

**GENERAL TECHNICAL
SPECIFICATIONS FOR ELECTRIC
WORKS**

INDOOR SWITCH GEARS (HT PANELS)

DESIGN CONDITIONS & SCOPE OF WORK:

All equipment and materials will be selected and rated for use at the following site conditions.

Ambient air temperature.	50° C.
Ground temperature.	30° C.
Solar gain	1100 w / m ²
Earth resistivity	200 deg. C. cm / w
Relative Humidity.	95% Max.
Atmospheric condition	Non corrosive, Humid and Dusty

GENERAL REQUIREMENTS

- The scope generally describes to design, manufacture, assemble, connect, wire, supply, test and commission 11 kv vacuum circuit breaker panel.
- The unit shall consist off tee off spring assisted three position , three pole vacuum circuit breaker.
- All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification.
- The equipment shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules and regulations as applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

COMPLETENESS OF SUPPLY

- It is not the intent to specify completely herein all details of the equipment. Nevertheless, the equipment shall be complete and operative in all aspects and shall conform to highest standard of engineering, design and workmanship.
- Any material or accessory which may not have been specifically mentioned but which is necessary or usual for satisfactory and trouble free operation and maintenance of the equipment shall be furnished without any extra charge.

DESIGN CRITERIA

The Switchgear shall be capable of continuous operation at specified rating under the following condition:

- Voltage variation : + / - 10 %
- Frequency variation : + 3%, -6%
- Combined voltage & frequency variation : 10 %

- The de rating of the equipments shall be done taking 50 deg C as an ambient temperature if it is designed at lower temperature. The maximum temp. in any part of the equipment at specified rating shall not exceed 85 deg C considering reference ambient temperature as 50 deg C.
- The system fault level for 11KV system is 350MVA. The breakers of the respective system shall have the breaking capacity corresponding to above fault levels specified.
- The breaker shall be Vacuum type. The circuit breaker shall be fitted with micro processor based self powered relay inside the front cover.
- The breaker ratings shall be as per drawing and bill of quantity.
- The cable termination shall be done by heat shrinkable termination method. The compartment should have sufficient height space for proper Termination / Bonding of cable leads.

SPECIFIC REQUIREMENTS

- The switchgear enclosure shall conform to the degree of protection IP-4X. The minimum thickness of sheet steel used shall be 2mm CRCA steel.
- The switch gear assembly shall comprise a continuous, dead-front, line-up of free standing, vertical cubicles. Each cubicle shall have a front hinged door with latches and a removable back cover. All covers and doors shall be provided with recessed neoprene gaskets. All doors shall have pad locking arrangement. Switchgear shall be fire retardant type.
- Circuit breakers, instrument transformers, bus-bars, cable compartment etc., shall be housed in totally isolated air tight separate compartments within the cubicle. The design shall be such that failure of one equipment shall not affect the adjacent units. Suitable venting arrangement shall be provided to release the gas pressure developed due to the operation of the breaker or due to live arc of fault.
- Each cubicle shall be separated from adjacent one by grounded sheet steel barrier and bus sealing arrangement.
- The switchgear panel shall be of arc proof version. Test report as per DIN VDE 0670 part 601, IEC-694/IEC-298 shall be furnished.
- All relays, meters, switches and lamps shall be flush mounted on the respective cubicle door or on control cabinet built on the front of the cubicle.
- Each switchgear cubicle shall be provided with a thermostat controlled space heater and single phase plug point operated at 230 V AC. 50 Hz.
- Bus connection from bus compartment to breaker compartment & breaker compartment to cable compartment and bus compartment to adjacent panels shall be through sealed resin cast bushing assembly.
- Each breaker cubicle shall be provided with 'service' and 'test' position limit switches, each having at least 4 NO & 4 NC contacts. All fixing bolts, screws, etc. appearing on the panel

shall be so arranged as to present a neat appearance. The swing of the door shall be more than 90 deg C.

BUS AND BUS TAPS

- The main buses and connections shall be of high conductivity copper, sized for specified continuous and fault current ratings with maximum temperature limited to 85 deg C (i.e. 35 deg C rise over 50 deg C ambient).
- Adequate contact pressure shall be ensured by means of two bolts connection with plain and spring washers and locknuts.
- Bimetallic connectors shall be furnished for connections between dissimilar metals.
- All Busbars, Jumpers and connection shall be fully insulated for working voltage with adequate phase/ground clearances. Epoxy cast-resin shrouds for joints shall be provided. All jointing hardware shall have nylon caps. All busbars, links, jumpers etc. shall be sleeved with sleeves of Raychem/DSG make and non-in flame able heat shrinkable type. Busbars, links, live parts etc. shall have nonflammable shrouds.
- No paper/cotton based insulation shall be used anywhere in the switch gear. Minimum amount of combustible and low smoke generation type insulating material shall be used.
- Safety shutter, phase barrier, busbar seal-off bushing plate, support insulators etc. shall be non-inflammable high tracking fiber glass/epoxy insulation system of grade 94V-O as per UL.
- All buses and connections shall be supported and braced to withstand dynamic electromagnetic stresses due to maximum short circuit current and also to take care of any thermal expansion.
- Busbars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from front of the switchgear assembly.
- The successful tenderer shall submit the calculation in support of selection of busbar conductor size, spacing and short time withstand capability.

CIRCUIT BREAKER

- Circuit breaker shall be triple pole, single throw, Vacuum type.
- Circuit breaker shall be drawout type, having SERVICE, TEST and DISCONNECTED positions with positive indication for each position.
- Circuit breakers of identical rating shall be physically and electrically interchangeable.
- Circuit breaker shall have motor wound spring charging facility with Mechanical & Electrical anti-pumping features and shunt trip. In addition facility for manual charging of spring shall be provided. The motor shall be suitable for operation with voltage variation from 85% to 110% of rated voltage. Spring charging motor shall be in a standard enclosure.

- For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open-close-open operation of the circuit breaker shall be possible after failure of power supply to the motor.
- Mechanical safety interlock shall be provided to prevent:
 - The circuit breaker from being racked in or out of the service position when the breaker is closed.
 - Racking in the circuit breaker unless the control plug is fully engaged.
 - Closing & opening of the breaker in an intermediate position between 'service' & 'test' and between 'Test' and 'Disconnected' position.
- Automatic safety shutters shall be provided to fully cover the female primary contacts when the breaker is withdrawn from service position.
- Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indication, an operation counter and mechanism charge/discharge indicator. The manual trip device shall be located on the front door. Indicators with shrouds will be visible from front door even when breaker is closed.
- Suitable padlocking arrangement shall be provided as stated below:
 - Circuit Breaker operating handle in the OFF position.
 - Each feeder panel operating handle in CLOSED , OPEN , EARTH position.
- Each breaker shall be provided with following :
 - Auxiliary switch, with 6 NO + 6 NC contacts, mounted on the drawout portion of the switchgear.
 - Position/cell switch with minimum 3 NO + 1 NC contacts, one each for TEST and SERVICE position.
 - Auxiliary switch, with 4 NO + 4 NC contacts, mounted on the stationary portion of the switchgear and operated mechanically by a sliding lever from the breaker in SERVICE position.
 - Limit/auxiliary switches shall be convertible type that is facility for changing N.O. contact ton N.C. and vice-versa. Switch contact shall be rated 10A A.C. and 2A D.C. at operating voltage.
 - Circuit breaker shall be draw out type, complete with transfer trucks, self-aligning primary and secondary disconnects, positive guides to ensure proper alignment.
- Each breaker shall be provided with suitable encased rollers.
- The trip coils shall be operated satisfactorily at voltage between 70 % and 110 % of rated control supply voltage.

- Each circuit breaker cubicle shall be provided with an earthing facility to earth the incoming or outgoing feeders by the arrangement specified below. Earthing facilities shall be fully interlocked to prevent faulty operation e.g. earthing of live parts.
- Separate earthing truck, which can be inserted in place of circuit breakers, one truck suitable for incoming and the other for outgoing circuits shall be provided.
- Positive earthing of circuit breaker frame shall be maintained when it is in the connected position and in all other positions in which the safety shutters are in open position.
- Insulation used for auxiliary switches shall be anti tracking type.

INDICATION & MONITORING

- Each breaker cubicle shall be equipped with following:
 - One (1) number heavy duty spring return type TRIP-NORMAL-CLOSE control switch with pistol grip handle.
 - Three (3) indicating lights front of compartments:
 - GREEN : Breaker Open
 - RED : Breaker Closed
 - Amber : Trip
 - Blue : Spring charged/Low vacuum
- Lamp shall be LED type with series resistor, Lamp and lens shall be replaceable from the front.

CURRENT TRANSFORMER

- Current transformers shall be bar primary, cast resin type. All secondary connections shall be brought out to terminal blocks where Y or D connection will be made.
 - a. Class PS for differential & restricted earth fault relaying.
 - b. Class 5P20 for other relaying.
 - c. Class 1.0 and ISF < 5 for metering.
- The current transformer shall be capable of safely withstanding the short circuit, stresses corresponding to the fault level as indicated & shall be able to meet the short-time requirement specified.
- All CT secondary shall be earthed through separate switch link on terminal block. The secondary terminals of the CTS shall have the provision of shorting and disconnecting facilities by links.
- CT terminals & their polarities shall be clearly marked.

VOLTAGE TRANSFORMER

- Voltage Transformer shall be cast-resin, draw out type and shall have an accuracy class of 1.0, 3P. Voltage Transformer mounted on breaker carriage is not acceptable.
- High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully draw-out position.
- Low voltage fuses, sized to prevent overload, shall be installed in all ungrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the switchgear is energized.
- The connections from main circuit to PT shall be capable of withstanding short circuit stresses.

RELAYS

- Protective relay shall be micro processor based.
- Relays shall be of drawout design with built-in site testing facilities. Small auxiliary relays may be in non-drawout execution and mounted within the cubicle.
- Relays shall be rated for operation on 110 V secondary voltage and 5 A secondary current as shown on drawings. Number and rating of relay contacts shall suit the job requirements.

METERS

- All meters are digital type of 96 x 96 mm accuracy class of $\pm 2\%$.

SECONDARY WIRING

- The switchgear shall be fully wired at the factory to ensure proper functioning of control, protection, transfer and interlocking schemes.
- Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired upto terminal blocks.
- Wiring shall be done with flexible, 650V grade, FRLS PVC insulated switchboard wires with stranded copper conductors of 1.5 mm² for control and current circuits and 1.5 mm² for voltage circuits. All power wiring like space heater supply etc. shall be carried out with min. 4 mm² Cu, conductor, Wiring of trip circuit shall be with fluoro-plastic wires.
- Each wire shall be identified, at both ends, with dependent & cross addressing permanent markers bearing wire numbers as per Contractor's Wiring Diagrams. Trip circuit shall have red colour ferrule.
- Wire termination shall be made with crimping type ring connectors with insulating sleeves. Wires shall not be spliced between terminals.

- The wires shall run preferably through metallic trough adequately supported along its run to prevent sagging due to flexibility or vibration. The control & power wires shall be routed through separate troughs.
- Inter-panel wiring trough shall be furnished for wiring between switchgear cubicles. All wiring required for interlocking between the cubicles of any switchgear shall be furnished and installed. Wherever wires are passing through cutouts or openings they shall be protected by providing suitable grommet or gasket around the openings. Inter panel wiring at shipping sections shall be through terminal blocks placed suitably at intersection points.
- The colour of wire shall be taken as follows :
 - AC System Black
 - DC System Grey
 - Earthing System
 - CT & PT Wiring System Red, Yellow, Blue colour code.

