND STANDARDS

- 2.1 **All equipments their installation, testing and commissioning shall conform latest CPWD/ IS specifications in all respects.** Indian Standard Code of Practice for Electrical Wiring Installation IS:732-1989. It shall also be in conformity with Indian electricity Rules and the Regulations, National Electric Code, National Building Code, latest CPWD specifications amended up to date and requirements of the Local Electric Supply Authority. In general, all materials equipment and workmanship shall conform to the Indian Standards specifications and code. Mode of all measurement will be as per latest CPWD norms/ specifications Some of the applicable codes/standards are as under:

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| a) | CPWD General specifications for electrical works | Part-I (Internal)- 2005 |
| b) | CPWD General specifications for electrical works | Part-II (External)-1995 |
| c) | CPWD General specifications for electrical works | Part-III (Lifts & Escalators)-2003 |
| d) | CPWD General specifications for electrical works | Part-IV (Substation)-2007 |
| e) | CPWD General specifications for electrical works | Part VII (DG Sets) 2006 |
| f) | CPWD Specification/norms for measurement | Latest revision |
| g) | Guide for marking of insulated conductors | IS 5578 |
| h) | Guide for uniform system of marking and identification of conductor and apparatus terminals. | IS 11353 |
| i) | Low voltage switchgear and control gear assemblies | S 8623 Part-1 to 3 |
| j) | Specification for low voltage switchgear and control gear | IS 13947 |
| k) | Enclosed distribution fuse boards and cutouts for voltages not exceeding 1000V AC and 1200 V DC | IS 2675 |
| l) | Code of practice for selection, Installation and maintenance of switchgear and control gear. | ISI 10118 Part – 1 - 4 |
| m) | Low-voltage fuses for voltages not exceeding 1000V AC or 1500V DC | ISI13703 Part-1&2 |
| n) | PVC insulated (heavy duty) electric cables | IS 1554 |
| o) | PVC insulated cables for working voltages upto and including 1100V. | IS 694 |

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| p) | Conduit for electrical installations | IS 9537 |
| q) | Accessories for rigid steel conduits for electrical wiring | IS 3837 |
| r) | Boxes for the enclosure of electrical accessories | IS 14772 |
| s) | General and safety requirements for luminaries | IS 1913 |
| t) | Code of practice for earthing | IS 3043 |
| u) | Electrical accessories – circuit breakers for over current protection for household and similar installations. | IS 8828 |
| v) | Low voltage switchgear and control gear | IS 13947 part 1 – 5 |
| w) | Residual current operated circuit breakers | IS 12640 |
| x) | Current Transformers | IS 2705 |
| y) | Voltage Transformers | IS 3156 |
| z) | Direct acting indicating analogue electrical measuring instruments and their accessories | IS 1248 part – 1 to 9 |
| A1) | Control Switches (switching device for control and auxiliary circuits including contactor relays) for voltages upto and including 1000V ac and 1200V DC. | IS 13947 & IS 1336 |
| B1) | Dry type power transformer | IS 11171 |

In case of contradiction in specification the priority of the documents shall be as follows:

CPWD/ IS specification, BOQ, drawings, Technical specifications.

3.0 H.T. SUBSTATION

3.1 11 KV VACUUM CIRCUIT BREAKER PANEL BOARD

3.1.1 GENERAL:

Vacuum Circuit Breaker shall be incorporated in H.T. Panel wherever specified. VCB's shall conform to IEC 298 and 694 IS 3427, BS 5227 and VDE 0670, part 6 as well as the regulations mentioned therein. VCB's shall be suitable for operation on 11kV, 3 phase, 50Hz, AC supply.

3.1.2 TYPE AND CONSTRUCTION:

The metal clad panel shall be fully extensible and compartmentalized to give.

- a. Circuit Breaker Compartment
- b. Busbar Compartment
- c. CT and Cable Compartment

3.1.2.1 The compartments shall be safe to touch and compartments thus formed shall be dust proof & vermin proof. A separate metering chamber for fixing the necessary instrumentation metering and protective equipment shall provided.

3.1.2.2. The VCB shall consist of three air insulated poles incorporating mechanism of interrupters. The body of interrupters shall be made of nickel chromium steel supported on insulators made out of metalised aluminum oxide. The contacts shall be of chromium copper and butt shaped.

3.1.2.3 Vacuum circuit breaker shall be mounted on truck or a carriage mechanism. In case of truck mechanism, the breaker shall be on a trolley while in a carriage mechanism, shall be separate door and it shall be possible to perform all operations with front door closed. The draw out carriage shall have two positions for the circuit breaker viz isolated/test & service position. Bus bars shall be insulated type made of high conductivity copper supported on cast epoxy monobloc designed to withstand full short circuit currents and shall be provided all along the length of the H.T. board.

3.1.2.4 It shall be horizontal isolation, horizontal draw out type, fully interlocked, with dust and vermin proof construction, suitable for indoor instillation. The panel shall be supplied with the manufacturer's test certificates.

3.1.2.5 Certificates with date of manufacture and shall be complete in all respects as per details in the schedule of quantities. The steel work should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric

acid and recognized phosphate process and shall then be given power coating (Electrostatic) paint of manufacturer's standard shade.

- 3.1.2.6 The switchgear constructions shall be such that breaker operation and internal explosions do not endanger the operating personnel, and the front of the panel shall be specially designed to withstand these. Pressure relief flaps shall be provided for safely venting out gases produced inside the high voltage compartment, bus bar compartment and termination compartment. These flaps shall be vented upwards and cannot be opened from outside. These relief flaps shall be of such construction as not to permit ingress of dust/water in harmful quantities under normal working conditions. Enclosure shall be constructed with sheet steel of at least 2.0mm thickness. It shall have a rigid, smooth, leveled, flawless finish.
- 3.1.2.7 Voltage transformer of burden not less than 100 VA and a proper ratio as specified shall be provided in the incoming panel. The accuracy class for the VT shall be 0.5 as per IS 3156 parts I to III for incomers and class 1 for outgoing panels. The transformer shall be of cast epoxy resin construction. It shall be fixed/ withdraw able type. HRC fuses/ MCBs shall be provided on both HV and LV side.
- 3.1.2.8 The making contact arms (upper & lower) of the circuit breaker shall be encased in polypropylene tubes. Penetration type bushings shall be provided in the busbars & cable compartment for the fixed contacts.
- 3.1.2.9 Safety shutters shall be provided to cover up the fixed high voltage contacts on busbar and cable sides when the carriage is moved to Isolated/Disconnected position. The shutters shall move automatically with the movement of the draw out carriage. It shall, however, be possible to open the shutters of busbars side and cable side individually.
- 3.1.2.10 Mechanically operated circuit breaker auxiliary switches of minimum 5 NO + 5 NC ways, shall be provided for control and indication purposes. Control wiring shall be done by 1.5 sq. mm; 1.1kV grade stranded copper PVC insulated cable. All control fuses shall be HRC link type.
- 3.1.2.11 Terminal blocks shall be clamp type suitable for connection of only 2 wires per terminal and shall be 650 V grade. The L.T. control circuit shall be routine tested to withstand 1.5kV for one minute.
- 3.1.2.12 Busbar compartment shall be provided at the rear. Electrolytic copper busbars shall be of rectangular cross section and insulated. Busbars shall be supported properly by cast epoxy resin insulators so as to withstand thermal and dynamic stresses during system short circuits. Busbars shall be provided with necessary color coding for phases indication. The busbars shall be designed to withstand a temperature rise of 60 deg. C above and ambient temperature of 45 deg. C.

3.1.3 BUSBAR AND REGULATORS

- 3.1.3.1 All busbars and jumper connections shall be of electrolytic copper conforming to relevant IS standards. They shall be adequately supported on epoxy insulators to withstand electrical and mechanical stresses due to specified short circuit currents. Busbar cross section shall be uniform throughout the length of switch board.
- 3.1.3.2 Contact surface at all joints shall be properly cleaned and No-oxide grease applied to ensure an efficient and trouble free connections. All bolted joints shall have necessary washers for maintaining adequate contact pressure. All connection hardware shall have high corrosion resistance.
- 3.1.3.3 Busbar insulators shall be of track-resistance, high strength, and non-hygroscopic, non-combustible type & shall be suitable to withstand stresses due to over voltages and short circuit current. Busbar shall be supported on the insulator such that the conductor expansion and contraction are allowed without straining the insulators. The temperatures of the busbars and all other equipments, when carrying the rated of relevant Indian Standards, duly considering the specified ambient temperature.

3.1.4 EARTHING AND PROTECTIVE EARTHING

- 3.1.4.1 Copper earthing bus shall be provided. It shall be bolted/ welded to the framework of each panel. The earth bus shall have sufficient cross time fault currents to earth without exceeding the allowable temperature rise. Suitable arrangement shall be provided at each end of the earth for bolting. Earthing conductors and earth bus shall run inside at the back of the panel for entire length. Facilities shall be provided for integral earthing of busbars & feeder circuit. Earthing rod consisting of 16 Sq.mm. stranded/flexible copper cable 15 Mtr. long and connectors shall be supplied. Cost of this earthing rod is deemed to be included in the cost of VCB Panel.

3.1.5 METERING AND PROTECTION

- 3.1.5.1 The VCB Panel Board shall be provided with epoxy resin current transformers for metering and protection. The protection CTs shall be of accuracy class 5 P 10 of IS 2705- Part-III-1992. The metering CTs shall confirm to the metering ratio and accuracy class 0.5 of IS 2705-1992 for incomer and class 1 for outgoing feeders. Ammeter and voltmeter to be installed on panel shall be of moving iron type or as specified in the BOQ. All meters shall be 96mm square pattern, flush mounting type with necessary selector switches. Necessary indicating lamps of low voltage type with built in resistors shall be provided (maximum wattage 2.5W).

3.1.6 OPERATING MECHANISM

- 3.1.6.1 Vacuum Circuit Breaker shall be equipped with motorized spring charge. These operating mechanisms shall be of the stored energy type. In the closed state of the breaker, the energy stored in the springs shall be suitable for O-C-O duty.

3.1.6.2 Interlocking and Safety Arrangement

3.1.6.3 Vacuum Circuit Breaker shall be provided with the following safety and interlocking arrangements:

- i. The draw out carriage cannot be moved from either test/disconnected to service position or vice versa, when the circuit breaker is 'On'.
- ii. The circuit breaker cannot be switched 'ON' when the carriage is in any position between test & service position.
- iii. The front door of the panel cannot be opened when the breaker is in service position or in an intermediated position.
- iv. The low voltage plug & socket cannot be disconnected in any position except test/isolated position.
- v. The door cannot be closed unless the LV plug has been fitted.
- vi. It shall be possible to mechanically close and trip the circuit breaker through push buttons with the circuit breaker in service position and the door closed.
- vii. Individual explosion vents shall be provided for breaker, busbar, cable chambers on the top of the panel to let out the gases under pressure generated during an unlikely event of a fault inside the panel.
- viii. Circuit Breaker & sheet metal enclosure shall be fully earthed.
- ix. Self locking shutters shall be provided which close automatically and shall be interlocked with the movement of the draw out carriage mechanism.

3.1.7 Rating:

3.1.7.1 The rating of the vacuum circuit breaker shall be as per the drawings and schedule of quantities. The rated/breaking capacity of the breaker shall be 350 MVA (18.37 KA RMS) at 11 kV. The rated making capacity shall be as per the relevant standards.

3.1.8 Accessories:

3.1.8.1 Circuit Breakers shall be provided with the following accessories.

- i. Auxiliary Switch with minimum 5 NO+ 5 NC auxiliary contacts.
- ii. Tripping Coil
- iii. Mechanical Operation Counter
- iv. Spring Charging Handle

3.1.9 Additional Accessories

3.1.9.1 The loose items to be supplied with the 11kV VCB Panel Board shall comprise of the following:

- a. Instruction Book.
- b. Maintenance Manual.
- c. Reaching in/out handle.
- d. Handle for spring charging mechanism.
- e. Foundation bolts.
- f. Busbar Earthing & Circuit Earthing Trolley.

3.1.10 Mounting

3.1.10.1 Vacuum Circuit Breakers shall be mounted as per manufacturer's standard practice.

3.1.11 Auxiliary Supply

- a. The tripping shall be at 24 Volt D.C. through a power pack unit.
- b. Space heater indication & other auxiliary supply requirement shall be at 230 V AC. Necessary termination arrangements complete with isolating switch, control fuse & link shall be provided at one place in the panel for receiving the purchaser's cable.

3.1.12 TESTS

3.1.12.1 Factory Tests

The circuit breakers panel shall be subjected to routine tests at manufacturer's works in accordance with the details specified in the relevant IS specifications. These shall however necessarily comprise of the following.

- a. Power frequency voltage test on the main power circuit.
 - b. Verification of the correct wiring/Functional Test.
 - c. Dielectric test at 1.5kV on the control circuit. Apart from above, the vendor shall submit the routine test certificates for the following equipment.
 - i. Circuit Breakers
 - ii. Current Transformers
 - iii. Voltage Transformers
- The vendor shall submit the type test certificate for following along with the offer.
- a. Temperature rise test.
 - b. Impulse & power frequency voltage test
 - c. Short time current test on circuit breaker.

3.1.13 Site Test

3.1.13.1 General

1. Verification for completion of equipment, physical damage/deformities.
2. Alignment of panel, interconnection of busbars & tightness of bolts & connection etc.
3. Interconnection of panel earth busbar with plant earthing grid.
4. Inter panel wiring between transport sections.
5. Cleanliness of insulators and general Cleanliness of panel to remove traces of dust, water etc.

3.1.13.2 Circuit Breaker & Panel

1. Check for free movement of circuit breaker, lubrication of moving part & other parts as per manufacturers manual.
2. Manual/Electrical operations of the breaker and Functional test as per drawings.
3. Meggar before the Hi Pot test.
4. H.T. Test - Hi Pot test (Power frequency withstand test for one minute at 28kV RMS). At site Hi Pot test is carried out at 80% of 28kV RMS value.
5. Meggar after the Hi Pot test.
6. CT/PT ratio/polarity primary injection test.
7. Secondary injection test on relays to practical characteristics.

3.2 HT CABLES

3.2.1 Construction

All H.T cables shall be of 11kv grade XLPE earthed insulated & PVC sheathed flat steel wires (strips) armored electrical purity aluminum conductor cables shall be manufactured & tested in accordance with IS Specification.

3.2.2 TERMINATION JOINTS

Terminal joints shall be carried out as per IS specifications. Heat shrink cable termination kit shall be used for terminations.

3.2.3 INSTALLATION OF CABLES

Cable laying shall be carried out as per CPWD specifications.

3.3 11 KV TRANSFORMERS (OLTC TYPE)

GENERAL

The transformer shall be double wound core type, oil naturally cooled suitable for indoor installation. The transformer shall be designed shall be designed and

manufactured as per IS specification and having no load voltage ratio as 11000/433v. **Transformer should have efficiency not less than 98% on full load.**

SPECIFICATION STANDARD

Unless otherwise stated below, transformer & transformer oil shall conform to IS 2026 & 335 respectively.

SYSTEM OF SUPPLY

KV 3 phase, 50 Hz system

NO LOAD RATIO

11000/433 volts

KVA RATING

Transformer shall be suitable for continuous rating as stated in BOQ and on drawing.

TYPE

Indoor

WINDING

The transformer shall be copper wound.

CORE

The magnetic core shall be made up of cold rolled grain oriented low loss steel stampings.

COOLING

Natural oil cooling by means of pressed/round tubes around transformer tank (ONAN)

FREQUENCY

50Hz plus minus 3%

RATED VOLTAGE

Transformer shall operate at its rated KVA at any voltage plus minus 10% of rated voltage of that particular tap.

VECTOR GROUP

Corresponding to the vector symbol Dyn-11

CONNECTIONS

H.V side of transformer shall be provided with suitable size cable box for 3 core XLPE cable. Indoor heat shrinkable termination kit shall be used for termination of HV Cable. MV side of transformer shall be suitable for bus duct connection arrangement.

TAPPING

ON load tap changing arrangement on 11kv side. The range for circuit taps, which shall be provided on H>V side, shall be plus 5% & minus 15% in steps of 1.25%

TEMPERATURE RISE

The transformer shall conform to the requirements of temperature rise specified in IS: 2026(Part II) 1977. Continuously rated for full load, temp. rise not to exceed 50 degree C by thermometer in oil (55 degree C by resistance)

INSULATION LEVELS

The insulation levels shall be in accordance with IS 2076(Part III) 1977.

TERMINAL MARKINGS, TAPPING & CONNECTIONS

The terminal marking, tapings & connections shall be in accordance with IS 2026(Part I V) 1977.

REQUIREMENTS WITH REGARDS TO ABILITY TO WITHSTAND SHORT CIRCUIT.

As per IS 2026 (part I) 1977

IMPEDANCE VOLTAGE

As per table 3 of IS 2026 (part I) 1977

ON LOAD TAP CHANGING SWITCH

On load tap changer with RTCC panel and AVR

PARALLEL OPERATION

Transformer shall be suitable for parallel operation with similar unit of same rates.

FITTINGS

The following accessories and fittings shall be provided with the transformer

- i. **LIFTING LUGS:** The arrangement of lifting the active part of the transformer along with the cover of the tank by means of lifting lugs without disturbing the connections. Also complete transformer lifting lugs shall be provided.
- ii. **ROLLERS:** The transformer to be provided with 4 Nos. rollers fitted on cross channels to facilitate the movement of transformer.
- iii. **OIL CONSERVATOR:** The transformer to be provided with a conservator with welded end plates. It is to be bolted to the cover and can be dismantled for purposes of transport. It has to be provided with oil gauge with marking for minimum level and an oil filling hole with a cap which can be used for filtering of oil. For draining purposes a plug is to provide. A connection pipe between the conservator and tank is to be provided, which projects inside the conservator.
- iv. **AIR RELEASE VALVE:** An air release valve shall be provided on top of the tank cover to facilitate of the entrapped air while filling of oil.
- v. **BREATHER:** The transformer shall be provided with an indicating dehydrating silica gel breather of sufficient capacity.
- vi. **DRAIN VALVE WITH PLUG:** The transformer to be provided with drain valve with plug at the bottom of the tank.
- vii. **DIAGRM WITH RATING PLATE:** One diagram and rating plate indicating the details of transformer connection diagram vector group tap changing diagram etc.
- viii. **THERMOMETER:** Dial type thermometer (150mm dia) with maximum set pointer 75 degree C electrical contacts for electrical contacts for electrical alarm at high temp.
- ix. **EXPLOSION VENT:** Explosion vent or pressure relief device shall be provided of sufficient size of rapid release of any pressure that may be generated within the tank and which might result in damage in the equipment. The device shall operate at a static pressure less than the hydraulic test pressure for transformer tank.
- x. **FILTER VALVE:** Filter valve on the top of the tank.
- xi. **BUCHOLTZ:** Oil actuated relay equipment shall conform to IS 3637-1966(amended up to date) and shall be double float type having contacts which close following oil surge or under incipient fault condition. Bucholtz relay shall have contacts for alarm / trip.
- xii. **WINDING TEMPERATURE INDICATOR :**
- xiii. **Winding temperature indicator with electrical contact for alarm/ trip**
- xiv. **OIL TEMPERATURE INDICETOR:** Oil temp. Indicator with alarm & trip contacts.