TERMINAL BLOCKS

- Terminal blocks shall be 660 V grade box-clamp type with marking strips ELMEX 10 mm² or equal. Terminal for C.T. Secondary leads shall be disconnecting link type and shall have provision for shorting. Terminal for P.T. Secondary lead shall also be disconnecting link type.
- Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished. Multi connection terminal strip to be used if required.
- Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.
- Terminal blocks for inter panel / external / Space Heater wiring shall be separate from inter panel wiring.
- All control wire shall be terminated with ring type insulated lug only.
- The terminal block shall be grouped according to circuit functions and individual terminals in each block shall be serially numbered in accordance with the drawings. Such numbering shall be legible, permanent and indelible.
- The terminal blocks of different voltage classes shall be segregated.
- Similar type of terminal block shall be used for inter panel wiring at shipping sections.

CABLE TERMINATION

- Switchgear shall be designed for cable entry from the top. Sufficient space shall be provided for ease of termination and connection.
- Power cables shall be XLPE insulated, armored, overall PVC sheathed with stranded Aluminum/copper conductor.

- Control cables shall be PVC/XLPE insulated, armored, overall PVC sheathed with 1.5mm² stranded copper conductor.
- All provisions and accessories shall be furnished for termination and connection of cables, including removable aluminium gland plates, cables supports etc.
- The gland plates shall be minimum 4mm thick aluminium sheet. The gland plate and supporting arrangement for 1/C power cables shall be such as to minimise flow of eddy current.
- Sufficient space shall be provided between the power cable termination (end-boxes) and gland plate. Core balance C.T.s, wherever specified, shall be accommodated within this space.

GROUND BUS

- A ground bus, rated to carry maximum fault current, shall extend full length of the switchgear.
- The ground bus shall be provided with two-bolt drilling with G.I. bolts and nuts at each end to receive 50 x 6 mm G.I. flat.
- Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and drawout P.T. unit shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance.
- Wherever the schematic diagrams indicate a definite ground at the switchgear, a single wire for each circuit thus grounded shall be run independently to the ground bus and connected thereto.
- C.T. and P.T. secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing other.
- Suitable ground terminal, directly connected with the ground bus shall be provided in the cable chamber for grounding connection of cable screen / armour.
- All hinged doors shall be grounded using silver plated and braided copper flexible of adequate size.

NAMEPLATES

- Nameplates of approved design shall be furnished at front & back side of each cubicle and at each instruments & device mounted on or inside the cubicle.
- The material shall be 3ply lamincold or approved equal, 3 mm thick with white letter on black background. The letters of the nameplates shall be engraved.
- The nameplate shall be held by self-tapping screws. Nameplate size shall be minimum 20 x 75mm for instrument/device and 40 x 150mm for panels.
- Caution notice on suitable metal plate shall be affixed at the back of each vertical panel.

Following plate size & letter size shall be considered for nameplate.

SR.	NAMEPLATE NO.	PLATE SIZE (mm × mm)	LETTER SIZE (mm× mm)
1.0	Main nameplate	40 × 150	25 × 25
1.0	Equipment & device (Front)	20 × 75	5 × 5
1.0	Equipment & device (Internal)	6 × 20	3 × 3

SPACE HEATERS AND PLUG SOCKETS

- Each cubicle shall be provided with thermostat controlled space heaters and 10A, 3 pin plug socket.
- Cubicle heater, Plug/socket circuits shall have Individual MCBs.

A.C.POWER SUPPLY

- The following power supplies will be made available to the switchgear: A. C. supply : Double Feeder with manual change over switch.
- Isolating MCB will be provided at the switchgear for the incoming supplies.
- Bus-wires of adequate (minimum 4 sq.mm copper) capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating MCB shall be provided at each cubicle for A.C. supplies.
- A.C. load shall be so distributed as to present a balance loading on three-phase supply system.

TROPICAL PROTECTION

- All equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects & corrosion.
- Screens of stainless steel shall be furnished on all ventilating louvers to prevent the entrance of insects.

PAINTING

- All surfaces shall be sanding blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease rust and foreign adhering matter.
- After cleaning, the surfaces shall be given a phosphate coating followed by 2 coats of high quality primer and staved after each coat.
- The switchgear shall be finished in powder coat, shade RAL-7032 MATT finish.

- Sufficient quantity of touch-up paint (approx. 5 ltrs.) shall be furnished for application at site.

ACCESSORIES

- The following accessories shall be furnished along with the Switchgear:
- Earthing equipment suitable for earthing the bus or outgoing cable.
- Breaker carrier trolley if C.B. is of that design.
- Cubicle door opening key (1 for each panel).
- Withdrawal handles for breaker.
- Commissioning spares (Provide list of spares along with offer)

TESTS

- The switchgear shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

ROUTINE TEST

- The tests shall include but not necessarily limited to the following for switchgear :
- Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme & proper functioning of the equipment.
- All wiring and current carrying part shall be given appropriate High Voltage test.
- Test for meter/ relays for the respective function.
- Primary current and voltage shall be applied to all instrument transformers.
- Routine test shall be carried out on all equipment such as circuit breakers, instrument transformers, meters etc.
- One minute power frequency withstands insulation test as per relevant-IS.

TEST CERTIFICATE

- Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner.
- The equipment shall be dispatched from works only after receipt of Owner's written approval of the test reports.
- The test report shall furnish complete identification of the equipment such as serial no., rating, equipment designation as per schematic etc. & date of test.

SPARES

- The Bidder shall submit a list of recommended spare parts for two (2) years satisfactory and trouble free operation, indicating the itemized price of each item of the spares in the appropriate annexure. Self life of consumable spares would be indicated specifically.

DRAWINGS, DATA & MANUALS

- Drawings, Data & Manuals shall submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of contract and/or elsewhere in the specification for approval & subsequent distribution after the issue of Letter of intent.

Drawing / Document to be submitted:

- Outline dimensional drawing of the switchgear showing general arrangement, space requirements and cable entry points, location of breaker, CT, Pt busbar chamber, grounding arrangement etc.
 - Bill of Materials.
 - Typical foundation plan.
 - Typical breaker control schematic.
 - Test reports on circuit breaker/CT/PT.
 - Technical leaflets on & complete specifications & OEM address for bought out items.
 - Bus bar & circuit breaker sizing calculation along with relevant Test Reports.
- Instruction manuals of switchgear & individual equipment. The manual shall clearly indicate that the installation method, check-up and tests to be carried out before commissioning of the equipment as well as monitoring tests, their interval & maintenance / overhauling procedure & schedule.

TECHNICAL DATA SHEET FOR H. V. INDOOR SWITCHGEAR:

Sr. No.	DESCRIPTION	
1.0	GENERAL :	
1.1	Ambient temperature	50° c.
1.2	Atmosphere	Non corrosive, Humid and Dusty
1.3	Location	Indoor
1.0	ELECTRICAL DATA :	
1.1	Type of breaker	Vacuum Circuit Breaker
1.2	Service	Continuous
1.3	Voltage	A SPER TENDER
1.4	System earthing	Solidly earthed
1.5	Frequency	50 Hz. +/- 3%
1.6	No. of phase	3
1.7	System fault level	AS PER TENDER
1.8	Fault current	AS PER TENDER
1.9	Max. system voltage	AS PER TENDER
1.10	Auxiliary supply :	24V D.C derived from batteries
1.11	Rated short time current	AS PER TENDER
1.12	Making capacity	AS PER TENDER
1.13	Busbar current rating and Material	AS PER TENDER
1.14	Cable entry	AS PER TENDER
1.15	Cable size	AS PER TENDER
1.16	Breaker particulars :	
(a)	Operating duty	0 - 3 M CO – 3M – CO
(b)	Operating mechanism	Motor charged spring / manual trip & close
(c)	Spring charging motor	230 V AC, 200 W
(d)	Trip / Closing coil	24 V DC, 180 W
(e)	Anti pumping feature	To be provided
(f)	Latching requirement	Trip free
(g)	Emergency trip push button	Required
(h)	Space heater and cubicle lamp	Required
1.17	Constructional requirements	Simplex Type

Sr. No.	DESCRIPTION	
(a)	Thickness of sheet steel for frame, enclosure, doors, covers & partitions	CRCA sheet - 2 mm, hinge type door with neoprene rubber gasket
(b)	Degree of protection	IP 44X
(c)	Colour	Powder coating – RAL-7032 MATT
(d)	Earth bus size	50 × 6 mm GI
(e)	Foundation frame	ISM-75, Suitable for five breakers with necessary bed plate and foundations bolt.
1.18	Annunciation : (1) Main incoming – Trip	To be Provided
1.19	PANEL ACCESSORIES	
(a)	Toggle switch for space heater and socket	230 V A.C, 10 A
(b)	Socket	3 pin 10 A
(c)	MCB for spring charging motor circuit	6 A, DP MCB
(d)	MCB for ON / OFF	Double pole, 16 A, 110 V D.C for D.C ckt. Double pole, 16 A, 230 V A.C for A.C ckt.
(e)	Local / Remote selector switch	4 ways, 2 positions, lockable in any position, angular movement, stay put, lever type handle.
(f)	Auto- Off – Manual switch	18 ways, 3 positions, lockable in all position, stay put, wing type handle.
(g)	Breaker control switch (Trip – Neutral – Trip)	6 ways, 3 position, spring return to neutral, angular movement, pistol grip type handle.
(h)	LED indicating lamp (230V A.C)	Breaker RYB On - Red colour Breaker RYB Off - Green colour Auto trip - Amber colour Trip ckt healthy - Amber colour Spring charged - Blue colour Low vacuum - Blue colour 100 ohm, 3 / 4 W resistor
(i)	Filament Bulb	2 / 3 W bulb for R, Y, B, Healthy indication
(j)	Space Heater	230 V A.C, 100 W
(k)	Limit switch for test and service position	Not applicable

Sr. No.	DESCRIPTION	
1.0	RELAY	
1.1	Instantaneous Phase Over Current Relay : 50/50n	To be Provided
1.2	AC Inverse Definite Minimum Phase Over Current Relay : 51/51n	To be Provided
1.3	Lock out relay : 86	To be Provided
1.4	Under Voltage Relay : 27C	To be Provided
1.5	Buchholz relay : 63 GP & Aux. Relay for alarm & trip – 63 GP X1 & X2	To be Provided
1.6	Oil Temperature Indicator : 49-2 & Aux. Relay for alarm & trip 49-2 X1 & X2	To be Provided
4.0	METERING	
4.1	Digital Multi Function Meter including parameters Amp., Voltage, KW, KWH, KVAR, KVARH, PF, Frequency etc.	To be Provided
5.0	CURRENT TRANSFORMER / POTENTIAL TRANSFORMER	
5.1	CT For Metering. Accuracy Class VA burdon	Cast Resin type 1.0 15 VA
5.2	CT For Protection. Accuracy Class VA burdon	Cast Resin type 5P15 / PS 15 VA
5.3	PT For Metering. Accuracy Class VA burdon	Cast Resin type 1.0 100 VA
5.4	PT For Protection. Accuracy Class VA burdon	Cast Resin type 5P15 100VA

METHOD OF MEASUREMENT

- All the items will be measured as mentioned in Bill of quantity.

H.V. / H.T. XLPE CABLES

SCOPE

- The scope shall cover supplying, laying, testing and commissioning of 3 core H.T cables which shall be capable of operating at a sustained conductor temperature of 90°C and suitable for a maximum conductor short-circuit temperature of 250°C.
- This specification gives the general requirement of cables. However, it is the responsibility of the vendor to take the joint measurement and obtain client's approval before the placement of orders to the main supplier / manufacturer. Cut lengths will not be accepted.

REFERENCE CODES & STANDARDS:

- IS : 8130 – 1984 Conductors of Insulated Cables.
- IEC : 228 - Conductors of Insulated Cables.
- IS : 10810 - Methods of various tests on cables and their accessories
- IEC : 502 - Extruded solid dielectric-insulated power cables for rated voltage from 1 KV up to 30 KV.
- IEC : 287 - Calculations of continuous current rating of cables (100% load factor).
- IS : 7098 (Part II) - Cross-linked polyethylene insulated PVC sheathed cable for Voltage from 1.3 KV up to 33 KV.
- IS : 5831 - 1984 PVC insulation & sheath of electrical cables.

OPERATING CONDITIONS

Electric system

- System Voltage : 11 KV/1.6 KV
- Frequency : 50 Hz.

Environment

- Ground temperature : 40°C.
- Ambient air temperature : 50°C.
- Solar gain : 1100 w/m²
- Earth resistivity : [The bidder shall confirm the Earth Resistivity Test]
- Atmospheric conditions : Humid, salty and dusty

MEASUREMENTS

- The cables will be measured in meters. The unit rate shall include cutting the cable into required lengths, packing, loading, unloading, insurance, transportation, delivery to stores/site as per work order, stocking in stores, testing of cables at stores etc. of medium voltage cable. Total quantity in meters shall be measured lug to lug basis.

CONSTRUCTION

CONDUCTORS

- The conductor shall be of circular stranded Aluminium to IS : 8130 & IEC : 228. It shall be clean, reasonably uniform in size & shape smooth & free from harmful defects. Any other form of conductor may also be accepted if in line with modern trends.

CONDUCTOR SCREEN

- The conductor screen shall consist of an extruded layer of thermosetting semi-conducting compound which shall be extruded simultaneously with the core insulation.

INSULATION

- The insulation shall be super clean XLPE compound applied by extrusion and vulcanized to form a compact homogenous body.

INSULATION SCREEN

- Each insulation have an insulation screen in two parts consisting of :
- Non-metallic semi-conducting compound tape part and a metallic screen part.
- The non-metallic part shall be directly applied upon the insulation of each core and may consist of an extruded semi-conducting material extruded simultaneously with the conductor screen and insulation (triple extrusion).
- The semi-conductor shall be readily strippable and must not be bonded in such a manner that it has to be shaved or scraped to remove.
- The metallic part shall consist of a copper tape helical applied with a 10% overlap. A binder tape of copper shall be applied over the copper wire metallic screen.

LAYING UP

- The cores shall be identified on the non-metallic part of the insulation screen by legible printing on the length of each conductor or, by the inclusion of a marker tape.
- The cores shall be laid up with a right hand direction of lay.
- No cables shall be directly buried in the ground. They shall be laid in trenches, trays, racks or in conduits or pipes. The cables of different voltage grade shall be laid in different trays. 2 mtr loop to be provided on both the sides.

Binder tape / Moisture barrier:

- During lay up, a suitable open spiral binder may be applied, at the manufacturer's discretion, before the application of an extruded inner covering.

FILLERS

- Fillers shall be PVC.

INNER COVERING / SHEATH

- The inner covering shall be extruded over the laid up cores to form compact and circular bedding for the metallic layer.

METALLIC LAYER

- The metallic layer shall be galvanized steel wire.

OUTER SHEATH

- The tough outer sheath, black coloured best resisting PVC polyethylene compound type ST-2 as per IS : 5831 for the operating temperature of the cable shall be provided over the armour as specified in relevant standards by extrusion process.

CABLE MARKING

Embossing on outer sheath:

- The PVC outer sheath shall be legibly embossed with the legend: "ELECTRIC CABLE 11000 VOLT "etc.
- The letter and figures shall be raised and shall consist of upright block characters. The maximum size of the characters shall be 13 mm. And the minimum size 15% of the cable circumference or 3 mm. whichever be the greater. The gap between the end of one set of embossed characters as above and the beginning of the next shall not exceed 150 mm.

Identification of Manufacturer and year of manufacture:

- An identification of the manufacturer, the year of manufacturing, cable size shall be embossed at regular intervals on the PVC outer sheath. This shall not affect the spacing between repetitions of the legend as given above.

SEALING AND DRUMMING

- After tests at the manufacturers works, both ends of the cable shall be sealed to prevent the ingress of moisture during transportation and storage.
- Cable shall be supplied in lengths of 500 mtrs. or as required in non-returnable drums of sufficiently sturdy construction.
- The spindle hole shall be 110 mm. minimum diameter.
- Each drum shall bear on the outside flange, legibly and indelibly in the English language, a distinguishing number, the manufacturer's name and particulars of the cable viz. voltage, length, conductor size, cable type, insulation type and gross weight shall also be clearly visible. The direction for rolling shall be indicated by an arrow.

TESTING

- Type tests and Routine tests shall be carried out in accordance with the relevant IEC standards / IS. The copies of routine test results shall be submitted along with each drum length or part thereof.

TRANSPORTATION & DELIVERY

- The cable shall be supplied in the actual length as per joint measurement at site.
- The cable shall be dispatched at client's store or at site as per detailed instructions given by Client at later stage.
- The cables shall be loaded from the main vendor's store, transported, unloaded at Client's stores and properly stocked as per instruction of client's local representative.

1.6 TECHNICAL DATA SHEET FOR H. T. XLPE CABLE :

Sr. No.	Particulars	Description
1.0	ENVIRONMENT DETAILS	
1.1	Ambient Temp In Degree Celsius	50 Degree Celsius
1.2	Ground Temp In Degree Celsius	35 Degree Celsius
1.3	Relative Humidity	90 % At 35 Degree Celsius
1.4	Altitude	< 1000 Meter Above MSL
1.5	Atmosphere	Non Corrosive, Humid and Dusty
1.0	SYSTEM DETAILS	
1.1	System Voltage	AS PER TENDER
1.2	System Frequency	AS PER TENDER
1.3	Grounding	AS PER TENDER
1.4	Fault Level	AS PER TENDER
		AS PER TENDER
1.0	CABLE	
1.1	No. of Cores	3 (Three)
1.2	CABLE CONDUCTOR	
1.1.1	Size Of Conductor	As per BOM
1.1.2	Material	High Purity Aluminium
1.1.3	Construction	Stranded
1.1.4	Shape	Compacted Circular
1.1.5	Confirming To	Is-8130
1.3	Conductor Screen	Extruded Semi-conducting Material
1.4	CONDUCTOR INSULATION	
1.4.1	Material	High Purity Void And Moisture Free Cross Linked Polyethylene (XLPE) Using Gas Curing Process

Sr. No.	Particulars	Description
1.4.2	Thickness	> = 5.5mm
1.5	INSULATION SCREEN	EXTRUDED SEMI-CONDUCTING MATERIAL HAVING COPPER TAPE OVER IT
1.6	CORE IDENTIFICATION TAPE	Yes Required
1.7	CORE LAYING	Right Hand Direction
1.8	INNER SHEATH / COVER	Extruded
1.9	ARMOURING	
1.9.1	Material	Flat Steel GI Strip
1.9.2	No Of Strip	4
1.9.3	Size Of Strip	0.8 mm
1.10	OUTER SHEATH	
1.10.1	Material	PVC
1.10.2	Type	St-2 As Per Is-5831-1984
1.10.3	Thickness	> = 1.4 Mm
1.10.4	Colour	Black
1.11	MARKING ON OUTER SHEATH	YES
1.11.1	Voltage Grade	Yes
1.11.2	No. of Cores/Size of Conductor / Material of Conductor	Yes
1.11.3	Type Of Insulation	Yes
1.11.4	Details About Armour	Yes
1.11.5	Details Of Standards	Yes
1.11.6	Year Of Manufacturer	Yes
1.11.7	Any Other Details	Yes
4.0	TESTING	
4.1	Type Test As Per Is	Certificate To Be Provided for each drum
4.2	Routine Test As Per Is	Yes To Be Witnessed By Client
4.3	Acceptance Test	Yes To Be Witnessed By Client
5.0	CABLE DRUM	Non Returnable
5.1	Material	Wooden / Steel
5.2	Marking On Cable Drum	As Per Manufacturer's Standard

METHOD OF MEASUREMENT

- All the items will be measured in running metre and termination in unit nos as in Bill of quantity.

DISTRIBUTION TRANSFORMER

SCOPE OF WORK

Design, manufacture, testing and inspection at places of manufacturer, painting, supply, delivery to site, the transformers with all related accessories and specifications as specified below with technical data sheet and bill of quantity.

CODES & STANDARDS

- The design, material, construction, manufacture, inspection, testing and performance of power transformers shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards and codes of practice.
- Transformers shall conform to the current applicable standards and codes of practice as specified as under. In case of conflict between the applicable reference standards and this specification, this specification shall govern.

SR.	ITEM	RELEVANT IS	RELEVANT IEC
1	Power transformer	IS 2026	IEC 76
2	Fittings & Accessories	IS 3639	
3	Climate Proofing	IS 3202	IEC 354
4	Loading of Transformer	IS 6600	IEC 296
5	Oil	IS 335	IEC 137
6	Bushings	IS 20650	IEC 144
7	Degree of Protection	IS 2147	IEC 76
8	Testing, Tolerances on guaranteed Particulars	IS 2026	IEC 76
9	Buchholz Relay	IS 3637	
10	Electrical Insulation	IS 1271	IEC 85

CONSTRUCTION

GENERAL CONSTRUCTIONAL FEATURES

- All material used shall be of best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions without distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts for the work which they have to perform.

- Similar parts, particularly removable ones, shall be interchangeable. Pipes and pipe fittings, screws, studs, nuts and bolts used for external connections shall be as per the relevant standards. Bolts and nuts exposed to atmosphere shall be galvanized.
- Nuts, bolts and pins used inside the transformers and tap changer compartments shall be provided with lock washers or locknuts.
- Exposed parts shall not leave pockets where water can collect.
- Internal design of transformer shall ensure that air is not trapped in any location.
- Facility shall be provided for lubrication of bearings and mechanisms.
- Materials in contact with oil shall be such as not to contribute to the formation of acid in oil. Surface in contact with oil shall not be galvanized or cadmium plated.
- Labels shall be provided for all identifiable accessories like relays, switches, fans, current transformers etc. All label plates shall be of non-corrosive material.
- All internal connections and fastenings shall be capable of operating under overloads and over-excitation allowed as per specified standards without injury.

PAINTING

- The interior of all transformer tanks and other oil filled chambers and internal structural steel work shall be cleaned of all scale and dust by shot blasting unless otherwise approved. These surfaces shall be painted with not less than two coats of heat resistant, oil insoluble and insulating varnish. Steel surfaces exposed to the weather shall be thoroughly cleaned and have a priming coat of zinc chromate applied. The second coat shall be of an oil and weather resistant nature, preferably of distinct colour from the prime and finish coats. The final coat shall be of a glossy oil and weather resisting non fading paint of specified shade.
- Metal parts not accessible for painting shall be made of corrosion-resistant material.
- Interior surfaces of mechanism chambers and marshalling kiosks shall receive three coats of paint after proper cleaning. The final coat shall be of a light colour anti-condensation paint.

ELECTRICAL AND PERFORMANCE REQUIREMENTS

- Transformers shall operate without injurious heating at the rated kV at any voltage within +10 % to -15 % of the rated voltage of that particular tap.
- Transformers shall be capable of delivering the rated current at a voltage equal to 105 percent of the rated voltage without exceeding the limiting temperature rise.
- Unless otherwise specified, transformers shall be designed for operation at a frequency of 50 Hz.
- The maximum flux density in any part of the core and yokes, at normal voltage and frequency shall be such that the flux density under over voltage conditions shall not exceed the maximum permissible values for the type of core and yoke material used. The type of material and values of flux density in the core/ yoke for the 100%, 125% and 140% and the hysteric characteristic curves shall be included in the Bid, and shall be subject to approval. In

case of transformers with variable flux density the voltage variation which affects the flux density at every tap shall be kept in view while designing transformers.