- xv. **MARSHALLING BOX:** the transformer shall be provided with suitable size marshalling box to terminate the control cables of thermometer and bucholtz relay.
- xvi. **CONTROL CABLING:** all control cables required from Marshalling box to H.T panel board for Trip/alarm of winding temp. Indicator, oil temp indicator, Buckholz relay etc. shall be provided and deemed to be included in the rate of transformer equipments.
- xvii. **TRANSFORMER OIL:** First filling of oil.
- xviii. **EARTHING:** Two separate earthing terminals are to be provided at the sides of the tank on both the sides for earthing.
- xix. **ON LOAD TAP CHANGER;** High speed resistor type OLTC shall be provided along with RTCC and AVR.

SOAK PIT

Soak pit for oil filled transformer shall be made as per IS 10028 (Part II) 1981 with up to dated amendments. Sump shall be formed in the transformer room and shall be connected to soak pit outside the transformer room with a pipe. All the civil works required for the soak pit shall be done by the contractor and the cost shall be deemed to be included in quoted rates of the transformer item.

INSTRUMENTATION MANUAL

The successful bidder shall submit three copies of manual of complete instructions for the installations, operations, maintenance and repair, circuit diagrams, foundations and trenching details shall be provided with the transformer.

SHOP DRAWINGS

The selected supplier shall prepare and furnish shop drawings for the approval by the consultant/client before commencing fabrications/ manufacture of the equipment. Shop drawing shall be based on the requirement laid down in the specifications. The manufacture of the equipment shall be commencing only after the shop drawings have been approved in writing by the consultant. Transformer shall be manufactured conforming to specification of Local supply authority.

INSPECTION

- i) The transformer shall be inspected on arrival as per the inspection manual of the supplier
- ii) Shall be examined for any sign of damage and special attention shall be given to the following parts.

- Oil tank and cooling tubes
- Bushes cracks or broken
- Oil sight glass

INSTALLATION

- i) The transformer shall be installed as per transformer manual of the transformer supplier and conforming to Indian standards.
- ii) The transformer is to be erected on suitable size M.S channels embedded in the cement concrete flooring including providing & fixing the channel. The transformer supplied shall be lifted by all lifting lugs for the purpose of avoiding imbalance in transit.
- iii) The transformer wheels shall be locked by suitable locking arrangement to avoid accidental movement of the transformer.
- iv) The transformer cable end boxes shall be sealed to prevent absorption of moisture.
- v) The transformer natural earthing and body earthing shall confirm to Indian Standard.

FACTORY TEST

The transformer shall be subjected to test as laid down in IS 2026 (Part I) 1977 at factory/manufacturing unit prior to dispatch of the transformer to the site.
All original test certificates shall be furnished.

TESTING AT SITE

Prior to commissioning of the transformer the following tests shall be performed

- i) Insulation resistance of the winding between phases and earth of H.V and M.V side.
- ii) Winding resistance of all the winding on all tap positions shall be taken.
- iii) Di-electric strength of the transformer oil shall be checked in accordance with India standards. In case the test is not satisfactory, the oil shall be filtered till proper dielectric strength of oil is obtained.
- iv) The supplier gives sufficient advance information about the test schedule to enable the owner to appoint his representative.

HIGH SPEED RESISTOR ON LOAD TAP CHANGER

GENERAL

High speed resistor on load tap changer shall be provided with the transformer wherever specified. The high speed resistor OLTC shall be for rated voltage up to 11KV rating current of 100 Amp, 3phase, 17step conforming to Indian standard with AVR & RTCC panel.

TYPE AND CONSTRUCTION

OLTC shall be a compact unit for use with three phase distribution transformer. It shall be completely self contained and designed to bolt directly to a part flange on the transformer.

The assembly comprise of

1. Tank
2. Selector Switch
3. Driving Mechanism
4. Barrier Board
5. Local control Gear
6. Control cable Terminations
7. AVR & RTCC panel

TANK

The complete tap changer shall be housed in a single tank of welded sheet steel construction. The tank shall be divided into two separate compartments to house the selector switch, driving mechanism and Local control gear. Access to the compartments shall be made easy by means of removable covers and a weather proof door. Anti- condensation heater shall be provided in the compartment which houses driving mechanism and control gear.

SELECTOR SWITCH

The three phase of the tap changer shall be adequately spaced for full interphase insulation but mounted as a common assembly using vertical synthetic resin bonded insulating boards, each carrying a circle of fixed contacts. Insulating rods and tubes shall be used for the horizontal spacing of the phases and the fixed contacts shall be connected via the barrier board to appropriate trappings in the transformer winding. Each phase shall have a single rotary contacts support ring with sliding contact take off connection. This ring carries separately insulated spring loaded snap connected by a non inductive resistance unit accommodated on the contact carrier. One main moving contact shall be connected directly to the center boss take off point, the second; transition moving contact shall be connected to the resistor. The three contact support rings shall be attached to the central insulating drive shaft, which rotates in self aligning ball bearings in the two outer phase boards. This center shaft shall be of glass reinforced synthetic resin construction .access to the selector switch shall be via removable cover on the top of the tank.

DRIVE MECHANISM

Operation of the selector switch shall be by means of a stored energy spring device having appositve snap- action for rotating the moving contacts quickly through the angle required for each tap change. The driving mechanism compartment shall be

external to the oil filled switch tank. The rotary drive from the driving mechanism to the selector switch shall pass through a frictionless positive oil tight gland. The angular movement of selector switch shaft shall be controlled by an indexing wheel which shall be positively locked by the periphery of the operating cam except during the actual time of tap – change operation. The operating cam shall be freely mounted on its shafts, rotation being imparted to it by means of tension springs attached radially between the operating cam hub and the periphery of a concentric spring carrying gear wheel. The spring carrying gear wheel shall be rotated by a driving motor through cam. When the drive pin on the operating cam enters the slot in the indexing wheel the lock shall be disengaged but rotation shall be prevented by the locking arm pawl engaging in other slot of indexing wheels. The spring carrying gear wheel continues to rotate thus charging the springs. When sufficient energy has been stored a trip pin on the gear wheel shall lift the rocking arm restraining the indexing wheel and the spring energy shall be released to move the tap selector switch one position the cam locking coming in operation accurately controlling the angular movement.

The operation of the selector switch shall be thus positively assured and shall be dependent only upon the quick release of the spring energy. It shall be thus independent of the motor drive. The tap changing sequence shall now be complete and the driving motor shall be brought to rest by the resetting of auxiliary switches and mechanical friction device. For protective purpose automatic declutching by shear pins shall be incorporated in the drive. The mechanism shall be provided with the auxiliary switches necessary for its operation. A step by step switch for position indication shall also be fitted and additional paralleling & out of step switches provided. A tap change mechanical counter, mechanical tap position indicator, mechanical end stops and electrical limit switch shall be provided. A detachable handle for hand operation shall be provided. The fittings of this handle shall automatically disconnect the motor drive shaft by the operation of a simply spring loaded dog clutch and at the same time isolate the electrical control supply.

BARRIER BOARD

The connections from the transformer winding shall be taken through an insulating terminal barrier board, which shall be supplied loose for the clamping to the transformer port flange. Thus the transformer shall be treated and filled with oil before the tap changer is fitted. This arrangement allows the tap selector switch contacts to be inspected or the complete tap changer to be handled separately without disturbing the oil level in the transformer.

LOCAL CONTROL GEAR

The motor reversing contactors and associated local control gear shall be housed in the same compartment as the driving mechanism with a common hinged weather proof door. Weather proof local control switches when required shall be mounted in an accessible position below the door.

OPERATION MECHANISM

An impulse is received either from a remote control panel or from a local manual operation switch, which energizes the appropriate raise/lower contactor to initiate a tap changer in the required direction. The contactor when energized seals itself via its own contact and the driving motor commences to run. At a predetermined point a directional sequence switch closes, taking over the handling duties of the contactor whose original hold circuit shall be isolated. At the completion of the tap changer the directional sequence switch opens and de-energizes the driving motor. The arrangement ensures that a short period initiating pulse shall be accepted by the control gear.

CONTROL CABLE TERMINATION

A detachable undrilled gland plate and the terminal station for all the external connections shall be provided in the driving mechanism compartment of the tap changer.

AUTOMATIC VOLTAGE REGULATOR

Solid state automatic voltage regulator shall be provided for the regulation of the secondary voltage of the power transformer with on load tap changer (OLTC). The band width control shall allow the dead band to be set in the terms of upper (LOWER VOLTS) and lower (RAISE VOLTS) voltage limit around a particular nominal value with a specified sensitivity. AVR shall be provided with time delay control to allow the regulator to respond only to voltage fluctuations lasting for period greater than a selected time delay. Where the voltage correction requires more than one tap change, the time delay shall be reinitiated before further tap changes. Regulations shall reset automatically after voltage correction. Solid state lamps (LED) shall be provided to indicate voltage outside the preset limit & control relay operation.

RTCC PANEL

RTCC panel shall be provided to operate OLTC from control room located in substation. RTCC shall be provided with main switch, a sequence selector switch. RTCC shall be provided with lower push button & raise push button, tap change in progress & complete. A.C supply ON/OFF lamp indicator & AVR relay operated operation indication. Cubical panel shall be totally enclosed, floor mounting and fabricated with a framed structure with rolled/folded sheet steel channel section of minimum 2mm thickness. All the sheet steel work forming the exterior of RTCC panel shall be smoothly finished and all steel work used in construction of RTCC panel shall undergo a rigorous metal treatment process consisting of effective cleaning by hot alkaline degreasing solution followed by the cold water rinsing, pickling in dilute sulphuric acid to remove scales and rust formation, a recognized phosphating process, passivating in deoxidize to retain & augment the effects of

phosphating, drying with compressed air and dust free atmosphere, primer coating with two coats of highly corrosion resistant primer applied under strictly controlled conditions and finished coat of stoving synthetic enameled paint of grey color.

3.4 CABLE TRAY

Cable tray is manufactured at Indian Standard Specification. Laying is done as per IS & cpwd specification.

3.5 EARTHING

Earthing specified in BOQ is done as per IS & CPWD specification.

4.0 MAIN L.T. PANEL, MV PANELS & CAPACITORS PPANELS

4.1 GENERAL

Main/ MV Panels shall be indoor type, metal clad, floor mounted, free standing, totally enclosed, extensible type, air insulated, cubicle type for use on 415 Volts, 3 phase, 50 cycles system.

4.2 CONSTRUCTION

Main/Sub Panels shall be:

- i. Of metal enclosed, indoor, floor mounted, free standing construction (unless otherwise specified) type.
- ii. Made up of the requisite vertical sections, which when coupled together shall form continuous dead front switchboards.
- iii. Provide dust and damp protection.
- iv. Be readily extensible on both sides by the addition of vertical sections after removal of the end covers in case of Main Panels.
- v. All panels shall be front access type.

Main/Sub Panels shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses, as the effects of humidity, which are likely to be encountered in normal service.

Each vertical section shall comprise of the following:

- i. A front-framed structure of rolled/folded sheet steel channel section, of minimum 2 mm thickness, rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, moulded case circuit breaker, main horizontal busbars, vertical risers and other front mounted accessories. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 2 mm thickness and 100 mm height. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.
- ii. A cable chamber housing the cable end connections, and power/control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling, and adequate safety for working in one vertical section without coming into accidental contact with live parts in an adjacent section.

- iii. A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.
- iv. Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

The height of the panels should not be more than 2400 mm for MV Panels. Operating handle of breaker in top most compartments shall not be higher than 1800 mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be less than 350mm.

Doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 1.6 mm thickness. All sheet panels shall be smoothly finished, leveled and free from flaws. The corners should be rounded. The apparatus and circuits in the power control centers (panels) shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

Apparatus forming part of the Main/Sub Panels shall have the following minimum clearances.

- i. Between phases - 32 mm
- ii. Between phases and neutral - 26 mm
- iii. Between phases and earth - 26 mm
- iv. Between neutral and earth - 26 mm

When, for any reason, the above clearances are not available, suitable insulation shall be provided. Clearances shall be maintained during normal service conditions.

Creepage distances shall comply with those specified in relevant standards.

All insulating material used in the construction of the equipment shall be of non-hygroscopic material, duly treated to withstand the effects of the high humidity, high temperature tropical ambient service conditions.

Functional units such as circuit breakers and moulded case circuit breakers shall be arranged in multi-tier formation, except that not more than two air circuit breakers shall be housed in a single vertical section. Cable entry for various feeders shall be from the rear. Panel shall be suitable for termination of bus duct for incoming breakers.

Metallic/insulated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:

- i. Main busbars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.
- ii. Cable termination of one functional unit, when working on those of adjacent unit/units.

All doors/covers providing access to live power equipment/ circuits shall be provided with tool operated fasteners to prevent unauthorized access.

Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections.

4.3 METAL TREATMENT & FINISH

All steel work used in the construction of the Main/Sub Panels should have undergone a rigorous metal treatment process as follows:-

- i. Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.
- ii. Pickling in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.
- iii. A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.
- iv. Passivating in de-oxalite solution to retain and augment the effects of phosphating.
- v. Drying with compressed air in a dust free atmosphere.
- vi. Panel shall be powder coated with epoxy based powder paint after the above process so as to render the material suitable for corrosive environment.
- vii. Paint shade shall be Pebble (light) grey, shade no RAL 7032 unless otherwise specified.

4.4 BUSBARS

The busbars shall be air insulated and made of high conductivity, high strength aluminum alloy complying with the requirement of IS-5082.

The busbars shall be suitable braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of 25kA RMS symmetrical for one second. The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent busbars. Large clearances and Creepage distances shall be provided on the busbar system to minimize possibilities of fault.

The Main/Sub Panels shall be designed that the cables are not directly terminated on the terminals of breaker etc. but on cable termination links. Capacity of aluminum busbars shall be considered as 0.8 Amp per sqmm. of cross sectional area of the busbar. The main busbars shall have continuous current rating throughout the length of Panels. The cross section of neutral busbars shall be same as that of phase busbar for busbars of capacity up to 200Amp; for higher capacity the neutral busbar shall not be less than half (50%) the cross section of that the phase busbars. The busbar system shall consist of main horizontal busbar and auxiliary vertical busbars run in busbar alley/chamber on either side in which the circuit could be arranged/connected with front access.

Connections from the main busbars to functional circuit shall be arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Busbars to be colour coded with PVC sleeves.

4.5 SWITCHGEARS

Refer subhead 5.00 – LT switchgears

4.6 CABLE TERMINATIONS

Cable entries and terminals shall be provided in the Main/Sub Distribution Panels to suit the number, type and size of aluminium conductor power cables and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. A cable chamber 150 mm. high shall be provided at the bottom through out the length and depth of the MDB/SDB. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

4.7 LABELS

Labels shall be anodised aluminium with white engraving on black background shall be provided for each incoming and outgoing feeder of Main/Sub Distribution and all Panels.

4.8 TEST AT MANUFACTURES WORK

All routine tests specified in IS: 8623-1977 shall be carried out and test certificates submitted.

4.9 TESTING AND COMMISSIONING

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following.

- a) Operation checks and lubrication of all moving parts.
- b) Interlocking function check.
- c) Insulation test: As per CPWD Specifications.
- d) Trip tests & protection gear test.

5.00 L.T. SWITCHGEARS

5.01 AIR CIRCUIT BREAKERS

5.01.1 GENERAL

Air circuit breakers shall be incorporated in Main Distribution Panels wherever specified. ACBs shall conform to IS 13947 (Part 2) & IEC 947 (2) in all respects. ACBs shall be suitable for operation on 415 volts, 3 phase, 50Hz, AC supply.

5.01.2 TYPE AND CONSTRUCTION

Air Circuit Breakers shall be of enclosed pattern, dead front type with 'trip free' operating mechanism. It shall have microprocessor based electronic release. Air Circuit Breakers shall be EDO type (Electrically drawout type unless otherwise specified) with horizontal drawout carriage. The ACBs shall be strong and robust in construction with suitable arrangements for anchoring when in fully engaged or fully drawn-out positions. The carriage or cradle on which the breakers are mounted shall be robust design made of fabricated steel, supported on rollers. Cradle shall also comprise of main and secondary separable contacts and all draw out mechanism in a completely fig welded assembly. There shall be no dependence upon the switchboard frame for any critical alignment. The withdrawal arrangement shall be such as to allow smooth and easy movement.

All the current carrying parts of the circuit breakers shall be silver plated, suitable arcing contacts shall be provided to protect the main contacts. The contacts shall be of spring loaded design. The sequence of operation of the contacts shall be such that arcing contacts 'make before' and break after' the main contacts. Arcing contacts shall be provided with efficient arc chutes on each pole and these shall be such suitable for being lifted out for inspection of main as well as arcing contacts. The contact tips and arc chutes shall be suitable for ready replacement. Self aligning isolating contacts shall be provided. The design of the breaker shall be such that all the components are easily accessible to inspection, maintenance and replacement. Interphase barriers shall be provided to prevent flashover between phases.

5.01.3 OPERATING MECHANISM.

Air Circuit breaker shall be provided with a quick-make, trip free operating mechanism, the operating mechanism shall be 'strain-free' spring operated. The operating handle shall be in front of the panel type. The design shall be such that the circuit breaker compartment door need not be opened while moving the breaker from completely connected, through test, into the disconnected position. Electrical operated breakers shall have a motor wound spring charged closing mechanism. Breaker operation shall be independent of the motor, which shall be used solely for charging the closing spring. The operating mechanism shall be such

that the breaker is at all times free to open immediately and the trip coil is energised. Mechanical operation indicator shall be provided to show open and closed position of breaker. Electrically operated breakers shall be additionally provided with mechanical indication to show charged and discharged condition of charging spring. 24 volt DC supply through battery backup for closing and opening for tripping circuit.

Means shall be provided for slow closing and opening of the breaker for maintenance purposes and for manual charging and closing of electrically operating breakers during emergencies.

5.01.4 INTERLOCKING AND SAFETY ARRANGEMENT

Air Circuit Breakers shall be provided the following safety and interlocking arrangements:

- i. It shall not be possible for breaker to be withdrawn when in "ON" position.
- ii. It shall not be possible for the breaker to be switched on until it is either in fully inserted position or for testing purposes it is in fully isolated position.
- iii. The breaker shall be capable of being racked into 'testing', 'isolated' and 'maintenance' positions and kept locked in any of these positions.
- iv. A safety catch to ensure that the movement of the breaker, as it is withdrawn is checked before it is completely out of the cubicle.
- v. The operating mechanism shall provide for racking the breaker into connected, test and disconnected positions without operating compartment door. When cubicle door shall be open position, the breaker can be pulled out to a fourth position, maintenance, where free access shall be possible to all parts of the breaker.

5.01.5 RATING

The rating of the circuit breaker shall be as per the drawings and schedule of quantities. Rated service breaking capacity (Ics) of the breakers shall be 50kA unless otherwise specified at 415 volts. The rated making capacity shall be as per the relevant standard.

5.01.6 ACCESSORIES

The breaker shall be equipped with electronic microprocessor based release to provide over current & earth fault protection. The breaker shall be fitted with following accessories for control, signal and interlocking.

- i. Auxillary contacts 6 NO + 6 NC, of rating 16Amp at 415 volts 50Hz.

- ii. Shunt release for tripping the breaker remotely and shall be suitable for 240 volt/415 volt 50Hz with range of operation from 10% to 130% of rated voltage.
- iii. Micro switches shall be mounted on the cradle of draw out breaker to indicate the position of the breaker on the cradle.
 - a. Kit for test/isolated indication.
 - b. Kit for service position indication.
 - c. Kit for shutter assembly.
- iv. Accessories for following interlocking schemes shall be provided.
 - a. Accessory kit for locking the breaker in isolated position. This kit is useful for interlocking scheme as well as keeping personnel and equipment safe.
 - b. Door interlock kit: Panel or cubicle door cannot be opened with the ACB in Test or Service position.
 - c. Lockable trip push button.