- Unless otherwise specified, transformers shall be designed for the following over fluxing withstand capability:
 - 110% - Continuous for all transformers.
 - Transformers shall operate below the knee of the saturation curve at 110 percent voltage to reduce ferro resonance and non-linear oscillations.
- Unless otherwise stated, transformers shall be capable of operation continuously, in accordance with the applicable standard loading guide at their rated kVA and at any of the specified voltage ratios.
- Overloads shall be allowed within the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, on-load tap changers or other auxiliary equipment shall apply.
 - Transformer core shall be built up of low loss non-ageing grain oriented silicon steel insulated laminations. Adequate cooling ducts shall be provided. Transformer tanks shall be of robust construction fabricated out of M.S. plate. All welded joints and valves shall be tested after fabrication of the tank to withstand up pressure of 1.0 kg/sq.cm. in excess of the static head of oil. Bolted joints shall carry non-deteriorating -gaskets.
 - Transformer cooling shall be as specified under equipment schedule with fixed or removable radiator tubes of seamless construction and adequately braced to the tank.
 - All normal fittings required under section 14 of IS: 2026 - Part I shall be provided. Additional fittings shall also be provided as stipulated in the Datasheet.
 - The transformer shall be supplied with oil conforming to IS: 335. The transformer shall be delivered after drying out and ready to put into commissioning without further drying out at site.
 - The thermal ability to withstand short circuit shall be demonstrated by the calculations.
 - The dynamic ability to withstand short circuit shall be demonstrated by reference to tests on similar transformers.
 - Every care shall be taken to ensure that the design and manufacture of all transformers shall be such as to reduce noise and vibration to the level obtained in good modern practice.
 - The transformers shall be designed with particular attention to the suppression of harmonic voltage, especially the third and fifth, so as to eliminate wave form distortion and from any possibility of high frequency disturbances reaching such a magnitude as to cause interference with communication circuits.

- All rated quantities subject to the guarantees shall be within the tolerances given in applicable standards.
- The finally assembled core with all the clamping structures shall be free from deformation and shall not vibrate during operation.
- All internal metal parts of the transformer, with the exception of individual laminations, core bolts and their individual laminations, core bolts and their individual clamping plates shall be earthen.
- Windings shall be subjected to a shrinking and seasoning process, so that no further shrinkage occurs during service. Adjustable devices shall be provided for taking up possible shrinkage in service.
- Materials used in the insulation and assembly of the windings shall be insoluble, non-catalytic and chemically inactive in the hot transformer oil, and shall not soften or be otherwise affected under the operating conditions.
- The completed core and coil assembly shall be dried in vacuum at not more than 0.5 mm of mercury absolute pressure and shall be immediately impregnated with oil after the drying process to ensure the elimination of air and moisture within the insulation. Vacuum may be applied in either vacuum oven tank or in the transformer tank.

VALVES

- Valves shall be of forged carbon steel upto 50 mm size and of gun-metal or of cast iron bodies with gun-metal fittings for sizes above 50 mm. They shall be of full-way type with screwed ends and shall be opened by turning counter clockwise when facing the hand wheel. There shall be no oil leakage when the valves are in closed position.
- Every valve shall be provided with an indicator to show the open and closed positions and shall be provided with facility for padlocking in either open or closed position. All screwed valves shall be furnished with pipe plugs for protection.
- All valves shall be provided with flanges having machined faces drilled to suit the applicable requirements. Oil-tight blank flanges shall be provided for each connection for use when any radiator is detached and for all valves opening to atmosphere. If any special radiator valve tools are required, the same shall be provided.

TRANSFORMER COOLING EQUIPMENT

- Radiators and coolers shall be designed to withstand the vacuum and pressure conditions specified for the tank. They shall be so designed as to avoid pockets in which moisture may collect, to completely drain oil into the tank and to prevent formation of gas pockets when the tank is being filled.
- The clearance between all pipe work and live parts shall be more than the clearance for live parts to earth.

BUILT-ON RADIATORS

- Unless otherwise approved, for transformers rated 500 kVA and above, tank mounted radiators / coolers shall be of the detachable type with bolted and gasketed flanged connections.

TAPS AND TAP CHANGE GEAR

- Tapings shall be On Load / Off Load (where ever applicable as mention in data sheets) and brought out from HV winding and terminated in an external motor operated tap switch with position indicator. Transformer output shall remain unaffected for any tap position.

ON-LOAD TAP CHANGE GEAR

- The tap changers shall be of ON circuit type mechanically rugged and arranged to provide for convenient inspection and maintenance without necessity for un-tanking. *The* position indicators shall be positive and there shall not be any ambiguity resulting into incomplete tap change with respect to the mechanical tap position indication. The operating handle of tap exchanger shall be brought out of the tank at the side at an accessible height from ground level. Tap changer operating switch mounted on the top of the transformer tanks will not be acceptable. Provision of padlocking the tap changers without interfering with visual tap position indicator shall be provided.

LOSSES

- Bids will be evaluated based on the formula furnished.
- For the purpose of evaluation of Bids, the quoted load losses and iron losses shall be increased to take into consideration tolerance as permitted by applicable standards.

REJECTION

- The client may reject any transformer if during tests or service any of the following conditions arise:
 - No load loss exceeds the guaranteed value by 20% or more.
 - Load loss exceeds the guaranteed value by 20% or more.
 - Impedance value exceeds the guaranteed value by + or - 10% or more.
 - The difference in impedance values of any two phases during single phase short circuit impedance test exceeds 2 percent of the average value guaranteed by the BIDDER.
 - Oil or winding temperature rise exceeds the specified value by 5 Deg.Cent.
 - Transformer fails on impulse test.
 - Transformer fails on power frequency voltage withstand test.
 - Transformer is proved to have been manufactured not in accordance with agreed specification.

- The client reserves the right to retain the rejected transformer and take it into service until the BIDDER replace, at no extra cost, the defective transformer by a new transformer. Alternatively, the BIDDER shall repair or replace the transformer within a reasonable period to the client satisfaction at no extra cost.

DRAWINGS & INFORMATION

ALONGWITH OFFER

- The bidder shall submit completely filled data sheet as per the given format along with GA drawing indicating list of accessories.

HANDING OVER DOCUMENTS

The supplier shall submit following:

- GA drawing
- HV / LV Cable Box
- Foundation layout
- Rating and Diagram Plate
- Data sheet indicating results of tests
- Test reports

INSPECTION AND TESTING

Following tests should be performed as acceptance test at manufacturing place,

- Measurement of winding resistance
- Measurement of voltage ratio and check' of voltage vector relationship
- Measurement of impedance volt age/short-circuit impedance (principal tapping) and load loss
- Measurement of no-load loss and current
- Measurement of insulation resistance
- Tests on on-load tap-changers, where appropriate
- Any other special test, if asked for in data sheet

MODE OF MEASUREMENT

- Supply of the transformer including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.

TRANSPORT, DELIVERY AND STORAGE

- The quoted price must include all the costs for necessary mode of transportation upto the final location of transformer or site store. The transformer should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including insurance.
- The transportation for any auxiliary item or detachable part of equipment should be simultaneous and carry necessary instructions for assembling and storage requirements.
- The extra transformer oil, if asked for, shall be supplied in sealed non returnable drums.

GUARANTEE OF PERFORMANCE

- The quotes values of parameters shall be within given tolerance for given period of service life.

SPARES

- The bidder shall quote for minimum spares required for two years safe operation of transformer along with the offer separately.

MAKE OF COMPONENTS

- The bidder should indicate the list of manufactures for bought out items. The client / Consultant reserve the right to select or change the make of material from the submitted list.

1.0 ATTACHMENTS

DATASHEET

SR.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
1.0	GENERAL FEATURES		
1.1	Make		
1.2	Installation	AS PER TENDER	
1.3	Service	Continuous	
1.4	Climate	Non Corrosive	
1.5	Type of cooling	ONAN	
1.7	Allowable temperature rise	Oil - 50 deg.c. Winding - 55 deg.c.	
1.8	Painting	Epoxy, shade no. 631 as per IS : 5	
1.9	Oil type	Mineral oil	
1.10	Position	Plinth mounted	
1.0	ELECTRICAL DATA :		
1.1	Earthing : L.V. side	 Solid	

SR.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
1.2	No. of windings	Two	
1.3	Phase	3	
1.4	Frequency	50 Hz.	
1.5	Voltage ratio	AS PER TENDER	
1.6	Phase connection	AS PER TENDER	
1.7	Vector group	AS PER TENDER	
1.8	% impedance	Max. 5% without IS tolerance	
1.9	Rating in KVA	AS PER TENDER	
1.10	Winding insulation class	"A"	
1.11	Terminations :		
a)	H.V. side	Cable box	
b)	L.V. side	Disconnecting Type cable box with rain coated protected system at Horizontal / Vertical joints.	
		AS PER TENDER	
1.0	TAP CHANGER :		
1.1	Tapings	H.V.	
1.2	Tap changer	ON load	
1.3	Tapping range	-10 % to +15%	
1.4	No. of steps	in steps of 1.5%	
4.0	Limit for transformer operation under over load condition as per IS	Required	
5.0	ACCESSORIES :		

SR.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
	Double float Buchholz relay with alarm & trip contacts Marshalling box Sampling valve Plain oil level gauge Conservator & conservator drain valve Bidirectional rollers Oil temp. indicator with alarm & trip contacts Bottom drain / Filter valve Double diaphragm Explosion vent Silica-gel breather Air release plug	Required	
	Separate neutral bushing Top oil filter valve Jacking pads Lifting lug Earthing terminal 1 set of detachable radiator with shutoff valve Winding temp. indicator with alarm & trip contacts Rating and diagram plate HV & LV gland plate	Required	
6.0	PERFORMANCE DATA :		
6.1	Rated guaranteed loses without tolerance		
a)	No load at 100% voltage	Required	

SR.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
b)	No load at 110% voltage	Required	
c)	Full load Cu. Loss	Required	
6.2	Rated No load current	Required	
a)	No load at 100% voltage		
6.3	Rated efficiency at 0.8 P.F.	Required	
a)	At full load		
b)	At 75% load		
c)	At 50% load		
6.4	Rated regulation	Required	
a)	At 0.9 P.F. lag		
b)	At 0.8 P.F. lag		
c)	At unity P.F.		
6.5	Impedance voltage	Required	
a)	Primary – Secondary		
6.6	Load at which max. efficiency occurs	Required	
6.7	Maximum efficiency	Required	
6.8	Maximum flux density	Required	
6.9	Current density	Required	
7.0	MECHANICAL DATA :	Required	
7.1	Weight :	Required	
a)	Core & windings		
7.2	Dimensions (mm.) : (Dimensions should be considered including all accessories)	Required	

Note : All routine tests as per 'IS' shall be carried out in presence of purchaser / consultant's representative

DIESEL GENERATOR SET

SCOPE:

- This specification covers the design, construction features, manufacture and performance of emergency diesel generator. The scope includes supply, installation, testing and commissioning of D.G. set along with fuel pipeline, residence type exhaust pipe insulation and all the accessories required for trouble free operation.

CODES AND STANDARDS:

The DG set shall meet the requirements of the following standards and rules:

IS : 2253	Designation for type of construction and mounting arrangement of rotating electrical machines.
IS : 4691	Degree of protection providing by enclosures of rotating electrical machinery.
IS : 4728	Terminal marking of rotating electrical machines.
IS : 7132	Guide for testing 3 Phase Synchronous Machines.
IS : 5422	Turbine type generators.
IS : 4889	Methods of determination of efficiency of rotating electrical machines.
IS : 1271	Insulating materials for Electric machinery and apparatus in relation to their thermal stability service, classification.
IS : 4722	Specification for rotating electrical machines.
IS :13947	AC circuit breakers.

DESIGN CONDITIONS:

All equipment and materials will be selected and rated for use at the following site conditions.

Summer outdoor design temperature	50° C.
Surface temperature	80° C.
Relative Humidity	95% Max.

DESIGN & CONSTRUCTION :

GENERAL :

- The diesel engine offered shall be of the regular production models of the manufacturer for industrial applications and already type tested either at the manufacturer's works or outside. The type test report shall be furnished to the purchaser for his review if so desired.

In case the proposed engine model has not been type tested, vendor shall furnish with the offer, a reference list of its existing industrial installation and at least three of these engines should have completed, 5000 hours of running at site.

- Unless otherwise specified in the equipment data sheets, the diesel engine shall be provided with class A1 governing as per the latest edition of B.S. 5514.
- The "Cyclic irregularity" of the diesel engine for direct coupling to an electric generator, "angular deviation of A.C. generators" given by diesel engine for parallel operation, and the "engine governor speed droop characteristics", shall be restricted to the values specified under the latest edition of B.S. 5514.

- The vendor shall be responsible for carrying out torsional analysis of the dynamic system as specified in the latest edition of British Standard-5514. The results in the form of a report shall be submitted to the purchaser for scrutiny and reference, if desired.
- Vendor shall provide the flexible exhaust connections to connect the engine exhaust to the exhaust piping. The required size of the exhaust piping should be clearly specified by the vendor.
- The common base plate for mounting the diesel engine and the driven equipment as well as the flexible coupling, shall be supplied by the vendor.
- Vendor shall indicate in the bid, the IS Noise Level rating of the diesel engine with the offered exhaust silencer, which should not exceed more than 75 db at 1 Mtr. distance.

ENGINE STARTING:

- Diesel engines shall be capable of starting without the use of cold starting aids so long the ambient temperature at the site is not below 4° c.
- Where the diesel engine is specified / offered with battery starting arrangement, the starter motor shall be capable of starting the engine without having to disengage the driven machine with the help of a clutch. Where the diesel engine is equipped with a dual starter the synchronizing switch and the corresponding wiring / connection with the starter motor shall be provided by the vendor.
- In case of diesel engines driving the engine mounted battery charging alternator, the Vendor shall also provide Battery, automatic Electronics float & boost type battery charger suitable for taking power from supply authority's power source and mounted on a free standing type of a panel.
- The battery charger as specified in the equipment data sheet, shall be capable of delivering a current equal to 100% of the 20 hour discharge rate of the battery and also equipped with charging rate selector device.
- As specified in the data sheets, the diesel engine is required to start / stop automatically, the vendor shall provide the necessary controls (automatic - cum -manual) in the engine panel and the interconnecting wiring and piping from the panel to the engine and starting equipment. A pilot lamp shall be provided in the line side of the starting equipment circuit to indicate that the controller is in the automatic position. In the event the engine does not start after three attempts have been made, the controller shall stop all further cranking and operate the audio-visual alarm. Shaft driven lubrication system is acceptable, alternatively D.C. motor driven lubrication pump with timer suitably interlocked with the starting system is acceptable.

ENGINE COOLING:

- Vendor shall supply radiator based cooling system.

ENGINE FUEL SYSTEM:

- Engine fuel system shall be complete in all respects but not limited to following :
- The daily service fuel tank capacity 990 liters shall be equipped with shielded level gauge, strainer and a hand hole of not less than 150mm diameter, besides the required fuel connections and a drain plug. One tanks of suitable capacity to be provided.
- The inside surfaces of the fuel tank and the float tank shall be coated with Enamel Red or Black of I.C.I. or its equivalent and the outside surface to be given two coats of the oil resistant primer paint. The fuel tank shall be hydrostatically tested at a pressure not less than 0.35 Kg./Cm.²
- Fuel oil transfer pump to transfer oil from barrels to day tank shall also be provided.
- All piping, valves, fittings and supports inside D.G. house shall be part of supply.

INSPECTION & TESTING:

- The vendor shall have the responsibility of providing purchaser's representative with all requisite facilities / equipment for carrying out satisfactory testing.
- The diesel engines shall be tested in the presence of purchaser's representative accordance with latest edition of B.S. 5514 or any other equipment standard as agreed to with the purchaser before the finalization of order.
- The routine load and fuel consumption test shall be of the 4 hours.
- Unless otherwise specified, 10% overload provision shall be kept while setting the fuel limit for the site running.
- The engine control panel/s after assembly and wiring, shall be functionally tested in the presence of the client's / consultant's representative.

ALTERNATOR:

- This specification define the requirements of design, manufacture, testing and supply of self excited emergency generator complete with automatic voltage regulator, control panel, isolator and other accessories as specified in the material requisition.
- Unless otherwise specified the emergency generator shall be supplied complete with :
 - Brush less excitation system complete with AVR.
 - Electric panel including control cubicle and associated auxiliary devices, relay panel and generator breaker / isolator, battery and battery charger.
 - Air inlet and outlet for generator cooling (inlet shall be oriented to suit total plant layout).
 - Lifting arrangement for the machine.
 - Foundation frame complete with foundation bolts to install alongwith engine on common base frame.
 - Lub. oil system integral with the prime mover lub. oil system.
 - Spares for commissioning.
 - Spares for two years of operation and maintenance.

- Any other part / accessories not specifically mentioned above but considered necessary for safe and reliable operation.

DESIGN AND CONSTRUCTION:

- The alternator design shall meet the requirement specified in data sheet and shall be suitable for the site conditions specified therein.
 - The alternator shall be mounted on a common base frame together with the prime mover unless otherwise agreed. The generator shall be provided with necessary lifting hooks and two earth terminals for connection to main earth grid.
 - The alternator winding shall be class “F” insulation with temperature limitation to Class “B”.
 - The stator windings shall be brought out to six insulated terminals in two separate terminal boxes. The alternator shall, therefore, be provided with three separate terminal boxes i.e. for the line and neutral stator connection and for control connection. The terminal box for the line terminal shall have 40 % free space and each segregated for easy cable end connection of cable size specified in data sheet. The neutral box shall in addition to the space for neutral earthing cable shall have sufficient room for the current transformers used for the protection of the generator. Star connection shall be formed in the neutral side of terminal box. The terminal box for control cable shall contain properly marked terminals for all internal equipments e.g. embedded temp. detectors etc. All terminals shall be stud type. The terminal boxes shall be complete with lugs and double compression type cable glands. Current transformers shall be as specified in data sheet.
 - All parts and accessories shall be suitable to withstand stresses due to over speed / overload / short circuit conditions specified.
 - Bearings shall be double shielded and prelubricated. Grease in the bearing enclosure shall provide additional lubrication to bearings as well as provide sealing against dust and moisture. On line greasing facility with excess grease expulsion system shall also be provided.
 - The alternator shall be air cooled unless otherwise agreed, alternator enclosure shall be as specified in data sheet.
 - The direction of rotation of the rotor of the machine shall be compatible with that of the prime mover. A clear indication of the direction of rotation shall be given on either end of the machine.
 - Field winding shall have class “H” insulation with excellent electrical and mechanical properties. The field winding shall be capable of operating at a field voltage with Excitation capacity $E_{max} / E_n = 1.6$ for at least two minute to meet improved stability requirements.
 - A rating plate of S.S material shall be fixed on the generator frame and shall give the following information :
 - a) Manufacturer’s name.
 - b) Serial Number, Type and frame reference

- c) Rated output in KVA & KW
- d) Rated power factor, frequency and voltage
- e) Rated stator current and speed in Rev. / Min.
- f) Class of insulation
- g) Phase rotation (CW or CCW)
- h) Customer's indent no.
- i) Year of manufacture
- j) Weight of rotor and stator in Kg.

EXCITATION SYSTEM:

- The generator shall be provided with brush less type solid state excitation system. The field of the exciter shall be either permanent magnet type or externally excited through external power, transformer and AVR. AC voltage generated in the exciter shall be rectified by the rotary rectifier assembly and feed power to the main field circuits of the generator. The exciter capacity shall be at least 20% more than the maximum requirement at any time. The exciter winding shall be insulated with class "F" insulation. Automatic solid state voltage shall be provided with the following features as a minimum.
 - Short circuit protection.
 - Manual voltage control switch with adjuster.
 - Cross current compensation for parallel operation.
 - Voltage build up circuitry.
 - Stator current limiter.
 - Field current limiter.

The current and potential transformers required to feed the AVR from the generator terminal shall be adequately rated.

SYSTEM OPERATION:

- The emergency generator set shall normally be in an unattended area. The control system shall operate in fail safe mode and shall include all controls and protection necessary for the safe operation of the package. The generator set shall function as per one of the following schemes :
 - Manual start in service mode.
 - Manual test mode.

PAINTING, PACKING AND TRANSPORT:

- All metal surfaces shall be thoroughly cleaned of scale, rust and grease etc. Prior to painting. Cleaned surfaces shall be given two coats of primer and prepared for final painting. Final finish shall be free from all sorts of blemishes.
- The equipment shall be shipped to site suitably packed to prevent any damage. Each package shall have labels to show purchaser's name, purchase order and equipment no. suitable lifting lugs etc. shall be provided and lifting points shall be clearly marked on the package. Packing shall be suitable for storage at site for a minimum period of 6 months.

TESTS AND INSPECTION:

- The owner or his authorised representative may visit the works during manufacture of equipment to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given all assistance to carry out the inspection.

- Detailed test procedure alongwith the facilities available at vendors works shall be furnished along with the bid. Owner's representative shall be given minimum four weeks advance notice for witnessing the final testing. Test certificates including test records and performance curves etc. shall be furnished for the complete D.G., individual test certificates of engine / alternator / common panel should be submitted, only thereafter complete D.G. would be tested.

TESTS:

- Equipment shall be tested to conform to the appropriate standards and the following tests shall be conducted in the presence of purchaser's :
 - Functional tests, continuity tests and high voltage test on control panel to establish the performance called for in the specification.
 - Power frequency voltage test on switch gear and mechanical / electrical operational check.
 - Routine tests for alternator as per IS : 4721.
 - Over speed test (1.2 times the rated speed for 2 minutes.)
 - Transient response tests for sudden application and rejection of loads of 25% , 50%, 75% and 100% of rated capacity.
 - Phase sequence test.
 - Vibration test.
 - Noise level test.
 - Dimensional and alignment test.
 - Wave from test.