5.01.07 MOUNTING

Circuit Breakers shall be mounted as per manufacturers' standard practice.

5.01.08 TESTING

Testing of each circuit breaker shall be carried out at the works as per IS 2516 and the original test certificate shall be furnished in triplicate. The tests shall incorporate at least the following.

- i. Impulse withstand test.
- ii. Power frequency withstand test.
- iii. Short circuit test.
- iv. Temperature - rise test under rated conditions.

5.02 MOULDED CASE CIRCUIT BREAKERS.

5.02.01 GENERAL

Moulded Case Circuit Breaker shall be incorporated in the Main/Sub Distribution Boards wherever specified. MCCBs shall conform to IS 13947 (Part 2) & IEC 947 (2) in all respects. MCCBs shall be suitable either for single-phase AC 230 volts or three phase 415 volts. All MCCBs shall have microprocessor based over current and short circuit releases with adjustable current setting from 0.8 In to 1.0 In or better.

5.02.02 Technical Specifications

The MCCB should be current limiting type with trip time of less than 10 milli sec under short circuit conditions. The MCCB should be either 3 or 4 poles as specified in BOQ.

MCCB shall comply with the requirements of the relevant standards IS13947 – Part 2 /IEC 60947-2 and should have test certificates for breaking capacities from independent test authorities CPRI / ERDA

MCCB shall comprise of Quick Make -break switching mechanism, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses.

The breaking capacity of MCCB shall be minimum 35KA / 50 KA or as specified in BOQ. The rated service breaking capacity should be equal to rated ultimate breaking capacities ($I_{cs}=I_{cu}$).

All MCCBs upto 200A ratings should be provided with Thermal Magnetic type release with adjustable Overload and fixed short circuit protections. MCCBs of ratings 250A & above shall be provided with Microprocessor based having inbuilt adjustable protections against Over Load (L), Short Circuit (S) and Ground Faults (G)] with time delay.

All MCCBs should be provided with the Rotary Operating Mechanism. The ROM should be with door interlock (with defeat feature) & padlock facility

MCCB should have Spreader links & Phase barriers as standard feature. Superior quality of engineering grade plastics confirming to glow wire Tests as Per IEC 60695-2-1 should be used for insulation purpose.

The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts.

5.02.02 FRAME SIZES

The MCCBs shall have the following frame sizes subject to meeting the fault level.

- | | | | |
|----|------------------------|-------|-------------|
| a. | Upto 100A rating | | 100A frame. |
| b. | Above 100A upto 200A | | 200A frame. |
| c. | Above 200A up to 250A | | 250A frame. |
| d. | Above 250A up to 400A | | 400A frame. |
| e. | Above 400A up to 630Aq | | 630A frame. |
| f. | Above 630A to 800A | | 800A frame. |

5.02.03 CONSTRUCTIONS

The MCCB's cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be quick make/quick break, trip-free type. The operating handle shall have suitable "ON", "OFF" "and" "tripped" indicators. Three phase MCCBs shall have common operating handle for simultaneous operation and tripping of all the three phases. MCCBS shall be provided with rotary handle.

Suitable extinguishing device shall be provided for each contact. Tripping unit shall be of thermal magnetic or static release type provided in each pole & connected by a common trip bar such that tripping of any pole operates all three poles to open simultaneously. MCCB shall be current limiting type.

Contact trips shall be made of suitable air resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

5.02.04 BREAKING CAPACITY

Unless otherwise specified, rated service breaking capacity of the Moulded Case Circuit Breakers shall be minimum 25kA or as mentioned in the BOQ

5.02.05 TESTING

- a. Original test certificate of the MCCB as per Indian Standards (IS) 315-C-8370 shall be furnished.
- b. Pre-commissioning tests on the Main Distribution/Sub Distribution Board incorporating the MCCB shall be done as per standard.

5.03 SWITCH DISCONNECTOR FUSE UNITS

The Switch Disconnecter Fuse Units shall be double break type suitable for load break duty (AC 23) quick make and break action. Hinged doors shall be duly interlocked with operating mechanism so as to prevent opening of the door when the switch is in 'ON' position and also prevent closing of the switch when the door is not properly secured. All contacts incoming and outgoing terminals of switch shall be adequately sized to receive proper size of cables. High rupturing capacity (HRC) fuse links shall be provided with switch fuse units and shall be in accordance with IS 13703-1&2-1993 and having rupturing capacity of not less than 31 MVA at 415 volts. HRC fuse links shall be provided with visible indicators to so that they have operated. The switch disconnecter fuse units shall be manufactured in accordance with IS 13947-3-1993.

FUSE

Fuse shall be of the high rupturing capacity (HRC) fuses links and shall be in accordance with IS 13703-1&2-1993 and having rupturing capacity of not less than 31 MVA at 415 volts. The backup fuse rating for each motor/equipment shall be chosen as the fuse does not operate on starting of motors/equipments.

5.04 MEASURING INSTRUMENTS, METERING & PROTECTION

5.04.01 GENERAL

Direct reading electrical instruments shall be in conformity with IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between -10 degree Centigrade to + 50 degree Centigrade. All meters shall be of flush mounting type of 96mm square or circular pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instrument glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three-phase supply.

The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The ratings type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

5.04.02 AMMETERS

Ammeters shall be moving iron or moving coil type or digital type as specified in the BOQ. The moving part assembly shall be with jewel bearing. The jewel bearing shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks, the ammeters shall be manufactured and calibrated as per the latest edition of IS:1248. Ammeters shall be instrument transformer operated, and shall be suitable for 5A secondary of instrument transformer. The scales shall be calibrated to indicate primary current, unless otherwise specified. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

5.04.03 VOLTMETERS

Voltmeter shall be of moving iron or moving coil type or digital type as specified in the BOQ. The range for 415 volts, 3 phase voltmeters shall be 0 to 500 volts. Suitable selector switch shall be provided for each voltmeter to read voltage between any two lines of the system. The voltmeter shall be provided with protection fuse of suitable capacity.

5.04.04 CURRENT TRANSFORMERS

Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1kV. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated acceptable minimum class of various applications shall be as given below:

Measuring : Class 0.5 to 1

Protection : Class 5P10.

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50KA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper

conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

All Current Transformer shall be Cast resin type.

5.05 MISCELLANEOUS

Control switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the filament type of low watt consumption, provided with series resistor where necessary, and with translucent lamp covers, bulbs & lenses shall be easily replaced from the front.

Push buttons shall be of the momentary contact, push to actuate type fitted with self-reset contacts & provided with integral escutcheon plates marked with its functions.

6.00 INTERNAL ELECTRIFICATION OF BUILDING

6.1 SCOPE

As specified in subhead 1.00

6.2 GENERAL

The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice for Electrical Wiring Installation IS: 732-1989 and IS: 2274-1963. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations, so far as these become applicable to the installation. Electrical work in general shall be carried out as per following CPWD Specifications with up to date amendment.

- Specifications for Electrical Works Part-I (Internal) by CPWD – 2005 or latest revision
- Specifications for Electrical Works Part-II (External) by CPWD – 1994 or latest revision

Wherever these specifications calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take precedence over the said regulations and standards.

6.3 DISTRIBUTION BOARDS.

As a general practice only pre-wired MCB type double door DB shall be used. Pre-wired DB shall have following features:

- i) Recess/ surface type with integral loose wire box.
- ii) Phase/neutral/ earth terminal blocks for termination of incoming & outgoing wires.
- iii) DIN channel for mounting MCBs.
- iv) Arrangement for mounting incomer MCB/RCCB/RCBO/MCCB as required.
- v) Copper bus bar.
- vi) Earthing terminals.
- vii) Wiring from MCBs to terminal block.
- viii) Interconnection between terminal block/ incoming switch/ bus bar/ neutral/ terminal block/ earth terminal connector with specified size of FRLS pre insulated copper conductor cable duly fitted with copper lugs/ thimbles.
- ix) Termination block should be suitable for termination of conductor/ cable of required size but minimum rated cross section of the terminal blocks should be 6 sq. mm.
- x) Terminal block shall be made of flame retardant polyimide material.

- xi) Coloured terminal blocks and FRLS wires for easy identification of RYB phases, Neutral and Earth.
- xii) Pre-wired DB shall be provided with a detachable cassette for safe removal of MCBs, RCCBs. Terminal connectors from the DB without loosening the internal cable connections of phase and neutral circuits.
- xiii) The pre-wired DB shall have peel able poly layer on the cover for protection from cement, plaster, paints etc during the construction period.
- xiv) Detachable plate with knock out holes shall be provided at the top/ bottom of board. Complete board shall be factory fabricated and pre-wired in factory, ready for installation at site. The box and cover shall be fabricated from sheet steel, properly pretreated, phosphotized with powder coated finish.
- xv) DB shall be of double door construction provided with hinged cover in the front.

Distribution Board shall be standard type. Distribution boards shall contain miniature circuit breakers of rating specified in BOQ/DB Schedule.

Miniature circuit breakers shall be quick make and quick break type with trip free mechanism. MCB shall have thermal and magnetic short circuit protection. All miniature circuit breakers shall be of 9 KA rated rupturing capacity unless otherwise specified.

Neutral busbars shall be provided with the same number of terminals, as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. All live parts shall be screened from the front. Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. A circuit identification card in clear plastic cover shall be provided for each distribution board.

MCB's shall be provided on the phase of each circuit. The individual banks of MCB's shall be detachable. There shall be ample space behind the banks of MCB's to accommodate all the wiring. All the distribution boards shall be completely factory wired, ready for connections. All the terminals shall have adequate current rating and size to suit individual feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and circuits shall be distinctly marked with a small description of the service installed.

Earth Leakage Circuit Breaker shall be current operated type and of 30mA sensitivity unless otherwise specified. It shall also provide over-current and short circuit protection i.e. it shall be MCB-cum-RCCB (Residual Current Circuit Breaker). In case ELCB doesn't have inbuilt short circuit protection, same rating MCB have to be provided for short circuit protection along with ELCB. Cost of this MCB is deemed to be included in the cost of ELCB. ELCB shall be housed within the Distribution Board.

Distribution Boards shall be ready for connections and shall be inspected in the factory by HSCC Electrical Engineer before dispatch.

Before procurement of Distribution Boards, MCB's, ELCB's (incomer and outgoing) etc., the contractor has to take approval of the DB Schedule/Drawings of each DB from the HSCC Electrical Engineer. The whole unit i.e. Distribution Board, MCB's, ELCB's etc. shall come from the manufactures premises/workshop. After inspection and clearance from the HSCC Electrical Engineer the same may be dispatched to site for installation. However if a single component (such as ELCB or MCB or DB) is required for any reason such as replacement, increase in no. of circuits in the DB, change in the load of existing circuit, change in the total load on a particular DB etc., the same may be ordered separately but after the approval of HSCC Electrical Engineer.

6.4 METALLIC CONDUIT WIRING SYSTEM.

6.4.1 TYPE AND SIZE OF CONDUIT.

All conduit pipes shall be of approved gauge (not less than 16 SWG for conduits of sizes up to 32 mm diameter and not less than 14 SWG for conduit of size above 32mm diameter) solid drawn or reamed by welding finished with black stove enameled surface. All conduit accessories shall be of threaded type and under no circumstances pin grip type accessories shall be used. The maximum number of PVC insulated 650/1100 volts grade copper conductor cable that can be drawn in conduit of various sizes shall be as per IS Code. No steel conduit less than 20mm in diameter shall be used.

6.4.2 CONDUIT JOINTS.

Conduit pipes shall be joined by means of threaded couplers, and threaded accessories only. In long distance straight run of conduits, inspection type couplers at reasonable intervals shall be provided or running threads with couplers and jam nuts shall be provided. In the later case the bare threaded portion shall be treated with anti-corrosive preservative. Threads on conduit pipes in all cases shall be between 13 mm to 19 mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories.

Cut ends of conduit pipe shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductor while pulling them through such pipes.

6.4.3 PROTECTION AGAINST CONDENSATION.

The layout of conduit should be such that any condensation or sweating inside the conduit is drained out. Suitable precaution should also be taken to prevent entry of insects inside the conduit.

6.4.4 PROTECTION OF CONDUIT AGAINST RUST.

The outer surface of conduit including all bends, unions, tees, junction boxes etc. forming part of conduit system shall be adequately protected against rust when such system is exposed to weather by being painted with two coats of oxide paint applied before they are fixed. In all cases, no bare threaded portion of conduit pipe shall be allowed. Unless such bare thread portion of conduit is treated with anticorrosive preservative or covered with approved plastic compound.

6.4.5 PAINTING OF CONDUIT AND ACCESSORIES.

After installation, all accessible surface (if any) of conduit pipes, fittings etc. shall be painted with two coats of approved enameled paint or aluminium paint as required to match the finish of surrounding wall, trusses etc.

6.4.6 RECESS CONDUIT.

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. In case of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work. Entire work of chasing the wall, fixing the conduit in chases, and burring the conduit in mortar before plastering shall form part of point wiring work.

The conduit pipe shall be fixed by means of staples or by means of saddles not more than 60cm apart or by any other approved means of fixing. Fixing of standard bends and elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with the long radius, which shall permit easy drawing in of conductors. All threaded joints of conduit pipe shall be treated with some approved preservative compound to secure protection against rust. Suitable inspection boxes to the barest minimum requirements shall be provided to permit periodical inspection and of facilitate replacement of wires, if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Wherever the length of conduit run is more than 10 meters, then circular junction box shall be provided.

6.4.7 METAL OUTLET BOXES & COVERS.

The switch box shall be made of modular metal boxes with suitable size modular cover plates. Modular metal box shall be made of mild steel on all sides except on the front.

The metal box (other than modular type) shall be made of metal on all sides except on the front. Boxes shall be hot dip galvanized mild steel. Metal boxes upto 20 x 30 cm size M.S. box shall have wall thickness of 18 SWG and MS boxes above 20 x 30 cm

size shall be of 16 SWG. The metallic boxes shall be painted with anticorrosive paint before erection. Clear depth of the box shall not be less than 60mm. All boxes shall be covered from top with Phenolic laminated sheet of approved shade. These shall be of 3 mm thick synthetic phenolic resin bonded laminated sheet as base material and conform to grade P-I of IS: 2036-1994.

6.4.8 ERECTION AND EARTHING OF CONDUITS.

The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested in presence of HSCC Electrical Engineer for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirement by means of special approved type of earthing clamp effectively fastened to conduit pipe in a workmen like manner for a perfect continuity between the earth and conduit.

6.4.9 SWITCHES.

All 5 and 15 Amp switches shall be modular type of 240 volts A.C. grade. All switches shall be fixed on modular metal boxes. All 5 Amp socket shall be 5 pin type and 15 Amp socket shall be 6 pin type (unless otherwise specified) suitable for 15/5 Amp. All modular switches, sockets, telephone outlets, TV outlet etc. shall be in off white finish unless otherwise specified. The switches controlling the lights or fans shall be connected to the phase wire of the circuit. Switch boards shall be located at 1200 mm above finished floor level unless otherwise indicated on drawings or directed by Engineer-In-Charge.

In case of computer power points, power points, telephone points etc. to be fixed on laminated partition board (furniture), same shall be fixed on laminated board (portion of laminated board meant for fixing power points) with base plate/cover plate as applicable, duly fixed with screws.

6.4.10 COVER PLATE.

All modular switches, sockets, telephone outlets etc. shall be fixed modular metal boxes with modular base plates and modular cover plates on top.

6.4.11 WALL SOCKET PLATE.

Each outlet shall have a switch located beside the socket preferably on the same cover plate/modular base. The earth terminal of the socket shall be connected to the earth wire.

6.5 WIRING.

All PVC insulated copper conductor wires shall conform to relevant IS Codes. All wires/cables shall be stranded type irrespective of its size. Cable conductor size and material shall be specified in BOQ.

All internal wiring shall be carried out with PVC insulated wires of 650/1100 volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be allowed in the length of the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light/fan. A light/fan switchboard may have more than one circuit but shall have to be of same phase. Looping circuit wiring shall be drawn in same conduit as for point wiring. Each circuit shall have a separate neutral wire. Neutral looping shall be carried out from point to point or in light/fan switchboards. A separate earth wire shall be provided along with circuit wiring for each circuit. For point wiring red/yellow/blue colour wire shall be used for phase and black colour wire for neutral. Circuit wiring shall be carried out with red, yellow or blue colour PVC insulated wire for RYB phase wire respectively and black colour PVC insulated wire for the neutral wires. Bare copper wire shall be used as earth continuity conductor and shall be drawn along with other wires. No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire.

Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust and dirt. Drawing and jointing of copper conductor wires and cables shall be as per CPWD specifications.

Maximum number of PVC insulated 650/1100 V grade aluminium/copper conductor cable conforming to IS : 694 - 1990

| Nominal Cross-Sectional area of conductor in Sq.mm. | 25mm | | 32mm | | 38mm | | 51mm | | 64mm | |
|--|------|---|------|----|------|---|------|----|------|----|
| | S | B | S | B | S | B | S | B | S | B |
| 1 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 1.5 | 10 | 8 | 18 | 12 | - | - | - | - | - | - |
| 2.5 | 8 | 6 | 12 | 10 | - | - | - | - | - | - |
| 4 | 6 | 5 | 10 | 8 | - | - | - | - | - | - |
| 6 | 5 | 4 | 8 | 7 | - | - | - | - | - | - |
| 10 | 4 | 3 | 6 | 5 | 8 | 6 | - | - | - | - |
| 16 | 2 | 2 | 3 | 3 | 6 | 5 | 10 | 7 | 12 | 8 |
| 25 | - | - | 3 | 2 | 5 | 3 | 8 | 6 | 9 | 7 |
| 35 | - | - | - | - | 3 | 2 | 6 | 5 | 8 | 6 |
| 50 | - | - | - | - | - | - | 5 | 3 | 6 | 5 |
| 70 | - | - | - | - | - | - | 4 | 3 | 5 | 4 |

NOTE:

1. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
2. The columns headed 'S' apply to runs of conduits which have distance not exceeding 4.25m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.
3. Conduit sizes are the nominal external diameters.

6.5.1 JOINTS.

All joints shall be made at main switches, distribution board socket and switch boxes only. No joint shall be made in conduits and junction boxes. Conductors shall be continuous from outlet to outlet.

6.5.2 LOAD BALANCING

Balancing of circuits in three-phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

6.5.3 COLOUR CODE FOR CIRCUIT WIRING.

Colour code for circuit and sub main wiring installation shall be Red, Yellow, and Blue for three phases. Black for neutral and yellow/green or green only for earth incase of insulated earth wire.

6.5.4 CLASSIFICATION OF POINTS.

6.5.4.1 General

Classification and measurement of Point wiring shall be as per CPWD specification for Electrical Works (Part-I-Internal) 1994.

6.5.4.2 Point Wiring (Modular)

Definition of point wiring

A point (other than socket outlet point) shall include all work necessary in complete wiring to the light points/fan/exhaust fan/call bell point from the controlling switch/MCB. The scope of wiring for a point shall, however, include the wiring work necessary in tapping from another point in the same distribution circuit i.e. from first switch board (wiring from distribution board to first switch box is covered in the circuit wiring and is not in the scope of point wiring) to subsequent switch board(s) in the same distribution circuit. The point wiring includes all materials specified below including chasing the wall (in case of recessed wiring in wall), fixing the conduit and

making the wall good as it originally was. It also includes supply, drawing, testing and commissioning of wires.

Scope of point wiring

Following shall be deemed to be included in point wiring.

- (a) Supply & fixing conduit & conduit accessories for the same and wiring cables (including supplying and drawing wires) between the switch box and the point outlet. [See also (i) below]
- (b) All fixing accessories such as clips, nails, screws, phil plug, rawl plug etc. as required.
- (c) Modular Metal boxes for control switches, regulators, sockets etc. recessed or surface type, modular base plates and modular cover plates over the same.
- (d) Outlet boxes, junction boxes, pull-through boxes etc. but excluding modular metal boxes if any, provided the switchboards for loose wires/conduit terminations.
- (e) In case of recessed wiring in wall the scope includes chasing of wall, fixing the conduit and making the wall good as it originally was.
- (f) Control modular switch (5/6A) as specified.
- (g) Ceiling rose or connector (in case of points for ceiling/exhaust fan point, prewired light fittings and call bells).
- (h) Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.
- (i) Interconnecting wiring between points on the same circuit, in the same switch box or from another. Interconnecting wiring from first switchboard to subsequent switch board(s).
- (j) Protective (loop earthing) conductor (as specified in the BOQ) from one metallic switch box to another in the distribution circuits, and from switchboard to each point (light/fan/exhaust fan/call bell etc).
- (k) Bushed conduit where wiring cables pass through wall etc.
- (l) Ceiling rose (in the case of pendants except stiff pendants).
- b) Lamp holder (in the case of goose neck type wall bracket, batten holder and fittings which are not pre-wired).
- c) Back Plate (in the case of stiff pendants).
- d) MS Fan Boxes with MS hook (as per CPWD specifications) for the erection of Ceiling Fans

Note :- In the case of call bell points the words “from the controlling switch or MCB” shall be read as “from the ceiling rose meant for connection to bell push”.

Measurement of Point Wiring (other than socket outlet points)

- i) There shall be no linear measurement for point wiring for light points, fan points, exhaust fan points and call bell points. These shall be measured on unit basis by counting,

- ii) No separate measurement shall be made for interconnections between points in the same distribution circuit and for the circuit protective (loop earthing) conductors between metallic switch boxes.

6.5.5. Circuit and Submain Wiring

Circuit Wiring

Circuit wiring shall mean the wiring from the distribution board upto the tapping point for the nearest first point of that distribution circuit i.e. up to the nearest first switch box.

Submain Wiring

Submain wiring shall mean the wiring from one main/distribution switchboard to another.

Measurement of circuit wiring and submain wiring

- (i) Circuit and submain wiring shall be measured on linear basis along the run of the wiring. The measurement shall include all lengths from end to end of conduit, exclusive of interconnections inside the switchboard etc. The increase on account of diversion or slackness shall not be included in the measurement.
- (ii) The length of circuit wiring with two wires shall be measured from the distribution board to the first nearest switch box in the circuit irrespective of whether neutral conductor is taken to switch box or not.
- (iii) When wires of different circuits are grouped in a single conduit, the same shall be measured on linear basis depending on the actual number and size of wires run.
- (iv) When circuit wires and wires of point wiring are run in the same conduit, circuit wiring shall be measured on linear basis depending on the actual number and sizes of wires run in the existing conduit.
- (v) Protective (loop earthing) conductors, which are run along the circuit wiring and submain wiring, shall be measured on linear basis and paid separately. This is not applicable if protective conductor is clubbed with the BOQ item of circuit and submain wiring.

6.5.6 Power Plug Wiring

5A Plug Wiring

Wiring for all 5 A Socket Outlets shall be done with 2X1.5 sqmm PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing MS Conduit) along with the earth wire as specified in the BOQ/Drawings, from the switchboard or 15A power point as the case may be.

Measurement of 5A point wiring shall be done on number basis from switchboard/15A power point to 5A point. Conduit of point wiring/power point wiring can also be used for 5A point wiring, but both phase and neutral wires shall come directly from switchboard/power point. Looping of neutral shall not be done.

15A Power Plug Wiring

Wiring for all 15 A Socket Outlets/Gyser point shall be done with 2X4 sqmm PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing MS Conduit) along with the earth wire as specified in the BOQ/Drawings, directly from the MCB-Distribution Board or from one power point to another in case of computer power points. Looping shall not be done in general 15A power points (other than computer power points).

Measurement of power point wiring shall be done on number basis under following two subheads:

- i) Directly from MCB-Distribution Board to the Socket Outlets
- ii) From One power point/computer power point to another (looping)

Wiring for 20A Metal Clad Socket Outlets

Wiring for all 20A Metal Clad Socket Outlets shall be done with 2X6 sqmm PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing MS Conduit) along with the earth wire as specified in the BOQ/Drawings, directly from the MCB-Distribution Board. Measurement of wiring for 20A Metal Clad Socket outlet shall be done on number basis i.e. complete wiring directly from MCB-Distribution Board to the socket outlet.

No extra payment shall be made on account of minor changes in location of power points (15A or 20A or computer power points) due to change in the architectural layout or change due to any other reason. Height of the power socket outlets shall be 300mm from the finished floor level unless otherwise specified.

6.5.7 CONDUCTOR SIZE.

Wiring shall be carried out with following sizes of PVC insulated stranded single core copper conductor wire/cable.

- i. Light point. - 1.5Sq.mm
- ii. Ceiling /Cabin/Exhaust Fan Point - 1.5Sq.mm
- iii. Call Bell Point - 1.5Sq.mm
- iv. Plug Point (5 A Outlet) - 1.5Sq.mm

- v. Circuit Wiring - 2.5Sq.mm
- vi. General Power Point - 4Sq.mm
- vii 20A Industrial Socket Outlet – 4 Sqmm
- viii Special Power Point – 6 Sqmm
- ix A/C Box with 32A MCB- 6 Sqmm

6.5.8 LIGHTING FIXTURE AND FANS

6.5.8.1 GENERAL

- a. The Contractor shall supply and install lighting fixtures including but not limited to lamps, ballasts, accessories fixing hardware necessary for installations, as shown on the Drawings, as required, and as herein specified.
- b. All fixtures shall be delivered to the building complete with suspension accessories, canopies, hanging devices, sockets, holders, reflectors, ballasts, diffusing material, louvers, plaster frames, recessing boxes, etc. all wired and assembled as indicated.
- c. Full size shop detail drawings of special fixture or lighting equipment, where called for in the fixtures schedule, shall be submitted to the HSCC Electrical Engineer for approval.
- d. Fixtures, housing, frame or canopy, shall provide a suitable cover for fixture outlet box or fixture opening.
- e. Fixtures shall comply with all applicable requirements as herein outlined unless otherwise specified or shown on the Drawings.
- f. Manufacturer's name and catalogue number of light fixtures, fans, switchgears etc. shall be strictly adhered.
- g. Fixtures shall bear manufacturer's name and the factory inspection label.
- h. Fixtures shall be completely wired and constructed to comply with the IEE wiring regulations requirements for lighting fixtures, unless otherwise specified.
- i. Revamping the fixture shall be possible without having to remove the fixture from its place.
- j. Lamps of the proper type, wattage and voltage rating shall be furnished and installed in each fixture.

6.5.9 INSTALLATION

Fixtures shall be installed at mounting heights as detailed on the Drawings or as instructed on site by the Engineer-In-charge.

Pendent fixtures within the same room or area shall be installed plumb and at a uniform height from the finished floor. Adjustment of height shall be made during installation.

Flush mounted recessed fixtures, shall be installed so as to completely eliminate leakage of light within the fixture and between the fixture and adjacent finish.

Fixtures mounted outlet boxes shall be rigidly secured to a fixture stud in the outlet box. Hickeys or extension pieces shall be installed where required to facilitate proper installation.

Fixtures located on the exterior of the building shall be installed with non-ferrous metal screws finished to match the fixtures.

6.5.10 LAMPS-GENERAL

Lamp shall be supplied and installed in all lighting fixtures listed in the BOQ.

Lamp shall be the part of Fitting no extra Payment will be made

Lamps used for temporary lighting service shall not be used in the final fixture units.

Lamps shall be of wattage and type as shown in the BOQ.

Lamps for permanent installation shall not be placed in the fixtures, until so directed by the Engineer In-charge.

6.5.11 BALLASTS-FLUORESCENT

Ballasts shall be electronic type and having high power factor type.

Ballasts shall have manufacturer's lowest sound level and case temperature rise rating.

Ballasts shall be special cool operated type.

Ballasts for indoor fixtures shall be protected by an integral thermal automatic resetting protective unit, which shall disconnect the ballast in the event of overheating.

Ballasts shall be of the same manufacture as the lamps/fixture.

6.5.12 FIXTURE SAMPLES

Detailed catalogue for all fixtures or if so required by the HSCC Electrical Engineer sample fixtures shall be submitted for prior approval of the HSCC Electrical Engineer before orders for the fixtures are placed.

6.5.13 TESTING

After all lighting fixtures are installed and are connected their respective switches, test all fixtures to ensure operation on their correct switch in the presence of the engineer.

All non-operating fixtures or ones connected to the wrong or inconveniently located switch shall be correctly connected as directed by the Engineer In-charge.

6.5.14 CEILING FANS

All ceiling fans shall be provided with suspension arrangement in the concrete/slab/roof members. Contractor to ensure that provision are kept at appropriate stage at locations shown on the drawing. Fan box with MS hook shall be as per CPWD specification. Ceiling fan shall be double ball bearing type, copper wound motor complete with canopy, down rod, blades etc. and shall conform to relevant IS standards ceiling fan shall be white in colour. Ceiling fan shall be provided with electronic regulator. Electronic Regulator shall be suitable for 240 volts A.C supply 50 Hz and shall be of continuous duty type

6.5.15 EXHAUST FANS

Exhaust fans shall be heavy-duty type with double ball bearing and conforming to IS 2312 (latest revision). Exhaust fan shall be complete with copper wound motor, capacitor, Louver/shutter, frame and mounting bracket. Exhaust fan shall be suitable fan operation on 240 volts single phase A.C supply.

7.00 TELEPHONE SYSTEM

7.01 Telephone point wiring

- (a) The point wiring shall be carried out with Double pair telephone wire/cable, unarmoured, PVC insulated, 0.61 mm dia annealed tinned copper conductor (IS: 2532-1965) in suitable size conduit (one pair always remaining spare for one point)

Minimum Dia of Conduit for Internal/External Telephone Wiring - 20mm.

If more than one telephone point has to be provided at one point, multicore, unarmoured telephone cable shall be used (pairs required are equal to 2 No. of points) in suitable size of conduit.

- (b) The point shall commence from the main telephone tag box/sub tag box and would terminate at outlet box of point. Connection at both ends included in point wiring.
- (c) Fixing of conduit, conduit accessories draw out boxes and outlet box etc. in concealed/surface conduit works as that of wiring for light fixtures shall be applicable for telephone wiring conduit system also.
- (d) Joint in telephone wiring (between main tag box/sub tag box and outlet box of point) shall not be allowed and the contractor should bear the wastages of wire if resulted due to this special requirement of telephone system.
- (e) External/Internal telephone and intercom wiring can be drawn in the same conduit, provided after drawing wires, 50% of conduit cross sectional area is free. However, independent PVC insulated telephone wire of suitable pairs shall be used for external, internal and intercom.
- (f) To identify each pair of multipair telephone wire/cable, PVC indication numbers shall be put on both ends of pair just before termination.

7.02 Telephone Tag Boxes

These shall be of MS sheet 2 mm thick with connector suitable for telephone connection (as approved by ITI). It shall have hinged MS sheet cover.

9.00 ADDRESSABLE FIRE DETECTION AND ALARM SYSTEM

9.01 GENERAL

The Contractor shall supply and install the Addressable Fire Detection & Alarm System as per schedule of quantities are as herein specified. The system shall include Addressable Main Fire Alarm Control Panel, battery charger, batteries, addressable heat detectors, addressable smoke detectors, manual fire alarm station, fire alarm bells/hooters, response indicators, conduiting, wiring and all necessary accessories required to complete fire alarm system installation as per IS: 2189-1988. Equipment like control panel, smoke detector, heat detectors etc shall be EN-54/ UL approved.

9.02 FEATURES

The system shall be general alarm electrically supervised type activation of manual fire alarm station or any of the automatic alarm initiating devices shall sound the general alarm bells on all floors and shall give indication on the control panel. The signal shall be continuous until the station from which it is originated is restored to normal and a reset button on the control unit is operated.

The system shall be electrically supervised against open and ground on both the stations and signal device wiring. Open and ground in the system shall cause a trouble bell to ring at the fire alarm control panel and a trouble lamp to light. It shall be possible to silence the bell but the lamp shall remain lit until the fault is rectified. In case of power failure the system shall automatically changeover to the battery standby.

9.03 CONDUITING & WIRING

Conduiting & Wiring for FDA system shall be carried out in M.S Conduit with copper conductor PVC insulated wires.

9.04 CONTROL PANEL

The fire control panel has to be addressable type.

The Main Fire Control Panel shall be constructed to sheet steel of red colour, and provided with windows for the alarm and trouble lights. All components shall be of the plug in type, for simple replacement and extension in the future. Control panel shall be wall mounting type conforming to IS 513-1986.

The number of loops is mentioned in B.O.Q. Each loop shall be able to support at least 128 any device addressable analog/digital (as the case may be) sensors and control module etc. The control panel shall have alphanumeric display. The Main Fire control panel shall be provided with all necessary relays, resistors, fuses, transformers, rectifiers and all other components to assure full and proper functioning of the system. All relays shall conform to the relevant IS Standards. Control panel shall include power on lamps, system trouble lamps, audible trouble signal, trouble silence switch with ring back, alarm silence push button with repeat alarm capability, low battery indicator with reset, ground detection indicator, alarm

reset, milli ammeter, supervised alarm lamps, zone "Open" test pushbutton, zone alarm test push button, end of line resistors etc.

Each zone shall be equipped with an auxiliary contact for control of a remote annunciation.

Main control panel shall include a power supply model to provide a filtered and regulated source of power to provide additional power wherever supplementary power is required within the system. It shall include an output fuse, key reset switch, provision for automatic transfer to standby power upon primary power failure.

Main control panel shall in addition have audible signal and lamp to indicate as failure of the charge of battery.

Two stages general Alarm shall be provided in which a continuous evacuation alarm is immediately given in zone of fire and its adjoining zones. In other zone intermittent alarm signal shall be provided as per IS 2189-1988.

Repeater Panel shall be of same specification as main control panel and shall have fire/fault indication with audio device.

9.05 CHARGER AND BATTERY

Unit shall comprise a ventilated cabinet supplied complete with charger, meters, high rate charge switch and lock and key in a sheet metal enclosure.

9. 06 ELECTRONIC HOOTERS

Hooter shall be electronic solid-state speaker type having tone for fire, which shall be wailing. Hooter should be loop powered having an output of approximately 6 watt. The audible range shall be around 100m under normal condition. Cable for this in our system shall be 2 cores. The switching shall be provided on the control panel. The outer enclosure of the speaker shall be of MS sheet and shall be suitably oven baked and painted. The speaker shall be 4" heavy magnet type. All hooters shall be on one or more circuits.

9.07 MANUAL ALARM CALL POINT FOR SURROUNDINGS (ADDRESSABLE)

The manual call point shall be electrically compatible with the standard range of automatic detectors so that it can be connected directly into a supervised two-wire zone of the manufacturer's standard range of control units. The manual call point shall be of pleasant, streamlined and flat appearance permitting its use as flush and surface mounted unit. The manual call point shall consist of base plate, insert and cover. The push button shall have minimum one normally closed plus one normally open contacts. The push button shall not be shrouded and the same shall be projected out from the surface of the MS Box. The whole assembly of push button shall be enclosed in the 16 SWG MS Box except from the front side. The front side shall be sealed with breakable glass covering neoprene or equivalent gasket. The glass cover shall be fixed in such a way that the actuating push button is kept depressed (with NC contact open) so long as the glass cover is in contact. In case

of fire, when the glass cover is broken to give the fire warning the push button shall be released due the spring action hence giving remote fire alarm through the NC contact. The breaking of the glass must release an alarm. All inscriptions, texts and marks must be on the manual call point front plate, not on the glass, so that the glass can easily be replaced anywhere. The alarm contacts shall be of self-cleaning design to prevent failure after a prolonged period of inactivity in unclean environments.

It shall be possible to test the call point without destroying the seal or removing the cover. The manual call point shall be equipped with a self-holding device to maintain the alarm condition until reset by an authorized person. The complete unit and the push button shall be painted signal Red. The internal surface of the MS enclosure of the box shall painted white colour. The external painting shall be of synthetic enameled paint. Aluminium hammer shall be suspended on a hook fixed to the external MS enclosure by means of a non-corrodible easy breaking of the glass cover.

Manual alarm call point located on the outer walls of the building and/or exposed to weather conditions shall be weather proof type and satisfying the requirement of APB.

The manual call point shall be capable of being remotely tested from control panel.

9.08 OPTICAL (PHOTOELECTRIC) TYPE SMOKE DETECTORS (ADDRESSABLE TYPE)

The optical type smoke detectors shall be based on light attenuation by smoke/ or light scattering by smoke particles. Smoke detectors shall have an inherently stable sensor with built-in automatic compensation for changes in ambient conditions. All electronic circuits must be solid-state devices and virtually hermetically sealed to prevent their operation from being impaired by dust, dirt or humidity. All circuitry must be protected against usual electrical transients and electromagnetic interference. Reversed polarity or faulty zone wiring shall not damage the detector. The detector shall have no moving parts or components subject to wear. The response sensitivity of each detector shall be factory set. A built-in barrier shall prevent entry of insects into the sensor. The detector shall be designed for fast and simple laboratory cleaning.

The detector shall be inserted into or removed from the base by a simple push-twist mechanism to facilitate exchange for cleaning and maintenance. The manufacturer shall produce and provide test equipment allowing to test and exchange smoke detectors upto 7m (23ft) above floor level. The detector shall connect to the control unit via a fully supervised two-wire circuit.

The detector shall be capable of being remotely tested from control panel.

9. 09 HEAT DETECTOR (ADDRESSABLE TYPE)

Heat detector shall be combined rate of rise and fixed temperature type. Heat detectors shall consist of two independent thermistors, designed to automatically compensate virtually hermetically sealed to prevent their operation from being impaired by dust, dirt of humidity. All circuitry must be protected against usual

electrical transients and protected against usual electrical transients and electromagnetic interference. Reversed polarity or faulty electromagnetic interference. Reversed polarity or faulty zone wiring shall not damage the detector. The detector shall have no moving parts or components subject to wear. It shall be possible to test the detector in the field. The response (activation) of a detector shall be clearly visible from the outside by a flashing light of sufficient brightness. The detector shall be installed into the base by a simple push-twist mechanism to facilitate exchange for cleaning and maintenance. The detector shall connect to the control unit via a fully supervised two-wire circuit.

The manufacturer shall produce and provide test equipment allowing to test and exchange rate-of rise/fixed temperature heat detectors up to 7m (23ft) above floor level.

The detector shall be capable of being remotely tested from control panel.

9. 10 PLUG-IN BASES

The smoke & heat detectors shall fit into a common type of standard base. Once a base has been installed, it shall be possible to insert, remove and exchange different types of detectors by a simple push-twist movement. The standard base shall be equipped with screw wiring terminals capable of securing wire sizes up to 16mm² and weakening of contact pressure. The standard base shall be supplied with a sealing plate, preventing dirt, dust, condensation or water from the conduit reaching the wire terminals or the detector contact points. All standard bases shall be supplied with a removable dust cover to protect the contact area during installation and construction phase of the building. It must allow the check out and certification of the zone wiring before insertion of any detectors. The standard base shall feature a built-in mechanism, which allows mechanical locking of an installed detector head, thus preventing unauthorized removal or tampering while maintaining.