DATA SHEET FOR DIESEL GENERATOR SET

SR. NO.	PARTICULARS	REQUIRED DATA
1.0	Prime mover	Diesel Engine
1.0	Quantity required	AS PER TENDER
1.0	Service	Prime mover for generating set
4.0	Rating	AS PER TENDER
5.0	RPM	AS PER TENDER
6.0	Voltage	AS PER TENDER
7.0	Voltage variation / regulation Steady state - slow variation In load (0.0% to 100% at P.F. 0.8)	1% or less
8.0	Voltage deep (sudden load application 0.0% to 100% at P.F. 0.8)	-5%, recovery time - 0.25 sec.
9.0	Frequency	50 Hz.
10.0	Frequency variation / regulation	0.5 Hz.
11.0	Temperature rise	Class 'F' used as Class 'B'
11.0	Alternator Insulation Material	VPI Insulation preferred
11.0	Flywheel	Required
14.0	Vibration damper	Required (fluid type only)
15.0	Fuel pump air cleaner	Required
16.0	Fuel pump	Required
17.0	Oil filter, fuel filter etc.	Required
18.0	Lub oil pump	Required
19.0	24 V DC electrical system consisting of SMF lead acid battery set and suitable charger	Required
20.0	Safety controls	Required
21.0	Residential type Silencer	Required
21.0	Acoustic Hood	Required
21.0	AMF panel with MCCB	Required
24.0	Coupling	Required
25.0	Instrument panel consist of a) Starter switch with key b) Lub oil temp. gauge c) Water temp. gauge d) Lub oil pressure gauge e) Tacho cum Hour meter	Required Required Required Required Required Required
26.0	Fuel tank	Required (Capacity -990 Litres Max.)
27.0	Battery charger	Required (Electronics float & boost type)
28.0	Engine testing a) At shop b) At site	Required
28.0	Tool kits	Required
29.0	Literature (Two sets each) a) Operation & maintenance manual b) Parts catalogue / list	Required Required

Note:

- The engine H.P. should be selected so as to achieve required **KW** rating to be generated at site condition and derated considering temperature inside acoustic enclosure..
- D.G. set should be able to start by push button AMF relay, or remote command.
- The engine test shall be witnessed by the OWNER's representative.
- The engine should have automatic belt tensioning arrangement for battery charging alternator system.
- The engine should have facility for the indication of oil level in oil sump during running of the engine.
- The noise level should not be more than 75 db at 1 Mtr. distance and engine exhaust smoke emission level should be less than 1 bosch.
- Engine should be preferably from the engine manufacturers who maintain quality - assurance to international standard of ISO 9001.
- Engine should be fitted with electronic governor only.
- The engine water circular pump should be directly driven by engine gear system. V-belt driven system should not be adopted / accepted.

MODE OF MEASUREMENT

- Supply of the DG SET including transport to site, loading and unloading , exhaust etc. as specified will be treated as one unit for measurement and payment.

LT DISTRIBUTION PANEL

GENERAL DESCRIPTION

- Main Distribution Panels, Sub-Distribution Panels and Final Distribution shall be covered under this section. Panels/Boards shall be suitable for operation on 3 Phase/single phase, 415/240 volts, 50 cycles, 4 wire system with neutral grounded at transformer. All Distribution panels shall be CPRI tested design and manufactured by an approved manufacturer. CPRI certificate shall be made available.
- Distribution panels shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per IS-13947-1991.

CONSTRUCTION FEATURES:

- Distribution panels shall be 2 mm thick sheet steel cabinet for indoor installation, dead front, floor mounting/wall mounting type and shall be form as per site construction requirements. The Distribution panels shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors and folded covers, Neoprene gasket, padlocking arrangement and bolted back. All removable/ hinged doors and covers shall be grounded by flexible standard connectors. Distribution panel shall be suitable for the climatic conditions as specified in Special Conditions. Steel sheets used in the construction of Distribution panels shall be 2 mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to IS-8623-1977 (Part-1) for factory built assembled switchgear & control gear for voltage up to and including 1100 V AC.
- All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self threading screws shall not be used in the construction of Distribution panels. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panels. Minimum operating clearance of 275 mm shall be provided between the floor of Distribution panels and the lowest feeder compartment.
- Distribution panels shall be of adequate size with a provision of spare switchgear as indicated on the Single Line Diagram. Feeders shall be arranged in multi-tier. Knockout holes of appropriate size and number shall be provided in the Distribution panels in conformity with the location of cable/conduit connections. Removable sheet steel plates shall be provided at the top to make holes for additional cable entry at site if required.
- Every cabinet shall be provided with Trifoliate or engraved metal name plates. All panels shall be provided with circuit diagram engraved on PVC sheet. All live accessible connections shall be shrouded and shall be finger touch proof and minimum clearance between phase and earth shall be 20 mm and phase to phase shall be 25 mm.

BUSBAR CONNECTIONS:

- Bus bar and interconnections shall be of high conductivity electrolytic grade aluminium / copper as indicated in the bill of quantities complying with requirement of IS : 5082 – 1981 and of rectangular cross section suitable for carrying the rated full load current and short circuit current and shall be extendable on either side. Bus bars and interconnections shall be insulated with heat shrinkable sleeve of 1.1 KV grade and shall be colour coded. Bus bars shall be supported on glass fiber reinforced thermosetting plastic insulated supports at regular intervals to withstand the force arising from in case of short circuit in the system. All bus bars shall be provided in a separate chamber and all connections shall be done by bolting. Additional cross sectional area to be added to the bus bar to compensate for the holes. All

connections between bus bars and breakers shall be through solid copper / aluminium strips of proper size to carry full rated current and insulated with insulating sleeves. Maximum current density for the bus bars shall be 1A/sq.mm for aluminium and 1.4 A/sq.mm for copper bus bars.
Maximum allowable temperature for the Bus bar to be restricted to 85 deg C

TEMPERATURE – RISE LIMIT

- Unless otherwise specified, in the case of external surface of enclosures of bus bar compartment which shall be accessible but do not need to be touched during normal operation, an increase in the temperature rise limits of 25° C above ambient temperature shall be permissible for metal surface and of 15° C above ambient temperature for insulating surfaces as per IS 8623(Part-2) 1991.
- All main distribution panels and sub distribution panels shall be provided with MCCB of appropriate capacity as per Single Line Diagram. All final Distribution boards shall be provided with Miniature Circuit Breakers. Final Single Phase Distribution boards shall be connected to the incoming supply through double pole MCB units & earth leakage circuit breakers. All wiring for final distribution boards shall be concealed behind 5 mm thick bakelite sheet or M S sheet cover. All Distribution boards shall be completely factory wired, ready for connection. All the terminals shall be of proper current rating and sized 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.
- Continuous earth bus sized for prospective fault current shall be provided with arrangement for connecting to station earth at two points. Hinged doors/ frames shall be connected to earth through adequately sized flexible braids.

CABLE COMPARTMENTS

- Cable compartment of adequate size shall be provided in the Distribution panels for easy clamping of all incoming and outgoing cables entering from the top/bottom. Adequate supports shall be provided in cable compartment to support cables.

Moulded Case Circuit Breaker (MCCB)

- The MCCB should be current limiting type with trip time of less than 10 msec 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 or any accredited international lab.
- 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 as specified in the schedule of quantities. The rated service breaking capacity (Ics) should be equal to rated ultimate breaking capacities (Icu). MCCBs for motor application should be selected in line with Type-2 Co-ordination as per IEC-60947-2, 1989/IS 13947-1. The breaker as supplied with ROM should meet IP54 degree of protection.

Current Limiting & Coordination

- The MCCB shall employ maintenance free minimum let-through energies and capable of achieving discrimination up to the full short circuit capacity of the downstream MCCB. The manufacturer shall provide both the discrimination tables and let-through energy curves for all.

Protection Functions

- MCCBs with ratings up to 200 A shall be equipped with Thermal-magnetic (thermal for overload and magnetic for short-circuit protection) trip units
- Microprocessor MCCBs with ratings 250A and above shall be equipped with microprocessor based trip units.
- Microprocessor and thermal-magnetic trip units shall be adjustable and it shall be possible to fit lead seals to prevent unauthorised access to the settings
- Microprocessor trip units shall comply with appendix F of IEC 60947-2 standard (measurement of rms current values, electromagnetic compatibility, etc.)
- Protection settings shall apply to all poles of circuit breaker.
- All Microprocessor components shall withstand temperatures up to 125 °C

TESTING

- a) Original test certificate of the MCCB as per IEC 60947-1 &2 or IS13947 shall be furnished.
- b) Pre-commissioning tests on the switch board panel incorporating the MCCB shall be done as per standard specifications.

Interlocking

- Moulded, case circuit breakers shall be provided with the following interlocking devices for interlocking the door of a switch board.
 - Handle interlock to prevent unnecessary manipulations of the breaker.
 - Door interlock to prevent the door being opened when the breaker is in ON position.
 - Defeat-interlocking device to open the door even if the breaker is in ON position.
- The MCCB shall be current limiting type and comprise of quick make – Break switching mechanism. MCCBs shall be capable of defined variable overload adjustment. All MCCBs rated 200 Amps and above shall have adjustable over load & short circuit pick-up both in Thermal magnetic and Microprocessor Trip Units.
- All MCCB with microprocessor based release unit, the protection shall be adjustable Overload, Short circuit and earth fault protection with time delay.
- The trip command shall override all other commands.

Miniature Circuit Breaker (MCB)

- Miniature Circuit Breaker shall comply with IS-8828-1996/IEC898-1995. Miniature circuit breakers shall be quick make and break type for 240/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall be classified (B, C, D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values. MCB shall ensure complete electrical isolation & downstream circuit or equipment when the MCB is switched OFF.
- The housing shall be heat resistant and having high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP, TPN and 4 Pole miniature circuit breakers shall have a common trip bar independent to the external operating handle.

Residual Current Circuit Breaker Current Operated Type (RCCB)

System of Operation

- Residual Current Circuit Breaker shall conform to IEC 61008. RCCB shall work on the principle of core balance transformer. The incoming shall pass through the toroidal core transformer. As long as the currents in the phase and neutral shall be the same, no electro motive force shall be generated in the secondary winding of the transformer. In the event of a leakage to earth, an unbalance shall be created which shall cause a current to be generated in the secondary winding, this current shall be fed to a highly sensitive miniature relay, which shall trip the circuit if the earth leakage current exceeds a predetermined critical value. RCCB shall be current operated independent of the line voltage, current sensitivity shall be of 30 mA at 240/415 volts AC and shall have a minimum of 20,000 electrical operations.

Mechanical Operation

- The moving contacts of the phases shall be mounted on a common bridge, actuated by a rugged toggle mechanism. Hence, the closing /opening of all the three phases shall occur simultaneously. This also shall ensure simultaneous opening of all the contacts under tripping conditions.

Neutral Advance Feature

- The neutral moving contact shall be so mounted on the common bridge that, at the time of closing, the neutral shall make contact first before the phases; and at the time of opening, the neutral shall break last after allowing the phases to open first. This is an important safety feature which is also required by regulations.

Testing Provision

- A test device shall be incorporated to check the integrity of the earth leakage detection system and the tripping mechanism. When the unit is connected to service, pressing the test knob shall trip the ELCB / RCCB and the operating handle shall move to the "OFF" position.

EARTHING

- Earthing shall be provided as per IS: 3043-1987.

PAINTING

- All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivating (seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be as per BOQ confirming to IS Code No.5.

LABELS

- Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the distribution panels shall be pasted on inside of the panel door and covered with transparent plastic sheet.

METERS

- All voltmeters and indicating lamps shall be through MCB's.
- Meters and indicating instruments shall be flush type.
- All CT's connection for meters shall be through Test Terminal Block (TTB).
- CT ratio and burdens shall be as specified on the Single line diagram/BOQ.

CURRENT TRANSFORMERS

- Current transformers shall be provided for Distribution panels carrying current in excess of 60 amps. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondaries for operation of associated metering.
- The CTs shall conform to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class I.

POTENTIAL FREE CONTACTS

- Potential free contacts shall be provided for connection to Building Automation System in panels indicated in Schedule of Quantities.

INDICATING PANEL

- All meters and indicating instruments shall be in accordance with relevant Indian Standards. Meters shall be flush mounted type. Indicating lamps shall be of low burden, and shall be backed up with 2 amps MCB/MPCB as per relevant fault level and toggle switch.