The detector contact points shall be designed to retain the detector safely and to ensure uninterrupted contact also when exposed to continuous severe vibration. All electronic components of base and modules must be solid state and virtually hermetically sealed to prevent their operation from being impaired by dust, dirt or humidity. All circuitry must be protected against usual electrical transients and electromagnetic interference. Reversed polarity or faulty zone wiring shall not damage the detector. The standard base shall allow snap-on insertion of an (optional) electronic module, it shall be possible to turn a standard base part into an individually addressable detector base with its own unique identification address at the control unit. The standard base shall have a built in alarm indicator which is repeatable by connecting a simple 2 core wire to the base. No changes in the zone wiring shall be required to operate the additional alarm indicator. Removal and insertion of dust covers or detectors shall be feasible by a simple push twist movement, even if the locking device has been activated. Special base assemblies shall be available for use in air ducts and aspiration air-sampling system wherever required.

Contractor is required to submit samples and get approved from HSCC Electrical Engineer of all above mentioned items including Response Indicators, Hooters, manual call points.

10.00 LIFT INSTALLATION

10.01 The scope of work shall cover design, supply delivery, installation, testing and commissioning of passenger lifts/bed lifts. The scope of work shall also include the following item of civil works.

- a) Necessary scaffolding temporary barricade in the hoistway required during the erection of the elevators.
- b) Minor building work comprising of cutting holes and making good the car and counterweight rail brackets, hall buttons and indicators including laying of sills in position.
- c) Steel items such as machine beams, bearing plates buffer support channels, sill angles and fascia plates etc.
- d) Suitable trap doors with steel chequered plate covers.
- e) Providing and install a suitable vertical iron ladder for access to the pit.
- f) Any other item required for successful completion and commissioning of lifts. (including the hoisting beam in the machine room)

10.02 The work shall be done in accordance with regulations of any local code and following ISI codes which govern the requirements of installations.

IS: 1860-1980 code of practice for installation, operation and maintenance of Electric Passenger and Goods Lifts.

IS: 3534-1976 Outline dimensions of Electric Lifts.

IS: 4666-1980 Specifications for Electric passenger and Goods Elevators.

Indian Electricity Act 1910.

Indian Electricity Rules, 1956.

Delhi Lifts Rules, 1942.

10.03 SHOP DRAWINGS AND APPROVAL OF ELECTRICAL INSTALLATIONS:

The selected tenderer shall prepare a furnish shop drawings for approval by The Client, such shop drawings shall be based on the Architectural drawings and requirements laid down in specifications, local laws and regulations etc.

The detailed drawings shall be submitted within one month of placement of order. The successful tenderer shall obtain the approval of electrical Inspector and other local authorities as per requirements before submitting the drawings to Client/ Engineer. The contractor shall not proceed with in installation work till the drawings are approved by the Engineer-in-Charge. Expenses incurred such as license fee etc. towards obtaining the approval of Electrical Inspector, local authority shall be reimbursed to the contractor as per actual on production of documentary proof.

Approval of contractor's drawings shall not absolve the contractor of any of his obligations to meet the requirements of specification under this contract

Five sets of completion drawings operation manual, maintenance manual, spare parts details shall be submitted to the Client/ Engineer after completion of work.

10.04 GUARANTEE

The tenderer shall guarantee the equipment against all defects of materials and workmanship for a period of one year from the date of commissioning of the equipment as certified by the owner. Any defects arising during the guarantee period shall be rectified and replaced by the tenderer, at his own expense, to the satisfaction of the owner.

10.05 PERMITS, INSPECTION & LICENSE FEE

The contractor shall arrange all necessary local, provincial or national government permit and shall make arrangements for inspection and tests required thereby. Expenses to be borne by purchaser.

10.06 MAINTENANCE

After the completion of the installation and before handling over of each elevator by the elevator contractor, maintenance service for the equipment furnished shall be provided for a period of twelve (12) months. This service shall include regular examination of the installation by trained employees, and shall include all necessary adjustments, greasing oiling, cleaning supplies and genuine standard parts to keep the equipment in proper operation, except any parts made necessary by misuse, accident or neglect caused by other. Contractor shall provide 24 hours Emergency local call back service facility and shall furnish full details of such facilities available.

10.07 POWER SUPPLY

The apparatus shall be designed to operate on 3 Phase, 4 wires, 50 Hz A.C at 415V, The entire lift equipment should be suitable for operation at +10% to -20%, of the rated voltage. Supply for illumination signal equipment shall be 240 Volts.

10.08 ELECTRICAL WIRING

The necessary A.C. supply of 3 Phase, 415 Volts 50 HZ shall be made available in the main control switch unit to be provided by the contractor in the machine room. All the electrical works beyond the main supply switch shall be carried out by the contractor i.e. supply and installations of panels for drive motors, switches and control complete with wiring as per system requirement and approval of the Engineer.

The wiring shall be carried out strictly in accordance with Indian Electricity Rules and Indian code of Practice for Electrical Wiring Installation IS-732-1963 System Voltage not exceeding 650 V). For works not covered under any of the above wiring rules, the 13th edition of Electrical Engineers (Condense) shall apply. The cable and conduits to be used shall be of suitable size and grade conforming to relevant IS specification. Wiring for LT switchboard to the motor terminal shall be with heavy duty 1.1 KV grade PVC insulated PVC sheathed, FRLS aluminium cable. All the trailing cables used for control and safety device shall conform to IS: 4289-1967, Specifications for lifts cables. The trailing cable circuits for controls, safety devices, lighting and signaling shall be separate and distinct.

Power wiring between controller and main board to various landings shall be drawn in suitable size heavy gauge conduit stove enameled/painted conforming to I.S specifications.

The Voltage and frequency of the supply shall be subjected to variations permissible under Indian Electricity Acts and Rules.

10.09 PARTICULAR SPECIFICATIONS

| | | | |
|---------|--------------------|---|--|
| 10.09.1 | TYPE | : | Bed Lifts/Passenger Lifts. |
| 10.09.2 | NO. OF ELEVATORS | : | As Per Bill of Quantities. |
| 10.09.3 | CAPACITY | : | As Per Bill of Quantities. |
| 10.09.4 | SPEED | : | As Per Bill of Quantities. |
| 10.09.5 | FLOORS SERVED/RISE | : | As Per Bill of Quantities. |
| 10.09.6 | STOP | : | As Per Bill of Quantities. |
| 10.09.7 | OPENINGS | : | (All Openings on same side). As Per Bill of Quantities. |
| 10.09.8 | OPERATION | : | Simplex Collective as per BOQ. |

10.09.9 CAR FRAME:

The car frame, which supports the car platform and enclosures, shall be made of structural steel and equipped with suitable guides and a car safety device mounted underneath the car platform. The hoist ropes shall include adjustable self/ aligning hinges.

The car shall be so mounted on the frame that vibration and noise transmitted to the passenger is minimized.

10.09.10 CAR SAFETY AND GOVERNER :

Suitable car safety to stop the car whenever excessive descending speed is attained shall be operated by a centrifugal speed governor connected to the governor through a continuous steel rope.

The governor shall be provided with self tensioning device to keep governor rope in proper tension even after rope stretch. Suitable means shall be supplied to cut off power from the motor and apply the brake on application of the safety.

10.09.11 COUNTER BALANCE :

A Suitable guided structural steel frame with appropriate filler weights of cast iron shall be furnished to promote smooth and economic operation.

10.09.12 TERMINAL AND FINAL LIMITS :

Terminal limit switches shall be provided to slow down and stop the car automatically at the terminal landings within permissible over travel and final limit switches shall be provided to automatically cut off the power and apply the brake, should the car travel beyond the permissible over travel. They shall act independently of the operating devices and buffers.

10.09.13 TERMINAL BUFFERS :

Heavy duty spring buffers shall be installed as a means of stopping the car and counterweight at the extreme limits of travel. Buffers in the pit shall be mounted on steel channels which shall extend between both the car and counterweight rails.

10.09.14 CONTROLLER :

A Controller shall be provided to control starting stopping and speed of the elevator motor and also be automatically able to apply the brake if any of the safety devices operate or if power fails from any cause. In case of power failure and again restore of power the lift shall land to next floor and shall not go to basement/lowest level. Suitable software/hardware or rescue device shall be provided.

10.09.15 REVERSE PHASE RELAY :

A reverse phase relay shall be provided on the controller which is designed to protect the lift equipment against phase reversal and phase failure.

10.09.16 GUIDES :

Machined steel tee guides shall be furnished for the car and counterweight. The guide rails should be of steel solid and shall have tongued and grooved joints. Sliding clips shall be used for fastening the guides to allow building settlement without distorting the guide rails. To keep down the noise level and to reduce wear

and tear of the sections, only Nylon Ribs shall be used in the guide shoes, after smoothening of the rails. The flanges shall be machined for the fish plate mounting such that rail alignment at joints almost remain constant.

10.09.17 FOUNDATIONS :

The machine shall be placed directly above the hoistway upon the machine room slab provided by the Owner.

10.09.18 ROPES :

The elevator shall be provided with traction steel ropes. Steel wire rope having a tensile strength of not less than 12.5 Ton/cm² of good flexibility shall be used for lift. The lift rope shall conform to IS: 2365-1963.

10.09.19 MACHINE :

The machine shall be of the single wrap traction type and shall include a motor, electromechanical brake, steel worm, bronze gear, steel sheave shaft and Farrow-Molybdenum sheave all compactly mounted on a single base or bed plate. The worm shaft shall be provided with ball bearings to take the end thrust and roller bearings shall be furnished for the sheave shaft to ensure alignment and long bearing life. The driving sheave shall be grooved to ensure sufficient traction and minimize rope wear. Shall be provided for all bearings and the worm gear.

10.09.20 BRAKE :

The direct current brake shall be spring applied and electrically released and designed to provide smooth stop under variable loads. The brake should be capable of operation automatically by various safety devices, current failure, and by normal stopping of car. It should be possible to release the brake manually, such releases brake manually, such releases requiring the permanent application of manual force so as to move the lift car in short stops. For this purpose one set of brake release equipment shall be supplied.

10.09.21 MOTOR :

The motor shall be suited to the service proposed and arranged for adequate lubrication. The motor shall be class F insulation and one (1) hour rated squirrel cage induction type having high starting torque. It shall also be provided with Thermistors embedded in the stator windings for the highest degree of thermal motor protection.

10.09.22 CONTROL

The control shall be variable voltage variable frequency A.C. variable voltage, closed loop control system using solid state devices and electronic speed pattern generator to command the motor from a velocity transducer and load compensation circuits for a comfortable ride.

In Normal operation, the electromagnetic brake shall only be applied when the lift has come to a complete standstill. The brake shall only be meant for holding the lift in position at every landing, providing stopping without any jerking effect.

Each controller cabinet containing memory equipment shall be properly shielded from the pollution.

MICROPROCESSOR

The control shall employ a microprocessor working on a program such that precision leveling and highly efficient handling of passengers for least possible waiting and reduced travel time is ensured. The microprocessor system should be designed to accept programming with minimum downtime. It should be able to monitor the state of input calls (such as car calls from COP and hall calls from hall fixtures) and output commands such as starting, decelerating and stopping the elevator. It should be able to generate floor location data, thereby, providing a reference position to establish the safety zones for door opening and closing, and also to initiate leveling slowdown.

10.09.23 DUPLEX COLLECTIVE OPERATION

The operation shall be duplex collective with/without attendant for each elevator and shall consist of the following:-

IN THE CAR

There shall be furnished a flush type attractively finished stainless steel panel which contains a series of luminous buttons numbered to correspond to the landings served, an emergency stop switch and an emergency call button connected to a bell which serves as an emergency signal.

AT HOISTWAY LANDINGS

There shall be provided an UP luminous push button and a DOWN luminous push button at each intermediate landing and a single button at the terminal landings.

The car shall not start unless the door is in the closed position and all hoistway doors are closed in the locked position.

If the car is idle and one or more car or landing buttons above the landing at which the car is standing are pressed, the car shall start in the UP direction and proceed to the highest landing for which any button is pressed and stops at intermediate landing for which a car button or up landing button is pressed sufficiently in advance of the car's arrival at such landings to permit these stops to be made. After each stop, the car shall proceed in the UP direction until it reaches the highest landing for which a call is registered. The car shall not stop on the UP trip at any landing in response to a DOWN call.

Similarly, if the car is idle and one or more car or landing buttons below the landing at which the car is standing are pressed, the car shall start in the DOWN direction, proceed to the lowest landing for which any button is pressed and stop at each intermediate landing for which a car button is pressed.

When the car is idle and a button for a landing above the car and a landing below the car are pressed, the car shall start towards the landing corresponding to the button pressed first. The call registered for the landing in the opposite direction from the car shall be answered after the car has responded to the farthest call in the direction established by the button pressed first.

A time relay shall hold the car for an adjustable interval of few seconds at the landings at which stops are made to enable passengers to enter or leave the car.

OPERATION WITH AN ATTENDANT

The regular car operating panel shall include buttons, switches, etc. for the collective-automatic control and shall also include.

A two-position key-operated switch marked to indicate ATT (attendant operation)

A buzzer: UP and DOWN direction light jewels and A non-stop button.

A car operating panel shall also include an UP and DOWN button.

When the key-switch is in the position of WITH ATTENDANT, the direction light and buzzer shall become operative and the UP and DOWN direction button in the regular car operating panel shall be made effective for the attendant operation.

When an attendant operation, the car and hoistway doors shall open automatically at each stop but the closing of the doors shall be subject to the UP or DOWN direction buttons. As a visual signal to the attendant, the UP and DOWN direction jewel shall illuminate upon registration of either car or landing calls to indicate the direction of the travel of the car. The attendant shall operate the elevator normally in the direction indicated by the direction jewel but, if desired, opposite direction travel may be realized by pressure of a car button for a landing in that direction from the car.

The pressure of a direction button shall cause the doors to close and the car to start in the direction desired, provided a call is registered for that direction. If pressure of the direction button is released before the car starts, the doors will re-open and car shall not travel. It shall so arrange the pressure on direction button can be released, once the car has started.

Continuous pressure of the nonstop button shall cause the car to by-pass all landing calls and respond only to registered car calls.

10. 09. 24 CAR ENCLOSURES :

The car enclosures shall be of sheet steel and shall be of an elegant design comprising of the following :

- a) Suspended ceiling with light diffuser Perspex ceiling and fluorescent light.

- b) Concealed pressure fan with grille in suspended ceiling. The lift shall have sensor so that the fan is operation only when if there is at least one person inside the lift.
- c) Ceiling steel painted white.
- d) Complete stainless steel car enclosure in plain finish for passenger and Bed Lifts
- a) PVC flooring (with 3mm thick tiles of approved shade) for Bed Lifts
- b) Mirror on one face (front face when we enter the car)

10.09.25 CAR DOOR

The car entrance shall be provided with stainless steel sliding doors in plain finish giving a clear opening of 1200mm wide by 2000mm high for hospital lift. For passenger lift it will be as per CPWD specifications.

10. 09. 26 HOISTWAY DOORS :

At each landing, a center/ telescopic opening , stainless steel sliding door in plain finish giving a clear opening as per CPWD general specifications for electrical works –Part-III – Lifts & Escalators, shall be provided. Hoist way doors should be with one hour fire rating.

10. 09. 27 SIGNAL AND OPERATIVE FIXTURES :

The following signal and operative fixtures shall be provided for each lift in stainless steel face plates except in fireman's switch which shall have a glass face plate.

a) CAR OPERATING PANEL

There shall be one (1) No. panel in car, with hinged stainless steel face plate and shall comprise illuminated floor buttons, door open and emergency stop controls emergency call buttons, door open and emergency stop controls emergency call button, two position key operated switch, a Buzzer, UP and DOWN direction light panels, a non stop button, and an integral interphone. The jewels and accentuator shall be of modular construction, face plate mounted, rewired using snap on lugs.

b) HALL BUTTONS AND HALL POSITION INDICATOR

There shall be provided combined signal fixture (one riser) of compact design and of attractive hairline stainless steel face plate at the elevator entrance on each floor which for terminal landings shall have a single luminous push button and for intermediate landings shall have an UP luminous push button and a DOWN luminous push button. The jewels shall be of modular construction mounted on a stainless steel face plate. Whenever a button is pressed, the jewel shall light up to indicate registration of the call and shall remain enlightened till the car arrives.

c) CAR POSITION INDICATOR IN CAR

This shall be of compact design and of attractive hairline finish stainless steel face plate with easy to read digital display of the floors, indicating through which floor the elevator is passing or on which floor the elevator is stopped. This shall also incorporate illuminated arrows showing the direction of travel.

d) BATTERY OPERATED ALARM BELL AND EMERGENCY LIGHT

A solid state siren type alarm unit operated by 2 Nos. 9 volt rechargeable Nickel Cadmium batteries shall be provided which shall give a waxing and waning siren when alarm bell in the car is pressed momentarily.

An emergency light unit using a 9 volt dry battery power pack and incandescent lamp with stainless steel face plate shall be provided inside the car which shall operate automatically in the case of power failure.

e) OVERLOAD WARNING

Overload warning radars with audio-visual indication (visual indication shall show OVERLOADED) with stainless steel face plate shall be installed in the elevator car, so that when there is overload in the car the sign shall light up a flash indicating OVERLOADED and a buzzer shall operate during this period and the doors shall remain open until the overload is removed.

f) FIREMAN'S SWITCH

A toggle switch covered by a glass cover shall be provided on the ground floor for each elevator which shall permit a fireman to call the elevator to the ground floor by canceling all car and landing calls. The elevator shall then stop at the ground floor with the door open to permit the fireman to have exclusive use of the elevator without any interference from the landing calls.

g) INTERPHONE

Interphone shall have one master unit in each machine room, one master unit on the ground floor for each 1 (outside hoistway) and one slave unit in each elevator car.

10. 09. 28 ELECTRIC DOOR OPERATOR FOR CAR DOOR AND HOISTWAY DOOR :

An electric door operator for opening and closing the car door shall be provided. The opening of a car and hoistway doors shall be such that the doors shall start opening meant for so that by the time the elevator stops completely, the elevator and hoistway doors shall be fully open.

The equipment shall consist of a machine on the elevator car operating the car door when the car is stopping at a landing.

The car door and hoistway door shall be mechanically connected and shall move simultaneously in opening and closing.

The car and hoistway doors shall be power opened and closed and shall be checked in opening and closing with an oil cushioning mechanism built into the gear unit.

Each hoistway door shall be provided with an interlock which will prevent movement of the car away from the landing unit.

The doors are closed in the closed position as defined in the ISI codes.

An electric contact for the car door shall be provided which shall prevent car movement from the landing unless the door is in the closed position as defined in the ISI codes. The locking arrangement shall be so designed that the electrical circuit cannot be completed unless the doors are in the closed position and mechanical latching is effected.

Necessary switches shall be provided in the elevator machine room to control the operation of the doors.

The car and hoistway, doors shall open automatically as the car is stopping at a landing. The closing of the car and hoistway door must occur before the car can be started. Doors can be stopped and reversed during their closing motion.

10. 09.29 DOOR HANGER AND TRACKS :

For the car and each landing door, sheave type two point suspension hangers complete with tracks shall be provided. Means shall be provided to prevent the door from jumping off the track and for vertical and literal adjustment of doors.

Sheaves and rollers shall be of steel and shall include shielded ball bearing to retain grease lubrication. Adjustable ball bearings rollers shall be provided to take the upward thrust of the doors. Tracks shall be of suitable steel section with smooth surface. The locking of the two leaf parting type doors should be positive.

10. 09.30 SAFETY SHOE :

A safety shoe (one on each door panel) shall extent to the full height of and project beyond the front edge of the car door.

Should this shoe touch a person or an object while the car door is closing, the car and hoistway doors shall return to the open position. The doors shall remain open until the expiration of a pre-determined interval and then close automatically.

10.09.31 LANDING ENTRANCE MATERIAL'S :

These shall consist of headers, extruded aluminium sills and strut angles.

10.09.32 WIRING :

Complete wiring in the equipment.

10.09.33 AUTOMATIC RESCUE DEVICE :

Automatic Rescue Device to be provided for all the lifts with battery backup so that it can land to the nearest level in case of power failure. Automatic Rescue Device shall

have suitable battery backup so that it can operate the ARD at least seven times a day provided the duration between usage is at least 30 minutes.

10.00 LT CABLES

10.1 GENERAL

L.T. Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

10.2 MATERIAL

The L.T. power cable shall be PVC insulated PVC sheathed type aluminium conductor armoured cable and L.T. control cable shall be PVC insulated PVC sheathed type copper conductor unarmoured cable conforming to IS: 1554: 1988 (Part-I) with up to date amendments.

10.3 INSTALLATION OF CABLES

Cables shall be laid directly in ground, pipes, masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of HSCC Electrical Engineer. Cable laying shall be carried out as per CPWD specifications.

10.4 INSPECTION

All cables shall be inspected at site and checked for any damage during transit.

10.5 JOINTS IN CABLES

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilisation and avoiding of cable joints. This apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.

10.6 LAYING CABLES IN GROUND

Cables shall be laid by skilled experienced workmen, using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 metre. Cables shall be laid at depth of 0.75 metres below ground level for LT Cables and 1 metre below ground level for HT cable. A cushion of sand total of 250mm shall be provided both above and below the cable, joint boxes and other accessories. Cable shall not be laid in the same trench or along side a water main.

The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a

radius of bent not less than 12 times the diameter of cables. Minimum 3 metre long loop shall be provided at both end of cable.

Distinguishing marks may be made on the cable ends for identifications of phases. Insulation, tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identifications.

Cable route marker shall be provided as per CPWD specifications. Cost of cable route markers is deemed to be included in the cost of cables/cable laying.

PROTECTION OF CABLES

The cables shall be protected by bricks laid on the top layer of the sand for the full length of underground cable. Where more than one cable is laid in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Cable under road crossings and any other places subject to heavy traffic shall be protected by running them through Hume Pipes of suitable size. Pipes for cable crossing the road shall be laid at a depth of 1000 mm.

EXCAVATION & BACK FILL

All excavation and back fill required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.

The Contractor shall restore all surfaces, road ways, side walks, curbs, wall or the works cut by excavation to their original condition to the satisfaction of the Engineer-in -Charge.

LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/ CEILING

Cable shall be laid on perforated M.S. Cable tray/ladders. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/saddles. Care shall be taken to avoid crossing of cable.

CABLES ON HANGERS OR RACKS

The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required.

Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good.

The hangers or racks shall be designed to leave at least 25mm clearance between the cables and the face to which it is fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 150mm centres. These shall be designed to keep provision of some spare capacity for future development.

CABLES TAGS

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Tray tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

10.7 TESTING OF CABLES

Prior to installation burying of cables, following tests shall be carried out. Insulation test between phases, phase & neutral, phase & earth for each length of cable.

- a. Before laying.
- b. After laying.
- c. After jointing.

Along with the test as prescribed in IS Code, cross sectional area shall also be checked.

On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer in Charge.

- a. Insulation Resistance Test (Sectional and overall).
- b. Continuity Resistance Test.
- c. Earth Test.

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules. The Contractor shall provide necessary instruments, equipments and labour for conducting the above tests & shall bear all expenses of conducting such tests.

11.00 CABLE TRAY

11.01 Ladder Type Cable Tray

Ladder type cable tray shall be fabricated out of double bended channel section longitudinal members with single bended channel section rungs of cross members welded to the base of the longitudinal members at a centre to centre spacing of 250 mm. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanised or painted to the desired lengths.

11.2 Perforated Type Cable Tray

The cable tray shall be fabricated out of slotted/perforated M.S. Sheet as channel section single or double bended. The channel section shall be supplied in convenient length and assembled at site to the desired lengths. These shall be galvanised or painted as specified. Alternatively, where specified, the cable tray may be fabricated by two angle irons of 50mm x 50mm x 6mm as two longitudinal members, with cross-bracings between them by 50mm x 5mm flats welded/bolted to the angles at 1 m spacing. 2mm thick MS perforated sheet shall be suitably welded/bolted to the base as well as on the two sides.

11.3 Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works - Part II -External, 1994.

11.4 The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler plates and cable tray shall be scraped and removed before the installation.

11.5 The maximum permissible uniformly distributed load for various sizes of cables trays and for different supported span are as per CPWD General Specification of Electrical Work Part II -1994. The sizes shall be specified considering the same.

11.6 The width of the cable tray shall be chosen so as to accommodate all the cable in one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 800mm.

11.7 Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. (Details are typically shown in figure 3 of CPWD General Specification of Electrical Work Part II -1994). The radius of bend,

junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

- 11.8** The cable tray shall be suspended from the ceiling slab with the help of 10mm dia MS rounds or 25mm x 5mm flats at specified spacing as per CPWD General Specification of Electrical Work Part II -1994. Flat type suspenders may be used for channels upto 450mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angles 50mm x 50mm x 5mm at the bottom end as specified. These shall be grouted to the ceiling slab at the other end through an effective means, as approved by the PMC/Consultant to take the weight of the cable tray with the cables.
- 11.9** The entire tray (except in the case of galvanised type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.
- 11.10** The cable tray shall be bonded to the earth Terminal of the switch bonds at both ends.
- 11.11** The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross-joints, etc, and paid for accordingly.

12.00 EARTHING

12.01 GENERAL

All the non-current metal parts of electrical installation shall be earthed properly. All metal conduits trunking, switchgear, distribution boards, switch boxes, outlet boxes, and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. Earthing work shall conform to CPWD General Specifications for Earthing work shall conform to Internal) -1994 and Indian Electricity Rules 1956 amended up to date and in the regulations of the local Electricity Supply Authority.

12.02 EARTHING CONDUCTOR

Earth continuity conductor along with submain wiring from Main/Sub Distribution boards to various distribution boards shall be of copper. Earth continuity conductor from distribution board onward up to outlet point shall also be of bare copper. Earth continuity conductor connecting Main & Sub Distribution boards to earth electrode shall be with galvanised MS strip.

12.03 SIZING OF EARTHING CONDUCTOR

Single phase distribution board shall have one earth continuity conductor while three phase distribution board shall be provided with two earth continuity conductors. Earthing of main switch board and sub switch boards shall be earthed with two independent earth electrodes or as indicated elsewhere. Earth conductor laid in ground shall be protected for mechanical injury & corrosion by providing GI pipe.

- 12.04** GI pipe shall be of medium class 40mm dia and 4.5 metre in length. Galvanising of the pipe shall conform to relevant Indian Standards. GI pipe electrode shall be cut tapered at the bottom and provided with holes of 12mm dia drilled not less than 7.5cm from each other upto 2 metre of length from bottom. The electrode shall be buried in the ground vertical with its top not less than 20cm below ground level as per detail enclosed. Earth electrode shall not be situated less than 2metres from the building. The location of the earth electrode will be such that the soil has reasonable chance of remaining moist as far as possible. Masonry chamber of size 300 x 300 x 300mm shall be provided with water funnel arrangement a cast iron or MS frame & cover having locking arrangement at the top.

12.05 PLATE EARTH ELECTRODE

Earthing shall be provided with either GI plate electrode or copper plate electrode of following minimum dimensions.

- i. GI Plate Electrode : 600mm x 600mm x 6mm thick

- ii. Copper Plate Electrode : 600mm x 600mm x 3mm thick

The electrode shall be buried in ground with its faces vertical and not less than 3 metres below ground level. 20mm dia medium class GI pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on the top of this pipe for watering and earth electrode. Earth electrode the watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300mm deep. A cash iron or MS frame with cover having locking arrangement shall be provided at top of metres from the building. Care shall be taken that the excavation for earth electrode may not affect the column footing or foundation of the building. In such cases electrode may be further away from the building.

12.06 ARTIFICIAL TREATMENT OF SOIL

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, then the soil resistivity immediately surrounding the earth electrodes shall be reduced by addition of sodium chloride calcium chloride, sodium carbonates copper sulphate, salt and soft coke or charcoal in suitable proportions.

12.07 RESISTANCE TO EARTH

The resistance of earthing system shall not exceed 1 ohm.

13.00 SAFETY EQUIPMENTS

13.01 DANGER NOTICES

Danger notices shall be affixed permanently in a conspicuous position in Hindi or English and the local language of the district with sign of skull and bones at every overhead lines, transformer, electrical equipments motors, etc.

13.02 FIRST AID BOX

Standard first aid box with all standard contents shall be supplied.

13.03 FIRE BUCKETS

The fire bucket unit shall consist of our galvanised iron baskets, which shall be with round bottom, and of 13 liters capacity. They shall be filled with dry sand. Arrangement shall be made to hang them on GI pipe stand comprising of at least 2 vertical and one horizontal members of 50 mm GI pipe. The stands shall have hooks and locking chain arrangement. The buckets and stand shall be painted with epoxy red paint.

13.04 FIRE EXTINGUISHER

Foam type Fire extinguishers of 9 Kg. capacity and Dry Chemical type Fire Extinguishers of 10 Kg capacity shall be of approved make. It shall be filled with carbon tetrachloride. It shall have horns. Extinguishers shall be fixed on walls/columns with necessary clamps made out of 50 mm x 6mm MS flat and coated bolts and nuts grouted in wall/column.

13.05 RUBBER MAT

Corrugated rubber insulating matting shall be provided in front of all power & motor control centers, push button station and distribution board in the electrical rooms. The width of matting shall be one meter. It shall be as ISI mark.

13.06 INSTRUCTION CHART

Printed instruction chart both in English and Hindi and duly framed with front glass, prescribing treatment to be given to persons having Electric shock, shall be supplied.

14.0 DIESEL GENERATOR SETS

14.1 INTENT OF SPECIFICATION

- 14.1.1 This specification covers the design, manufacture, assembly, packing, dispatch, transportation supply, erection, testing, commissioning, performance and guarantee testing of **Diesel Gen-Sets with Acoustic Enclosure**, complete in all respects with all equipment, fitting and accessories for efficient and trouble free operation as specified here under.

14.2 SCOPE OF WORK:

14.2.1 Scope of Supply & Services:

General Scope of work shall include, supply, erection, testing and commissioning of the following:

- a) Diesel engine complete with all accessories, an Alternator directly coupled to the engine through flexible/rigid coupling complete with all accessories for starting, regulation and control, including base frame etc. interconnecting piping and accessories, power and control cable glands and lugs.
- b) Diesel Local/Remote control panel including cables between bidders local equipment and special cables if any.
- c) Equipment necessary for engine cooling system, radiators, pumps, valves, inter connecting pipes etc.
- d) Equipment necessary for fuel storing and distribution, day oil tank (990 Lt.), pipings, pumps, valves, level indicators etc.
- e) Flexible connections and residential type silencer of exhaust system, including thermal lagging.
- f) Batteries with iron battery stand and battery charging equipment, including their connections as necessary along with tools & accessories for battery maintenance.
- g) Anti Vibration Mountings etc.
- h) Preparing all related shop drawings for approval from client/consultant and statutory bodies.
- i) Obtaining approval of the installation of Diesel Generators by the Electrical Inspectorate and Pollution Control bodies and any other statutory bodies.
- j) Minor civil works like chasing, grouting etc. for execution of jobs.
- k) Carrying out performance and guarantee test at site available load but not more than the capacity of D.G. Set.

- l) Acoustic enclosure as per CPCB norms and type approved.

14.2.2 Specific Exclusions:

Following items of works are excluded from the scope of works under this specification:

- a) All civil works relating to DG foundation etc.
- b) All cables between contractors and owners equipment other than special cables external to the equipment.

- 14.3.2 The installation work shall conform to Indian Electricity act and Indian Electricity Rules as amended up to the date of installation.

The fuel oil installation shall meet all statutory requirements of Govt. of India as amended up to the date of installation. Any approval required from statutory authorities shall be obtained by the Contractor. Nothing in this specification shall be construed to relieve the contractor of these responsibilities.

- 14.3.3 Equipment conforming to any other National/International Standard which ensures equal or better quality may be accepted. In such case the bidder shall furnish copies of the standards in English along with his bid and shall clearly bring out the salient features of comparison with corresponding listed standards.

- 14.3.4 The equipment furnished under this specification has to operate in a tropical climate and shall be given tropical and fungicidal treatment as per relevant specification

14.3.5 Period of Operation/Duty Cycle:

The sets are intended to supply power only during an emergency for essential services and may be idle for long periods except for periodic routine tests once in a week. When there is a total failure of main power supply, the sets shall be required to operate continuously at full load for a period which at times may exceed even 24 hours.

14.4 ENGINE:

14.4.1 Type:

The diesel engine shall be of stationary type four stroke/two stroke with vertical in line or (V) type cylinder arrangement, Turbo-charged, cooled with radiators.

14.4.2 Rating:

- a) Prime power BHP rating of the engine shall be such that the DG set deliver the specified net electrical output while supplying power/driving all electrical and mechanical auxiliaries connected to alternator terminals and engine shaft at specified site conditions and ambient temperature of 50°C. The bidder shall submit the deration calculations if the engine is not designed for 50deg C. ambient temperature.
- b) It shall also be capable of satisfactorily driving the alternator at 10% over load at the rated speed for one hour in any period of 12 hours of continuous running.

The bidder shall have to furnish copy of deration chart from the original manual of the engine manufacturer and supporting calculations to arrive at diesel engine rating.

14.4.3 Speed and Vibration Levels:

- a) Speed shall be 1500 revolutions per minute. Speed governor/over speed protection shall be provided.

At due running conditions, speed shall be stabilized at plus or minus 2% nominal speed, regardless of load. At transient condition, engine speed shall vary not more than 10% plus or minus. Governor class shall be A1 (4% drop) for normal application unless otherwise specified.

- b) The engine vibration level shall not exceed 100 microns.

14.4.4 Lubrications:

- a) The engine shall have a closed cycle forced & splash lubricating system with positive oil pressure and a crank chamber for collection/storage of the lubricating oil during circulation.
- b) A lubricating oil filter shall be provided for operation under normal conditions for a period of 300 hours without the necessity of its replacement or cleaning.
- c) In case lubricating oil coolers are required it shall be supplied as an integral part of the Diesel Generator Set.
- d) Necessary temperature and pressure gauges and other instruments shall be supplied and fitted on the lubrication system.
- e) A lubricating oil level dipstick suitably graduated shall be provided and located in the accessible position.

14.4.5 Fuel System:

- a) The engine shall be capable of running on all types of diesel fuel oil normally available in India.
- b) The fuel consumption of the engine at full, three quarters and half of its rated power output shall be indicated by the Contractor in the bid.
- c) A fuel service tank of 990 litres capacity with each D.G. Set shall be provided on a suitably fabricated steel platform. The tank shall be complete with level indicator marked in litres, filling inlet with removable screen, an outlet, a drain plug, an air vent and necessary piping. The fuel tank shall be painted with oil resistant paint. All pipe joints should be brazed/welded.

14.4.6 Air Intake System:

The diesel engine shall be provided with special dry type air filters having low resistance to air passage, high dust retaining efficiency and provision for easy cleaning. Filters shall be suitable for achieving satisfactory engine operation and ensuring the engine life under tropical humid conditions, with sulphur dioxide fumes, abrasive dust and coal particles of 5 to 100 microns present in the atmosphere. The minimum efficiency of filters shall be 90% down to 5 micron size.

14.4.7 Cooling:

The diesel engine should be water cooled with radiator heat exchanger system. The cooling system should include temperature gauge with high temp., alarm/trip corrosion resistor etc.

14.4.8 Engine Governor:

The governor shall be Electronic ISO-Chronous type to maintain zero speed rate or regulation and shall be AI type as per BS:5514 in order to take care of heavy motor starting. It shall have necessary characteristics to maintain the speed substantially constant even with sudden variation in load. However, a tripping shall be provided if speed exceeds maximum permissible limit. The governor shall be suitable for operation without external power supply.

14.4.9 Turbo Charger:

It shall be of a robust construction, suitable of being driven by engine exhaust having a common shaft for the turbine and blower. It shall draw air from filter of adequate capacity to suit the requirements of the engine.

14.4.10 Quietness of Operation:

- a) The engine shall be designed to achieve maximum quietness of operation.

- b) Efficient residential silencer shall be provided as per engine manufacturer's approved make only for the exhaust.
- c) Noise level of the set shall not exceed 115-120dbA at one meter distance of the engine.

14.4.11 Engine Starting:

- a) Engine starting shall be by electric starting motor complete with manual/automatic starting arrangement. The starter motor shall conform to IS:4722 and shall be of adequate power for its duty and be of inertia or pre-engaged type. The pinion shall positively disengage when the engine starts up or when the motor is de-energized. The engine cranking shall be only from the panel both for AMF & DG sets (Manual) and any engine starting devices etc. that are given as original fitment on the engine by engine manufacturers shall be either removed or padlocking arrangement given for this so that all normal start/stop operations could be done only from panel whether the set is AMF or manual.

The engine wiring shall be appropriately modified, ferruled to totally match with schematic drawings of the panel.

- b) Time for Run-up to Speed:
From the initial operation of the starting device, the engine shall start, run up to normal speed and be capable of accepting 60% of full load within a maximum time of 20 seconds, and full load within a further 20 second.

14.4.12 Starter Battery:

- a) The battery shall conform to the requirement of IS:1651. Starting battery each of 12 V, heavy duty high performance approved make/quality shall be provided to enable crank & start the engine even in cold/winter morning conditions. Type/voltage/AH capacity of same on 20 hour rated discharge period shall be indicated in the offer. The battery set shall be capable of performing at least (5) five normal starts without recharging.
- b) The battery shall be provided with good quality teakwood stand painted with acid proof black paint with min 3mm thick rubber mat below the batter.
- c) Batteries shall be of load container type only and not with PVC moulded sealed container so that each individual cells are available for individual monitoring during its life span. Each cell shall be provided with electrolyte filling cap with level floats for easy monitoring of electrolytic level.
- d) The battery shall be provided with 2 Nos. cables, minimum 1.5m long heavy duty rubber/PVC insulated cabling with brazed tinned lug at one end and with brazed

tinned brass terminal lug at battery end - for connecting batteries to cranking system - with 0.25 m long inter battery connecting cable.

- e) The lugs shall be clearly stamped (+) or (-) and positive cable also red sleeved for easy identification.
- f) The batteries Set shall be supplied fully filled and first charged ready to use.