TESTING

Testing of panels shall be as per following codes:

- I. IS: 8623 (Part -I) 1977 for factory built assemblies of switch gear for voltages upto and including 1000 VAC.
- II. IS: 13947 : 1993 Degree of protection
- III. IS: 5578 & 11353:1985 Arrangement of bus bars.

WIRING

- In wiring a distribution panel it shall be insured that total load of various distribution panel and/or consuming devices is divided evenly between the phases and number of ways as per Consultants drawing.

INSTALLATION

- Installation of all LT panels shall include but not limited to the following to complete the installation, testing and commissioning:
 - a) Transporting materials from stores to exact location of installation.
 - b) Supply and installation of required base frame made of MS angle or channel sections and duly painted with black paint.
 - c) Positioning, aligning, fixing, assembling, and installation of LT panel issued free of cost by Client after carrying out proper cleaning and inspection.
 - d) Site supervision, testing for proper functioning / operation, and pre-commissioning tests.

COMMISSIONING & ONSITE TESTING

- a) All switchboards shall be tested for dielectric test with 1000V megger.
- b) All earth connections shall be checked for continuity.
- c) All busbar connections shall be checked and tightened properly.
- d) All cable terminations and terminal shrouding shall be checked if they are properly done.
- e) The operation of protective devices shall be tested by secondary injection test.
- f) The operation of circuit breaker shall be tested for all interlocks.
- g) Functional test shall be done for all ACBs, MCCBs and other components.
- h) Indicating lamps and meters shall be checked for proper working.

WORKMANSHIP:

The contractor shall erect the panel at site in co-ordination with the supplier if required. He should check for loose ends on the part of the supplier and shall inform client and consultant for the same. Physical and continuity tests shall be carried out by contractor. Also the field tests carried out by the supplier shall be recorded by the contractor.

MODE OF MEASUREMENT:

Contractor shall be paid for one panel erection as per BOQ Quantities part.

CAPACITOR & APFCR PANEL

SCOPE :

- This specification covers design, manufacture, supply, installation, testing and commissioning of automatic power factor correction panel with capacitor banks suitable for continuous duty.

CODES AND STANDARDS :

- The design, manufacture and performance of the power factor correction panel with capacitor banks shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment will also conform to the latest applicable Indian / British / IEC standards. In particular the equipment shall conform to the latest revisions of the following :

IS : 2834 Shunt capacitors for power system.

IS : 9224 Low voltage fuses.

- When the above standards are in conflict with the stipulation of this specification, this specification supersedes them.

CONSTRUCTION**CAPACITOR BANK**

- Capacitor banks shall comprise of identical delta connected three phase units. The individual capacitor unit shall be manufactured out of double layer APP design comprising of double hazy and thick polypropylene film between two electrodes of thick aluminum foil . Each individual element of the capacitor tissue unit shall be provided with silver fuse wire. The capacitor unit shall consist of many such elements in series / parallel combinations for getting the desired KVAR output. The capacitor shall be vacuum impregnated with liquid dielectric having high thermal stability. The dielectric losses of the capacitor shall be restricted to 1.5 watts per KVAR. The phase terminal connections of the capacitor unit shall be brought out at the top through metal insulators which should be soldered to the fabricated top cover. The capacitor shall be provided with suitably rated discharge resistors. The capacitor shall be designed to withstand the electro dynamic and thermal stresses caused by transient over current during switching.

BUSBARS CHAMBER :

- Capacitor bank shall be provided with a busbar chamber. The chamber shall be dust and vermin proof in construction, fabricated from 2 mm thick sheet steel. Continuous neoprene rubber gaskets shall be provided on all mating surfaces. TP Bus-bars shall be of AL supported on FRP insulators of adequate rating and strips.
- The bus bar sizes and clearances shall be suitable for connection of cables through crimping type cable lugs. Busbar chamber shall be extended suitably on one side to enable termination of cable. There shall be a provision of cable end box at the end of busbar chamber undrilled removable gland plate and access covers to be provided for cable entry as required.

EARTHING:

- The enclosure of individual capacitor unit shall be provided with 2 nos. 10 mm earth terminals each complete with two plain and one spring washer, nuts etc. These terminals shall be effectively bonded to the common sheet steel frame work. Each bank will have two external earth terminals in the busbar chambers complete with hardware.

PAINTING:

- The painting shall be as per "PAINTING" specification only.

DRAWINGS :

- The following drawings shall be submitted alongwith the bid :
 - a. General arrangement drawing showing overall dimensions, weight, internal arrangement and mounting details.
 - b. Terminal chamber, showing bus-bar arrangement with all dimensions.

TEST & TEST CERTIFICATES:

- Vendor shall carry out all routine tests as specified in IS : 2834 and shall furnish the test certificates.
- The vendor shall also carry out the thermal stability test on the units in the presence of purchasers representatives.
- The capacitor units shall be tested from electric supply authorities like state / local electricity board and the test certificates in duplicate shall be furnished to client and also the copy shall be submitted to the electric supply authority while getting the power supply released from them.

CAPACITOR PANEL:

- Capacitor control panel shall be automatic as specified in the data sheet and bill of quantity.
- The panel for capacitor shall be fabricated from 1.0 mm thick sheet steel and shall be finished as per clause no. 5.0. Earthing terminals shall be provided as per clause no. 4.0. The panel shall be provided with suitably rated TPN AL bus bar supported on FRP insulator and with heat shrinkable type sleeves. Each capacitor unit shall be connected to main bus bar through contactors of suitable rating (double the rating of capacitor current) with safety margin. Each unit shall be of suitable KVAR rating as specified. Protective HRC switch fuses of suitable rating shall be provided with base / holders as mentioned in the drawing.
- Connections shall be made with FRLS insulated flexible copper cables having crimped Cu. lugs. Continuous earthing conductor / strip shall run through and all capacitor units shall be earthed. Sufficient ventilation shall be provided in the capacitor compartment to limit the temperature rise to 85° C. Cooling fans shall be provided with ON-OFF switches as per requirements. Drawing pocket shall be provided for each panel at the door. Also, a 15 A switched socket and a lamp holder shall be provided for panel illumination at suitable location.

- The main bus bar shall be terminated on suitably rated SFU with fuse links or MCCB as per Drawing. Vertical compartment with detachable gland plate shall be kept for incoming cable connections from bottom or top as specified. The gland plate shall be provided with required size and nos. of knockouts.
- Capacitor units shall be mounted on angle frame of strong construction.
- The panel shall be mounted on M.S. channel section at bottom for easy installation.
- The panel shall be provided with lifting hooks / Eye bolts for handling.
- Automatic power factor correction sensing relays (APFCR) shall be provided with all related circuits and contactors for controlling the power factor to max. 0.98 by energizing the contactor and related capacitor bank "ON" or "OFF" as per load conditions.
- The controller shall be set for time lag of 40-60 seconds so that on sensing the low or high power factor it energize or de energize the contactor after 40-60 seconds.
- The Dust and Vermin proof switching compartment shall be isolated from capacitor mounting compartment.
- The panel shall be provided as per the respective drawing.
- The following drawings shall be submitted before procurement for approval from the client / consultant.
 - General arrangement and Fabrication details.
 - Power wiring diagram of capacitor panel.
 - Control wiring diagram of capacitor panel.
 - C.T. connection.
 - Manual for Automatic Power Factor Correction Relay.

MODE OF MEASUREMENT:

Contractor shall be paid for one panel erection as per BOQ Quantities part.

**MEDIUM VOLTAGE 1.1 KV GRADE
XLPE / PVC CABLES**

GENERAL DESCRIPTION

- The Medium voltage cables shall be supplied, laid, connected, tested and commissioned in accordance with the drawings, specifications, relevant Indian Standards specifications, manufacturer's instructions. The cables shall be delivered at site in the original drums with manufacturer's name, size and type clearly written on the drums.
- All cables shall be adequately protected against any risk of mechanical damage to which they may be liable in normal conditions of handling during transportation, loading, unloading etc.
- The cable shall be supplied in single length i.e. without any intermediate joint or cut unless specifically approved by the client.
- The cable ends shall be suitably sealed against entry of moisture, dust, water etc. with cable compound as per standard practise.

MATERIAL

- The MV cables shall be cross linked polyethylene (XLPE) insulated PVC sheathed of 1100 volts grade as asked for in the schedule of quantities. Cables upto 10 sq.mm shall be with copper conductor and 16 sq.mm and above shall be with aluminium conductor.

Technical Requirements:

All XLPE Aluminium/Copper Power cables shall be 1100 Volts grade, multi core constructed as per IS : 7098 Part-I of 1988 as follows :

- Stranded Aluminium /Copper conductor in case of 10 sq.mm. and above whereas solid conductor in case of 10 sq.mm. and below.
- Cores laid up.
- The inner sheath should be bonded over with thermo-plastic material for protection against mechanical and electrical damage.
- Armoring should be provided over the inner sheath to guard against mechanical damage. Armouring should be Galvanised steel wires or galvanised steel strips. (In single core cables used in A.C. system armouring should be non-magnetic hard aluminium Wires/Strips. Round steel wires should be used where diameter over the inner sheath does not exceed 13 mm; above 13 mm flat steel armour should be used. Round wire of different sizes should be provided against specific request.)
- The outer sheath should be specially formulated heat resistant black PVC compound conforming to the requirement of type ST2 of IS : 5831-1984 extruded to form the outer sheath.
- Conductor shall be of electrolytic Aluminium/Copper conforming to IS : 8130 and are compact circular or compact shaped.
- Insulation shall be of XLPE type as per latest IS general purpose insulation for maximum rated conductor temperature 70 degree centigrade.

- In Inner sheath laid up cores shall be bonded over with thermoplastic material for protection against mechanical and electrical damage.
- Insulation, inner sheath and outer sheath shall be applied by extrusion and lapping up process only.
- Uncoated, annealed copper / aluminium, of high conductivity, upto 4 mm² size the conductor shall be solid and above 4 mm² the conductors shall be concentrically stranded as per IEC: 228.
- Repaired cables shall not be used.
- Current ratings of the cables shall be as per IS: 3961.
- The XLPE insulated cables shall conform to latest revision of IS and shall be read along with this specifications. The Conductor shall be stranded Aluminium/Copper circular/ sector shaped and compacted. In multi core cables the core shall be identified by red, yellow, blue and black coloring of insulation.
- The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.
- Progressive automatic in line sequential marking of the length of cables in meters at every one meter shall be provided on the outer sheath of all cables.
- Cables shall be supplied in non returnable wooden drums as per IS: 10418.
- Both ends of the cables shall be properly sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation, storage and erection.
- The product should be coded as per IS: - 7098 Part-I as follows:-

Aluminium Conductor	A
XLPE Insulation	2X
Steel round wire armour	W
Steel strip armour	F
Steel Double round wire armour	WW
Steel Double strip armour	FF
Non-magnetic (Al.) round wire armour	Wa
Non-magnetic (Al.) strip armour	Fa
PVC outer sheath	Y

Core Identifications:

Two core	:	Red and Black
Three core	:	Red, Yellow and Blue
Four core	:	Red, Yellow, Blue and Black
Single core	:	Green, Yellow for earthing.

Black shall always be used for neutral.

Inspection

- All cables shall be inspected by the contractor upon receipt at site and checked for any damage during transit.

Joints in Cables

- The Contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoid cable jointing. This apportioning shall be got approved by the Owner's site representative before the cables are cut to lengths. Where joints are unavoidable heat shrinkable type joints shall be made. The location of such joints shall be got approved from the Owner's site representative and shall be identified through a marker.