14.4.13 Battery Charging System:

- a) Float rate charging and quick rate charging system shall be provided at the generator panel with appropriate bridge charger system, LC network, rate selector switch and generously rated charging transformer and silicon one rectifier bridge, so that the cranking battery system can be kept fully charged at all times from E.B. supply network with quick charging rate limited to 0.8 times rated discharge current with provision in control transformer and Si rectifier present to enable boost charging the battery at 2 times rated discharge current in case of emergencies. To this and in the mode selector switch boost charge position shall be present which however shall be kept disconnected at mode selector switch normally.
- b) DC ammeters to clearly indicate float charging current and quick/boost charging current shall be provided.
- c) Dropper resistor network on the load side of battery charger system shall be provided so that higher charger voltages in quick or boost conditions does not get impressed on the I/L and Contactor coils, which voltage shall remain well within +10% of rated voltage.
- d) Battery charging subsystem shall be designed for continuous operation at cubicle ambient of 50°C corresponding to 45°C ambient outside and should be designed to operate at 1.5 times rated maximum current corresponding to boost charge current which can reach in practice as high as 2.5 times or 3 times rated discharge current.
- e) Any charger dynamo and dynamo charging current network present on the set shall be made in operative so that both for AMF and manual application the cranking battery system is kept charged from the charger at the panels at all times during or shut down periods of the set.
- f) To the above and in case of manual DG sets, the input to charger subsystem viz., 240 V AC is foreseen to be provided from customer network from the portion that is normally supplied by manual DG Set during DG operation or being fed by E.B. System.

14.4.14 Engine Fitments:

The engine shall be provided with but not limited to following essential basic fitments:

| | | |
|---|---|--|
| Crank case breather | - | Dry type element. |
| Air Cleaner | - | Dry type mounted. |
| Corrosion resistor | - | to control acidity and impurities from coolant. |
| Lubricating Oil Cooler | - | |
| Filters | - | Lub oil & fuel oil, paper element type. |
| Coolant Pump | - | Gear Driven. |
| Fuel Pumps | - | Priming & Transfer |
| Governor | - | Electronic Class A1. |
| Turbo Charger | - | Exhaust gas driven in case of turbo charged engines. |
| Flywheel with flywheel housing | - | SAE Type |
| Vibration dampers | - | One Set |
| Exhaust/Intake manifolds | - | |
| Oil Sump (crank case) with dip stick | | |
| Engine Supports | | |
| Residential type silencer in exhaust system | | |
| Electrical starter 12 V or 24 V | | |
| Safety controls & instruments | | |

14.4.15 Engine Instrumentation:

The following instruments mounted on instrument panel shall be essentially present as minimum:

- Engine speed tachometer with service hour counter
- Lub oil pressure gauge
- Coolant water temperature gauge

The instrument panel shall be mounted on engine using rubber dampers for vibration isolation.

The gauges shall have clear red marking to identify the limiting dangerous levels, 'Zone Markings' on the scale to indicate the normal healthy & abnormal operating zones for the parameters concerned.

The metering could be either normal electro-mechanical analogue type or electronic digital type, latter being preferred as manufacturers fitment only.

The engine control panel must be supplied by the engine manufacturer only.

14.5 ALTERNATOR:

- 14.5.1 The alternator shall have brushless type with rotating field and static excitation circuit controlled by field control unit suitably compounded for voltage and load current for a self excited self regulated system.

14.5.2 The alternator shall be in SP-DP enclosure, foot mounted with ball and roller bearings on end shields.

14.5.3 The alternator shall conform to IS:4722/BS:2613 and shall be suitable for tropical conditions.

14.5.4 The alternator shall comply with the following specifications:

| | |
|----------------|---|
| Rating | - As per BOQ. (Shall be capable of 10 % over loading at the rated speed for one hour of 12 hours continuous running). |
| Voltage | - 415 V |
| Speed | - 1500 RPM |
| Frequency | - 50 Hz. |
| P.F. | - 0.8 lag |
| Enclosure | - IP:23 |
| Insulation | - H |
| Execution | -Self excited, self regulated with brushless system and static voltage control unit suitably compounded for voltage and current to maintain terminal voltage constant at $\pm 5\%$ at all load for p.f. not less than 0.8. lag. |
| Terminal Box | - As per BOQ. |
| Earthing Studs | - 2 Nos. in each DG |

14.5.5 Neutral Point:

The winding of the alternator shall be star-connected.

14.5.6 Terminal Box and Connection:

The alternator output terminals shall be enclosed in a terminal box mounted in an accessible position on the alternator frame. As far as possible, connections between the exciter and alternator shall be contained within the machine frame and connections carrying A.C. and D.C. shall be segregated from each other. The terminal box shall be of sufficient size to conveniently terminate the size and number of the Owner's cables, which shall be intimated during detailed engineering. Suitable tinned copper pads shall be provided for power cable termination along with all necessary hardware and cable lugs. Glands and lugs shall be provided for control cables also. For single phase cables, gland plate shall be of non-magnetic material. Gland plate shall be removable type.

14.5.7 The generating set shall be so designed that it is capable of reaching its full voltage and frequency and shall be ready to take full load within 30 seconds of a remote starting impulse being received.

14.5.8 Acoustic Enclosure:

Thickness of Sheet – 14-G:

High Class sheet metal fabricated enclosure for reducing the noise level of DG Set and also acts as weather proof housing. Genset will be an integral part of acoustic enclosure and whole construction will be on multi-fold sheet channels and ISMC sections. Enclosure construction is fully bolted keeping in view the major service requirements all doors are provided with specially designed hinges and lockable handles, battery, fuel tank is housed inside the enclosure.

Acoustic Materials:

Rock wool in the form of slabs of 75 – 100 mm thickness and 48 KG/Metric cube density (Specification of Rock wool conforms to IS:8183).

Further to increase the life of Acoustic material resin coated fiber glass cloth is provided on exposed surface of Rock wool slabs and the panels are supported by perforated sheets.

Ventilation:

Acoustic enclosure is designed in such a way that there are no hot pockets around engine and it is provided with suitable designed engine radiator/or additional axial flow fan and does not allow the temperature to rise more than 7°C.

To achieve optimal output and minimum sound level from the DG Set, suitable openings with acoustic hoods are provide for increasing the inflow of air required for combustion and forced ventilation. Air intake system as per the recommendations and engine requirement are provided.

- Acoustic hoods with noise splitters provided to block and reduce the sound leakage.
- The sound control system designed to suppress the sound level to 75 db maximum at 1 meters distance in open environment.

Silencer:

Specially designed low noise silencer is provided. Silencer & engine exhaust outlet, connected with flexible SS below.

Vibration Isolation:

To avoid transfer of vibration from Genet to enclosure & surrounding specially designed vibration isolators are used.

14.6 AMF PANEL:

14.6.1 General:

- a) The control panel shall be sheet steel enclosed and shall be dust and vermin proof providing a degree of protection of IP-42. Sheet steel used shall be cold rolled and at least 2.0mm thick and properly braced and stiffened.
- b) Control panel shall be provided with hidden hinged door(s) with pad locking arrangement and suitable brackets/channels shall be provided for floor mounting.
- c) All doors, removable covers and plates shall be caskeyed all around with neoprene gaskets. All accessible live connections shall be shrouded and it shall be possible to change individual switches, fuses, MCCBS without danger of contact with live metal.
- d) All live parts shall be provided with at least phase to phase and phase to earth clearances in air of 25mm and 20mm respectively.
- e) Adequate interior cabling space and suitable removable cable gland plate shall be provided. Necessary number of cable glands shall be supplied and fitted on to this gland plate. Cable glands shall be screwed on type and made of brass.
- f) Two number of earthing terminals shall be provided.
- g) All sheet steel work shall be degreased, pickled, phosphate and then applied with two coats of zinc chromate primer and powder coat finishing both inside and outside of shade 631 (gray).

14.6.2 AMF Control of Diesel Generating Sets:

- a) All DG Sets shall be controlled independently.
- b) Diesel Generator shall be capable of being stopped manually from remote as well as local. However, interlock shall be provided in the DG local control panel to prevent shutting down operations as long as circuit breaker is closed.
- c) **Auto Operation:**

When mains power is available, the healthiness of this power will be monitored through a mains voltage monitor. If voltages on the 3 phases are within limits, the monitor will send a closing signal to the mains breaker and mains power will be connected to the load.

If the voltage drops on any phase or on all phases, the monitor will sense this drop through a timer, and if this drop persists for more than a pre-adjusted period of

time (say 1 to 20 seconds) a signal is sent to the engine starting circuit while at the same time opening the mains supply breaker and disconnecting load from mains as voltage is below acceptable limits.

The engine starting control monitor will send a signal to the D.C. battery supply for starting the engine through the starting solenoid. When the engine is healthy, it starts up in a few seconds and the generator develops voltage. The generator voltage monitor, monitors the voltage and when the voltage is developed, this give a signal to the generator breaker which closes and connects the diesel generator to the load. Simultaneously, it sends a signal to de-energize the engine starting circuit and the starter motor is disengaged. The engine protection circuits for high water temperature and low lubricating oil pressure are also energized.

d) Resumption of Supply:

If voltage from mains is resumed, the main voltage monitor will sense this voltage for healthiness, i.e. for maintained correct voltage for a period of time (adjustable up to three minutes) and then send a signal to stop the engine and to change over the breakers from generator to mains and normal supply is resumed to the load. The solenoid operation and closing and tripping of breakers should be done through control voltage 24 V.D.C.

e) Failure to Start:

A three attempt starting facility using two impulse timers and a summation timer for engine shall be provided and if voltage fails to develop within 30 seconds from receiving the first start impulse, the set shall lockout automatically and a visual and audible alarm shall be given in the control panel. The remote panel shall receive "DG Trouble Alarm".

14.6.3 The control panel shall have the following provisions for the control of each DG Set:

1. MCCB's & ACB's as per BOQ.
2. Master engine control which for OFF/AUTO/MANUAL/TEST with a facility for starting and stopping of the set.
3. Voltmeter 144 Sqmm with selector switches for alternator/Mains/Phases complete with protection.
4. Local/Remote selector switch to facilitate remote starting/stopping of the DG Set.
5. Frequency meter 144 Sqmm reed type.
6. Current transformers required for metering.

7. Ammeter 144 Sqmm with C.T. & selector switch, KWH Meter, KW 144 Sqmm.
8. Mains Supply, voltage monitor.
9. Engine control monitor.
10. Alternator voltage monitor.
11. D.C. Control relays, timers.
12. Engine protection system for low oil lubricating pressure and high water temperature.
13. Window type annunciator with static relays, alarm/hooter and accept, test, reset push buttons for all functions.
14. Engine hours run counter.
15. Control fuses.
16. Lifting Hooks.
17. Gland Plates.
18. Power/Control Contactors.
19. Earthing Studs.
20. Antivibration pads.
21. IDMT relays [CDG – 31]
22. Under Voltage Relays
23. Over Voltage Relays

14.6.4 Indication/Annunciation:

Pilot indicating lamps/shall be provided for the following:

1. Charger - ON/OFF
2. Earth Fault
3. Set shutdown due to 'Engine high water temp.'
4. Set shutdown due to 'Low oil pressure'
5. Set shut down due to 'Lock of fuel'
6. Over speed trip

Indicating lamp shall be of the panel mounting filament type with series resistors.

14.6.5 The DG Sets would normally be controlled from remote for which following provisions are being made on the remote control panel. The necessary control devices/contacts for these external connections shall be wired out to the DG control panel terminal blocks.

1. Starting and stopping of the DG Set
2. DG running indication
3. Watt hour meter, Wattmeter, Voltmeter, Ammeter and Frequency meter.

14.7 ENGINE SAFEGUARDS:

Safeguards shall be provided and arranged when necessary to stop the engine automatically by the following:

- a) Energising a solenoid coupled to the stop lever on the fuel injection pump rack.
- b) De-energising the “fuel on” solenoid
- c) Energising the “fuel - cut off” solenoid.

The operation of the safeguard shall at the same time give individual warning of the failure by illuminating an appropriate local visual indicator and remote alarm at generator panel.

The contactors, relays and other devices necessary for signal and control, for above purposes shall be provided at Generator panel.

At the set at a easily accessible place an “EMERGENCY STOP” mushroom head stay put type P.B shall provided to stop the set in emergency mode.

The safe guard to “STOP THE SET” shall stop the set irrespective of mode selection of the set viz Auto, Manual or test for following cases, with simultaneous isolation of alternator ckt.

- a) Emergency stop P.B's operation
- b) Over speed.
- c) Low lube oil pressure.
- d) Earth fault

14.8 TESTS:

- 14.8.1 The alternator of each type and rating shall be type tested for the following tests as per IS:4722, IEEE 115 & BS:5000. Test certificates to be provided for routine and type tests from the manufacturers.

14.9 ERECTION, TESTING, COMMISSIONING AND PERFORMANCE & GUARAANTEE TESTS/PROCEDURE AT SITE:

The entire work of erection, testing and commissioning of equipment supplied under this package shall be carried out by contractor and performance and guarantee tests to be conducted at site are also included under the scope of this specification. For this purpose the contractor shall depute suitable qualified technical supervisor to site on advance intimation to the Owner along with all special testing equipment required for testing and performance and guarantee tests. The supervisor(s) shall be responsible for the installation, testing, commissioning checks and performance & guarantee tests mentioned in relevant clauses of this volume and the checks recommend by the contractor.

The contractor shall ensure that the equipment supplied by him is installed in a neat workman like manner such that they are leveled, properly aligned and well oriented. The tolerances shall be established in Contractors drawings and/or as stipulated by the Owner.

All special tools and tackles and spares required for erection, testing and commissioning of equipment shall be supplied by the contractor.

Erection, testing and commissioning manuals and procedures shall be supplied, prior to dispatch of the equipment.

The contractor shall ensure that the drawings, instruction and recommendations are correctly followed while handling, setting, testing and commissioning the equipment.

14.9.1 Commissioning Check Tests/Performance and Guarantee Test:

In addition to the checks and test recommended by the manufacturer, the contractor shall supervise the following acceptance tests to be carried out on each test at site.

i. Load Test:

The DG Set shall be given load test at site for a period of at least 6 hours depending upon the actual power factor of the load and set shall be subjected to the maximum achievable load without exceeding the engine or alternator capacity.

This full load test is to be followed immediately by a 10% overload run for one hour. The performance of the engine, alternator shall be satisfactory at the end of this overload run.

During the load test half hourly records of the following shall be taken:

- a) Ambient temperature
- b) Cooling water temp.
- c) Lubricating oil pressure.
- d) Speed
- e) Voltage, wattage and current output.
- f) Oil tank level

ii. Speed and Governing:

The speed of the engine shall be verified to ensure that it conforms to the requirement of BS:5514.

iii. Check of Fuel Consumption:

A check of the fuel consumption shall be made through out the test run of full load and overload.

iv. Noise Level:

The equivalent 'A' weighted sound level measured at a distance of 1 meter horizontally from the base of any equipment furnished and installed under these specifications expressed in decibels to a reference of 0.0002 microbar, shall not exceed the limit given as per CPCB norms. 75 dbA average at 1 mtr. distance from acoustic enclosure.

15.00 PROCUREMENT, INSPECTION OF EQUIPMENT & APPROVALS

Approved list of makes and vendors are given in the end of technical specifications. The makes of equipment/materials supplied shall be strictly as mentioned therein. For items not specially mentioned, prior approval shall be taken before procurement of the same. All equipments/material supplied shall be brand new and shall be procured directly from the manufacturers, dealers or authorised agents.

HSCC Electrical Engineer shall have access to the manufacturer's premises for stage inspection/final inspection of any item during its design, manufacturing, and assembly and testing. After carrying out the necessary factory tests and routine tests as per IS Standards, a copy of the routine test certificate shall be forwarded along with the call for carrying out the inspection at the manufacturer's works.

Based on the inspection certificate, HSCC Electrical Engineer reserves the right to carry out the inspection at a mutually agreed date and/or give inspection waiver. A minimum of two weeks will be needed after receipt of complete shop inspection report and other details to depute our inspector for inspection.

It is the responsibility of the contractor to ensure that all electrical works are carried out as per the IE Rules & regulations, National Building Code and IS Codes & Standards. All necessary drawings and details as required by Electricity Board, Electrical Inspector, Fire Department and other Local Statutory agencies, shall be prepared by the contractor. **The contractor is responsible to submit the drawings and other details as required to the Local Authorities (refer above) and obtain necessary approvals including sanction of load/enhancement of electrical load from SEB before energizing and commissioning.** All official fee required for getting the approval will be reimbursed on account of Client on submission of original documents.

17.00 CAPACITOR PANEL

17.01 SCOPE

Supply, installation, testing and commissioning of medium voltage capacitors and Automatic Power Factor Correction Panel (APFC) for improvement in power factor of electrical system. It will be connected to main LT panel. It shall improve power factor up to 0.98 lagging from initial power factor. Capacitor panel shall be provided with day/ night mode selector switch and double ratio C.Ts, for day/ night mode. Day/ night mode shall be selected based on estimated day / night load requirement.

17.02 RATING

Capacitor units as specified in the BOQ shall be used to form a bank of capacitors.

17.03 ENCLOSURE

The panel shall be indoor, floor mounted and free standing type with IP-42 degree of protection. It shall be completely made of CRCA sheet steel. The enclosure shall have sturdy support structure and shall be finished with powder coating in the approved colour shade. Suitable provisions shall be made in the panel for proper heat dissipation. Air aspiration louvers for heat dissipation shall be provided. The front portion shall house the switchgear and the rear portion shall house capacitors and series reactors (7%). The enclosure is to be suitably sized to accommodate all the components, providing necessary air clearance between live and non-live parts, providing necessary working clearance.

17.04 APFC Relay

Microprocessor based APFC relay, (intelligent VAR controller) of suitable steps as mentioned in the BOQ, shall sense the PF in the system and automatically switch ON/OFF the capacitor unit or bank to achieve the preset target PF. The controller shall have digital settings of parameters like PF, switching time delay, step limit etc, indication of PF, preset parameter, minimum threshold setting of 1% of CT current.

17.05 CAPACITORS

The capacitor shall generally conform to IS:13341-1992 and 13340-1993 and IEC 60831-1 & 2.

General specification: three phase, delta connected, 50 Hz.

- i. **Voltage:** Must be designed to withstand system over voltage, increased voltage due to series reactor and harmonics.
- ii. **Capacitor type:** The capacitor unit shall be super heavy duty mix dielectric type. The dielectric should be made of metalised tissue paper. These elements shall be

- combination of capacitor tissue paper and BOPP film impregnated with non PCB bio-degradable impregnant or film foil capacitor manufactured using Poly Propylene film placed between 2 layers of metal foil and winding. Capacitor should be fitted with safety device like pressure sensitive disconnecter. The capacitor should be low loss type (total losses should not exceed 0.45 W/ KVAR).
- iii. **Temperature category:** -25 degree C to 70 degree C.
 - iv. **Over voltage** +10% (12h in 24 hours), +15% (30 minutes in 24 hours), +20% (5 minutes) and 30% for 1 minute as per clause 6.1 of IS 13340-1993.
 - v. **Over current:** 2.5x I_n
 - vi. **Peak inrush current withstand:** 350 x I_n
 - vii. Capacitor shall be provided with permanently connected discharge resistors so that residual voltage of capacitors is reduced to 50 volts or less within one minute after the capacitors are disconnected from the source of supply.
 - viii. Each capacitor bank shall be provided with a terminal chamber and cable glands suitable for AYFY cable as specified.
 - ix. Two separate earthing terminals shall be provided for earth connection of each bank.

17.06 SWITCHGEAR & PROTECTION:

Incomer switchgear will be as specified in BOQ. Suitable contactor for each step shall be used and must be capable of capacitor switching duty. Busbars shall be suitably colour coded and must be mounted on appropriate insulator supports.

Power cable used shall have superior mechanical, electrical and thermal properties. Internal wiring between main bus bars, contactor, capacitor etc shall be made with 1100 volt grade PVC insulated FRLS copper conductor of appropriate size by using suitable copper crimping terminal ends etc suitable bus links for input supply cable termination shall be provided.

Control circuit shall be duly protected by using suitable rating MCB. An emergency stop push button shall be provided to trip the entire system (22.5 mm dia, mushroom type, press to stop and turn to reset). 440 Volt caution board shall be provided on the panel.

17.07 TESTS AT MANUFACTURER'S WORKS:

All routine and type tests as per IS:2834 relevant to capacitor banks as amended upto date shall be carried out at manufacturer's works and test certificates to be submitted to HSCC.

17.08 TEST AT SITE:

Insulation resistance with 500 V DC Megger shall be carried out and test results should be recorded.

Residual voltage shall be measured after switching of the capacitors and the same shall not be more than 50 volts after one minute. Each discharge resistor shall be tested for its working.

Drawings and Instruction manual:

17.09 INSTALLATION:

Capacitor bank shall be installed at least 30 CM away from the walls on suitable frame work of welded construction. The earth terminals provided on the body of capacitor bank shall be bonded to main capacitor panel earth bus with 2 nos 8 SWG copper or 6 SWG GI earth wire.

Contractor shall submit four copies of the following certified drawings:

- i. General arrangement of capacitor bank and control panel indicating main dimensions, type of mounting, location of various devices etc., including foundation details.
- ii. Schematic diagram for automatic sequential switching with terminals and ferrules numbers.
- iii. Wiring diagram of control panel indicating terminal blocks and various apparatus.
- iv. Final list of components of control panel.

Contractor shall also submit four sets of installation and maintenance manual.

22.0 Specifications of CCTV System:

1 . CCTV Camera & Accessories

1.A.1 Indoor High resolution Dome Type color camera

Camera Selected : minimum 520 TVL High resolution color camera or better

Lens Selected : Verifocal Lens 3.6 to 8 mm or as specified in BOQ

Mounting Selected : Ceiling Mount / Wall Mount

Advanced DSP technology 1/3-inch CCD imager color dome type Camera, high sensitivity, high resolution, 520TVL resolution or better with outstanding picture quality with Verifocal lens, where the picture quality provides optimal performance in virtually all situations. The Verifocal lens is planned so that the camera view can be adjusted as per the site requirement during commissioning phase to suit the actual field of view requirements.

Main features

- 1/3" format, interline transfer, CCD image sensor
- Horizontal resolution of 520 TVL with good picture quality
- Rated Voltage - 12VDC
- Signal to noise ratio is greater than 48dB
- Composite video output 1.0 Vpp, 75 ohm
- Gain control 21 dB, (max)
- Lens mounting C and CS
- High-resolution
- Advanced Digital signal processing
- Auto detection of lens type with a lens wizard
- Night sense extends the sensitivity
- Automatic sensing for tracking white balance

1.A.2 Camera Lens :

For optimizing angular fields right on site, varifocal lenses are the most versatile and practical solution available. These lenses allow for setting virtually any angle of the field, which maximizes surveillance effects.

Features:

- High-quality optics
- 1/3"-inch inch formats
- Iris range of F1.7-close
- Lens mount-CS
- Reliable, robust construction
- Focal length options
- Compact design
- Manual and DC iris versions

- Manual focus and zoom control

1.A.3 Camera Housing :

These models accommodate installation of Box type cameras with fixed focal, varifocal or up to a motorized zoom lens. For increased security, tamper resistant screws are provided for the locking clasps to prevent unwanted access to the housing contents.

Features:

- Protects camera/lens combinations
- 3mm glass window
- Aluminum housing casing, neoprene gaskets, UV-resistant polymer endcaps and all stainless steel hardware
- Hinged opening for easy installation and camera setup
- IP 65, Makes the housing dust & water tight
- Aluminum and advanced polymer construction
- Sunshield included in the design
- Cable routing through base or rare of housing. Cable routing through ensures that the water do not enter into the housing
- Tamper resistant.

1.A.4 Camera Mount :

These mounts are for indoor/outdoor mounting units designed for fixed camera, or camera housing installations.

Features:

- Maximum load-9Kg (20 lb)
- 360 deg rotation, 180 deg tilt
- Versatile design
- Adjustable mount heads
- Corrosion-resistant finish

1.A.5 Camera Power Supply Unit :

These series power supplies are designed for CCD cameras.

Features:

- For CCD cameras and other low applications
- 12 VDC output models
- CE certified,

II> Video Management & Control Equipment

A. Digital Video Recorder

Location of Device: Security Control Room

Type : 16 Channel IP based Digital Video Recorder

Mounting : 19" Rack Mount / Table top Mount.

Digital Video Recorder, 16-channel digital video recorder that records multiple camera signals while simultaneously providing live multiscreen viewing, recording, playback, remote viewing & archiving of recorded data. The DVR is having capacity of storage capacity of 2 TB internal & with option of external NAS, DAS boxes, CD/DVD writer via the SCSI-2 port. DVR having capacity of storage capacity suitable for recording 30 Days Backup . DVR will do real time recording at CIF resolution & MPEG4 compression. DVR will be embedded IP based web enabled DVRs. NO PC based /card based DVRs shall be accepted.

Features:

- Resolution - 720 X 576 PAL
- 16 channels inputs
- Storage space of 2 Hard Disk
- Supports 2 TB memory
- Image per sec - 25, 12.5, 8, 6, 5, 4,3,2,1,1/2,1/5, 1/10, 0 (PAL).
- AGC - Automatic or manually adjust for each video input.
- Compression - MPEG4 / H.264.
- Motion Sensing, Programming via included software, Sequencing of cameras, Simultaneous recording, playback & archiving, Smart motion search, Authenticated images for evidence, Video loss with on-screen indication.
- The DVR has 5 programmable modes, which defines different behavior of DVR, in respect to recording rate, alarm handling, motion detection in each mode.
- Internal or external DVD writer.
- Standard 10/100 Base T Ethernet port for networking.

III. CCTV Monitor

Location of Device : Security Control Room

Type : As per BOQ

Mounting : Table top Mount / Wall mount

A. CCTV Monitor

The Monitor is a high-performance, high-resolution color display monitor and delivers picture clarity with more than 700TVL lines of resolution.

Features:

- Rated Voltage- 230VAC, 50 Hz
- Linearity 7% maximum
- Horizontal resolution 700 TV lines
- Audio input 1 V line level
- Audio output - Loop-through line level, 1 W speaker
- Controls - On screen display menu, Brightness adjustment, Contrast adjustment, Selection of video input A or B or Y/C or in Sequence,
- Power: on/off switch
- On-Screen menus for monitor adjustments

IV> Video, Control, Power & Ethernet Cables

There are typically four applications of cable/wire found in a CCTV security camera system:

1. Power (2 Core X 1.5 Sq. mm Shielded Cable)
2. Video (RG 6 Co-axial Cable)
3. Ethernet (TCP/IP) (Cat 5E / Cat 6E cable)

The lengths cables, conduits & number of connectors required can be found out by actual measurement or approximate estimation can be done from the drawings available for the Hospital.

DVR Technical Specifications:

Real-Time Hybrid Web based Embedded Networkable DVR

The DVR should be a real-time hybrid DVR which supports real-time IP Cameras and analog cameras recording up to 16 channels. This is from the point of view of future expansion & making system expandable. With the hybrid video-in configurations for both analog cameras and IP devices, it should be designed to take advantage of analog video cameras and integrate the IP video technology in future. The DVR should provide Triple Operation that enables live display, playback, remote monitoring while recording. The DVR should provide Dual-Codec function that allows users to select H.264 / MPEG-4 compression for their specific applications. Furthermore, combining 4 internal HDDs and NAS devices with an efficient H.264 / MPEG-4 compression engine, vast recording should be available. The Central Management System (CMS) should provide distant accessibility for remote system control.

Following features should be available.

- Triplex+ Operation: Live, Record, Playback, Network
- Supports up to 4 internal HDDs
- Supports internal CD-RW / DVD+RW
- Dual-Main output (16001)

- Real-time recording for 16ch CIF resolution
- Dual-Codec
- Per Channel Configuration
- Supports NTP for time synchronization
- Supports Mobile View software
- Multi-language support
- Multiple built-in dome camera control protocols
- Supports WLAN, SMS
- Supports Pre-Alarm Recording
- Built-in Co-axitron Protocol for future PTZ camera requirements
- Remote application for remote monitoring
- CMS for large-scale video management

Humane Technology

- ezBurn for quick video export so that minimum training required for operation
- ezRecord for quick recording setting so that minimum training required for operation
- Exports AVI file for Microsoft Media Player
- Jog / Shuttle should be available for easy control & playback
- USB mouse (Optional)
- Compact Control Keyboard (Optional)
- storage should have a module for extended recording storage

Dual-Codec

The DVR applies Dual-Codec function that enables users to select MPEG-4 / MJPEG compression for various video management applications. With MJPEG compression for high image quality and MPEG-4 compression for small file size, the DVR should provide longer recording duration, faster data transmission, or higher image quality for different surveillance solutions.

Dual-Main Output

The DVR should be with Dual-Main Output function, which enables two main monitors for system control. Both main monitors can be used to modify system settings, view live video, or playback video. The DVR should manage control priority for different users. System administrator should be control the DVRs from different locations.

Transcoder

Built in the Turbo Module, the Transcoder improves users' remote monitoring experience while maintaining detailed local video data. The Transcoder allows different network video streaming format from local video archiving. DVR should record local video at a high quality / high frame rate setting, but stream network video at a lower bit / reduced frame rate to ensure smooth monitoring at remote site.

23.00 VIDEO CONFERENCING SYSTEM:

FULL High Definition End Point

1. Unit Components and General Features

The unit offered must be complete with High definition (HD) Videoconferencing Codec, High Definition Camera, Microphone, Remote Control and required cables. The HD (1080p) Camera and Codec should be from the same OEM.

The MCU and Video Endpoints should be from the same OEM.

The HD endpoint codec should support bandwidth upto 4M in a point to point call

The unit must have AC voltage range: 100-250 VAC, 50/60 Hz with power consumption not exceeding 100 Watts with power On/Off switch.

HD end point shall support special features like :

- Hybrid with IMS Network
- Group function
- SiteCall (HD dual stream)
- Call record
- Network address book
- SNP traversal between the public network and private network
- LDAP
- API for integration

The Unit should support Digital Caption with 16 colors where features like Caption banner, Rolling display mode, What-you-see-is-what-you-get (WYSIWYG), caption editing, Modifiable and optional front background color, Site name display and Text input by using the remote control should be available.

The Endpoint should support multiple language like english, spanish, french, german and Chinese

2. Audio/Video Standards / Protocols / Interfaces:

ITU standard protocols such as H.323, H.320, SIP variants for Video, H.261, H.263, H.263+, H.263++, H.264, VME (Video Motion enhancement) for Video Codecs, Audio codecs: G.711, G.722, AAC-LC/ AAC-LD

The End Point should support HD (1080p @ 30fps) as well as HD/SD.

The End Point should support various Video Resolutions such as CIF, 4CIF, 720p, 1080p.

The unit should support following video content formats or higher VGA, SVGA, XGA, ,WXGA,SXGA.

Should support minimum 16:9 Wide Screen. Should give both Picture in Picture (PIP) and side by side layouts on single screen.

Must have Audio Error concealment, Automatic Gain Control (AGC) feature, Automatic noise reduction feature and Echo canceller

The system should support strong encryption standards like AES or equivalent without affecting any end-point feature over IP network. The calls should be encrypted end to end.

The HD endpoint should support min of 2 DVI Video input and 2 DVI output interfaces

The HD endpoint should support audio input of 1 RCA, 1 XLR and 1 RJ45 interface to connect analog mic, VCR and IP based mic array at the same time
The end point should support min of 3 RCA audio interface

The end point shall have min of 1 USB interface to support wireless access

The end point shall support 720p@30fps at 512kbps and 1080@30fps at 1Mbps of bandwidth

End point shall support Dual Live streaming at 720p(30fps) and 720p(30fps)

3. Network / Security / Encryption

The Unit should have minimum two 10/100 Mbps port for Full- Duplex/Auto Sensing Ethernet interfaces for diverse IP Communication. The unit should support minimum bandwidth of 386 kbps onwards for establishing VC connectivity with MCU

The End Point should be configurable using utilities like TELNET/SSH/HTTP or equivalent

The unit should support AES media stream encryption, Conference access password, H.323 ID / IP address number and binding

4. Camera / Microphone

The camera must be of High Definition PTZ CMOS camera with minimum of 2.1 megapixel, 1080p resolution with min of 70 degree horizontal field of view.

The camera should support a minimum of 10x or more optical zoom or more with auto/manual focus/brightness/white balance, 1024x720 pixels progressive @ 30fps or higher.

Should be able to control near end and far end camera control (FECC).

Microphone Array (with min of 2 mics) with 360 degree pick up upto 6m and one microphone cable of min.

Min of 3 number of Microphone Array should be cascaded using serial cable if required in future

5. Advanced Features

Support integration with Microsoft OCS / Lync / LDAP

Hybrid with IMS Network

should have Telenet / Web Based Management Application

Multi Conferencing Unit (MCU)/ Bridge

The same / above mentioned HD End Point software should be upgradable to support 4 party video conferencing without any change in hardware

Each port of the same MCU should support min of 720p video resolution

The Embedded MCU should support multiple High Definition, Enhanced Definition and Standard Definition conferences simultaneously in CP

The Embedded MCU should be capable of connecting with Video Conferencing end points of multiple vendors and should interoperate

The HD endpoint codec should support bandwidth upto 8M in conference mode

The Embedded MCU should support connectivity to PC/Laptop to enable sharing of content and should facilitate endpoints to send/display presentations during a Video Conference

Embedded MCU should support the automatic repeat request (ARQ) protocol and video error resilience, thereby protecting the performance of a conference from being slight / marginal affected also even when the packet loss ratio reaches 5%.

Each Port of MCU shall support auto transcoding

6. Display Units

Screen Size- 42" LCD monitor with Anti Reflection/ Glare Technology
Resolution -1920x1080 (Full HD Resolution)

Brightness-450cd/m² or higher

Interfaces-VGA, HDMI, AV Port, DVI-D

Audio Input-AV, PC audio in

Audio Output-2 x 10W att speakers (integrated with monitor) or higher

Contrast Ratio-Dynamic Contrast Ratio 10000:1 or higher

W all mounting-Display to be supplied along with wall mounting kit and table stand

Energy Star Certified

24.00 LIST OF APPROVED MANUFACTURERS:

- | | | | |
|-----|---|---|---|
| 1. | 11 KV VCB Panel Board | - | Siemens/ Crompton Greaves/ Schneider- Areva - Alsthom/ ABB/L&T/ Andrew Yule |
| 2. | 11 KV XLPE Cable | - | Incab/ Universal/ NICCO/ CCI |
| 3. | Transformer | - | Crompton Greaves/ Schneider-Areva- Alsthom/ Bharat Bijlee/Andrew Yule |
| 4. | Bus Duct/rising mains | - | L&T/ Siemens/ ABB/ Lrgrand/ Schneider |
| 5. | Diesel Engine | - | Cummins/Kirloskar/ Caterpillar/Greaves Cotton |
| 6. | Alternator | - | Stamford/ Kirloskar/ Leroy Somer & Control/ - Crompton Greaves/ Cater pillar |
| 7. | Battery | - | Exide/ Standard Furrukawa/ Amar Raja |
| 8. | L.T. Cables | - | Universal/CCI/ NICCO/INCAB/Rallison Cables - Skytone / KEI/ Polycab/ Cab Com India |
| 9. | PVC insulated Wires/ Telephone wires & cables Co-axial cables | - | Finolex/ Havells/ Ploycab/ KEI/ Rallison/ National/ Cab Com/ Skytone/ L&T/ Batra Henlay |
| 9-a | Additional Make for telephone cable | - | Delton Cables |
| 10. | Telephone Tag Blocks | - | Krone Type |
| 11. | Modular Range of Switches, sockets etc | - | Anchor- Roma/ North West/ Toyama-Wallart/ MK-Wraparound/ MDS-Mosaic/ Havells-Crab tree |
| 12. | Industrial Sockets & Plugs. | - | Siemens/Schneider/Crompton/MDS/ BCH/ Havell's |
| 13. | M.S. Conduit | - | BEC/ AKG/ steel Craft |
| 14. | Light fixtures. (Flourescent, CFL, HPMV etc) | - | Philips/ GE/ Crompton |
| | Fancy light & other fixtures | - | Philips/ Decon/ Ankur/ May Fair |
| 15. | Ceiling Fan/ Exhaust fan | - | Crompton Greaves/ Alstom/ Usha/ Bajaj. |

| | | |
|--|---|--|
| 16. Main LT Panel/ Capacitor panels | - | L&T/ Siemens/ ABB/ Schneider or their licensed partners/ Authorized System Integrators. |
| 17. MV Panels | - | Adlec Systems Pvt Ltd - Advance Panels & Switchgears (P) Ltd - Tricolite - Jakson Engineers Ltd. - Zeta Industrial Corporation Pvt Ltd - Ambit Switchgear - Venus Controls & Switchgear Pvt Ltd - Neptune systems Pvt Ltd - Risha Control Engineers Pvt Ltd - SPC Electrotech Pvt Ltd.. - Nitya Electro Controls |
| 18. Air Circuit Breakers | - | L&T/ Siemens/ABB/ Schneider |
| 19. MCCB | - | L&T / Siemens/ ABB/ Schneider |
| 20. MCB-DB's, MCB, ELCB RCCB/ MCB-Isolator etc. | - | L&T/ Siemens/ MDS/ Schneider |
| 21. SDFU | - | L&T/ ABB/ Siemens/ Schneider |
| 22. Power Contactors | - | L&T/ Siemens/ Schneider/ ABB |
| 23. LIFTS | - | OTIS/ Kone/ Scheindler/ Mitubshi./ Johnson |
| 25. FDA System | - | Honeywell/ Edwards/ L&T/ Siemens |
| 27. CCTV | - | BOSCH/ L&T-Perito/ Sony/ Honeywell/ Panasonic |
| 27a. LED Monitor | - | Sony, Samsung, Panasonic |
| 28. PA System | - | BOSCH/ Harman/ Honeywell/ L&T |
| 29. UPS | - | Schneider –APC- Merlin Gerin/ Emerson/ Eton Power Ware |
| 30. Cable Joint kit | - | Raychem/ 3M/ Cabseal |
| 31. Capacitors | - | Schneider/ EPCOS/ L&T/ Ducati |
| 32. APFC Relay | - | EPCOS/ Beluk/ L&T/ Ducati |
| 33. Lighting Management System/ Occupancy Sensors etc | - | Philips/Lutron/ ETC/ Altonburger/ Mitsubishi/ Vestametic |
| 34. Video Conferencing system | - | Polycom, Cisco, Huawei |

35 LAN System

- I. Active Device - D-Link/Cisco/HP
- II. Passive Device - DigiLink/Molex/AMP.

25.00 LIST OF TENDER DRAWINGS: (Electrical Layout)

| <u>S.No.</u> | <u>Drawing Number</u> | <u>Description</u> |
|---------------------|---------------------------------------|---------------------------|
| 1. | HSCC/D&E/ANIMALHOUSE/IIIM-JAMMU/EL-01 | GROUND FLOOR PLAN |
| 2. | HSCC/D&E/ANIMALHOUSE/IIIM-JAMMU/EL-02 | FIRST FLOOR PLAN |
| 3. | HSCC/D&E/ANIMALHOUSE/IIIM-JAMMU/EL-03 | TERRACE FLOOR PLAN |