Jointing Boxes for Cables

- Cable joint boxes shall be installed with heat shrinkable sleeve and of appropriate size, suitable for XLPE armoured cables of particular voltage rating.

Jointing of Cables

- All cable joints shall be made in suitable, approved cable joint boxes and the filling in of compound shall be done in accordance with manufactures' instructions and in an approved manner. All straight through joints shall be done in epoxy mould boxes with epoxy resin.
- All cables shall be joined colour to colour and tested for continuity and insulation resistance before jointing commence. The seals of cables must not be removed until preparations for jointing are completed. Joints shall be finished on the same day as commenced and sufficient protection from the weather shall be arranged. The conductors shall be efficiently insulated with high voltage insulating tape and by using of spreaders of approved size and pattern. The joints shall be completely topped up with epoxy compound so as to ensure that the box is properly filled.

Cable End Terminations

- Cable end termination shall be done in cable terminal box using crimping sockets and proper size of glands of double compression type.
- Solderless crimping type Aluminium/Cu lugs conforming to IS suitable for cable size evenly crimped with high pressure tool & connected to switchgear terminals with brass/cadmium plated nut bolts in an approved manner.

Bonding of Cables

- Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armour clamp and gland. The clamps must grip the armouring firmly to the gland or casing, so that no undue stress is passed on to the cable conductors.

Cable Installation in Cable Trays and Cable Trenches.

- Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming kinks.

Laying of Cables on Cable Trays

- The relative position of the cables, laid on the cable tray shall be preserved and the cables shall not cross each other. At all changes in direction in horizontal and vertical planes, the cable shall be bent smooth with a radius as recommended by the manufacturers. All cables shall be laid with minimum one diameter gap and shall be clamped at every meter to the cable tray. Cables shall be tagged for identification with aluminium tag and clamped properly at every 20M. Tags shall be provided at both ends and all changes in directions both sides of wall and floor crossings. All cable shall be identified by embossing on the tag the size of the cable, place of origin and termination.
- All cables passing through holes in floor or walls shall be sealed with fire retardant Sealant and shall be painted with fire retardant paint upto one meter on all joints, terminations and both sides of the wall crossings by **“VIPER CABLE RETARD”**.

Laying of Cables in Ground

- Cable trench shall be dug to the minimum depth of 1 mtr and the width shall dependent on the no of cables to be kept with the layer of brick in between two cables.
- **Excavation of trenches** : The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided. Where gradients and changes in depth are unavoidable, these shall be gradual. The excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench. The bottom of the trench shall be levelled and shall be made free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 100 mm in depth. Prior to laying of cables, the cores shall be tested for continuity and insulation resistance. The cable drum shall be properly mounted on jacks, at a suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum and the spindle is horizontal. Cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire drum length shall be laid in one stretch. However, where this is not possible the remainder of the cable shall be removed by 'Flaking' i.e. by making one long loop in the reverse direction. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted off the rollers beginning from one end by helpers standing about 10 meters apart and laid in a reasonably straight line. Cable laid in trenches in a single tier formation shall have a cover of clean, dry sand of not less than 150 mm. above the base cushion of sand before the protective cover is laid. In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 300 mm shall be provided over the initial bed before the second tier is laid. Finally the cables shall be protected by second class bricks before back filling the trench. The buried depth of uppermost layer of cable shall not be less than 750mm.

Back Filling : The trenches shall be back filled with excavated earth free from stones or other sharp edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 300 mm. Unless otherwise specified, a crown of earth not less than 50 mm in the centre and tapering towards the sides of the trench shall be left to allow for subsidence.

Route Marker

- Route marker shall be provided along straight runs of the cables not exceeding 30 meters also for change in the direction of the cable route and underground joints.
- Route marker shall be of cast iron painted with aluminium paint. The size of marker shall be 100 mm dia with "Cable" and voltage grade inscribed on it.

Cable Trays

- Cable Trays shall be Galvanized and factory fabricated out of MS channels, angle iron, tee, bends, sections, flats and perforated sheet for different loads and number and size of cables as given below :
- Cable trays shall be galvanized and size as per BOQ.

Specification for Hot Dip Galvanizing Process for Mild Steel Used For Earthing, Cable Trays Or Junction Boxes For Electrical Installation.

General Requirements

I. Quality of Zinc

Zinc to be used shall conform to minimum Zn 98 grade as per requirement of IS: 209-1991.

II. Coating Requirement

- Minimum weight of zinc coating for mild steel flats with thickness upto 6 mm in accordance with IS:6745-1972 shall be 400 g/sqm.
- The weight of coating expressed in grams per square metre shall be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface.
- The Zinc coating shall be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs; rust stains bulky white deposits, blisters.
- Mild steel flats / wires shall undergo a process of degreasing pickling in acid, cold rinsing and then galvanizing.

Testing of Cables

- Cables shall be tested at works for all routine tests as per IS including the following tests before being dispatched to site by the project team.
 - a) Insulation Resistance Test.
 - b) Continuity resistance test.
 - c) Sheathing continuity test.
 - d) Earth test.(in armoured cables)
 - e) Hi Pot Test.

- Test shall also be conducted at site for insulation between phases and between phase and earth for each length of cable, before and after jointing. On completion of cable laying work, the following tests shall be conducted in the presence of the Owner's site representative.
 - f) Insulation Resistance Test(Sectional and overall)
 - g) Continuity resistance test.
 - h) Sheathing continuity test.
 - i) Earth test.
- All tests shall be carried out in accordance with relevant Standard Code of Practice and Electricity Rules. The Contractor shall provide necessary instruments, equipment and labour for conducting the above tests and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Owner's site representative, results will be noted and signed by all present and record be maintained.

WORKMANSHIP

- Cables shall be laid in the routes marked in the drawings. Where the route is not marked, the Contractor shall mark it out on the drawings and also on the site and obtain the approval of the CLIENT AND/OR ITS ARCHITECT before laying the cable. Procurement of cables shall be on the basis of actual site measurements and the quantities shown in the schedule of work shall be regarded as a guide only.
- Cables shall be laid on walls, cable trays, inside shafts or trenches. Saddling or support for the cable shall not be more than 500 mm apart. Plastic identification tags shall be provided at every 30 m.
- Cables shall be bent to a radius not less than 12 (twelve) times the overall diameter of the cable or in accordance with the manufacturer's recommendations whichever is higher.
- In the case of cables buried directly in ground, the cable route shall be parallel or perpendicular to roadways, walls etc unless marked on drawing by architect / consultant. Cables shall be laid on an excavated, graded trench, over a sand or soft earth cushion to provide protection against abrasion. Cables shall be protected with brick or cement tiles on all the three sides as shown on drawings. Width of excavated trenches shall be as per drawings. Back fill over buried cables shall be with a minimum earth cover of 750 mm to 1000 mm. The cables shall be provided with cables markers at every 10 meters and at all loop points.
- All cables shall be full runs from panel to panel without any joints or splices. Cables shall be identified at end termination indicating the feeder number and the Panel/Distribution board from where it is being laid. Cable termination for conductors up to 4 sq.mm. may be insertion type and all higher sizes shall have compression type lugs. Cable termination shall have necessary brass glands. The end termination shall be insulated with a minimum of six half-lapped layers of PVC tape. Cable armouring shall be earthed at both ends.
- In case of cables entering the buildings. It would be done duly only through pipes. The pipes shall be laid in slant position, so that no rainwater may enter the building. After the cables are tested the pipes shall be sealed with M. seal & then tarpaulin, shall be wrapped around the cable for making the entry watertight.
- Testing : MV cables shall be tested upon installation with a 500 V Meggar and the following readings established:

- Continuity on all phases.
- Insulation Resistance.
- between conductors.
- all conductors and ground.
- All test readings shall be recorded and shall form part of the completion documentation.
- Cable joints shall be done as per regular practice and check shall be carried out for loose connections and leakages. Insulation cutting shall be done properly taking care that no area of the conductor remains exposed. Crimping shall be done with the help of hydraulic tool. Proper insulation tape shall be applied at the cable and lug joint.

➤ Format for cable testing certificate :

- a. Drum no. from which cable is taken :
- b. Cable from _____ to _____
- c. Length of run of this cable _____ mtr
- d. Insulation resistance test
 - between core 1 to earth _____ mega-ohm
 - between core 2 to earth _____ mega-ohm
 - between core 3 to earth _____ mega-ohm
 - between core 1 to core 2 _____ mega-ohm
 - between core 2 to core 3 _____ mega-ohm
 - between core 1 to core 3 _____ mega-ohm
 - duration used:
- e. High voltage test: Voltage Duration
 - between core and earth
 - between individual cores

- The cable shall be laid side by side in trench with brick covering on all the three sides. The trench shall be such that sharp bends shall be avoided while laying the cable. The bedding of fine sand under the cable shall be not less than 6 mm. The trench shall be terminated in Manholes with specified size of R.C.C. hume pipes as shown in drawing. Cable markers shall be provided through out the route of cable at 10 mtrs distance. The trenches shall be refilled after the cable are laid and the Ground level shall be done as per original after pressing the same. The cables shall be checked for insulation resistance and continuity tests shall be carried out.

MODE OF MEASUREMENT:

1. Mode of Measurement for Cable Trench & Cable Tray.

- The cable laying shall be measured in rmt. The trenches dug and refilled shall be measured in cu. Mtr. The bricks and sand bedding shall be measured in rmt. The cable trays shall be measured in rmt.

1. Mode of Measurement for Cable and Cable End Terminations.

- The cables shall be measured in rmt and terminations on unit basis.

DISTRIBUTION BOARDS:

GENERAL DESCRIPTION

- Distribution Boards (DBs) shall be suitable for operation on 3 Phase/single phase, 415/240 volts, 50 cycles, neutral grounded at transformer. The DB shall be minimum dielectric strength of 1.5 KV / Sec. All Distribution Boards shall be manufactured by a manufacturer listed in Appendix-I.
- LDB's shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per IS-13947-1991.

CONSTRUCTION FEATURES

- DB's shall be made out of 1.6 mm thick high quality CRCA sheet steel and shall be pre-treated and powder coated sheet steel used in the construction of LDB shall be folded and braced as necessary to provide a rigid support for all component. DB shall be suitable for indoor / outdoor installation, wall mounting free standing type, in double door construction. The Final Distribution Boards shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors, Neoprene gasket, padlocking arrangement. All removable/ hinged doors and covers shall be grounded by 1.0 sqm tinned stranded copper connectors. Final Distribution Boards shall be suitable for the climatic conditions. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to IS-8623-1977 (Part-1) for factory built assembled switchgear & control gear for voltage upto and including 1100 V AC.
- All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self threading screws shall not be used in the construction of LDBs.
- Knockout holes of appropriate size and number shall be provided in the LDB's in conformity with the location of cable/conduit connections. Detachable sheet steel gland plates shall be provided at the top / bottom to make holes for additional cable entry at site if required.

Distribution Boards shall comprise of the following:

- A panel for mounting where appropriate incoming supply circuit breaker & other auxiliaries for Control & distribution as required.
- Installations accessories shall be part of the DB for fixing conductor and rails for mounting MCB's and RCCB's etc. Neutral bus bars & earthing bus bars required in the circuit. All busbars in the LDB shall be insulated type.
- Service cable /interconnection shall be part of the Distribution Boards.
- The board shall be installed at a height such that the operating is within reach of the normal human height i.e. 1.2 to 1.8 meters from finish floor level.
- Degree of protection shall be IP-52 for indoor application, IP-54 for kitchen & laundry and IP-55 for outdoor application.
- All three phase distribution boards shall have 4 rows and single phase distribution boards shall have single rows for housing of MCB's and RCCB's unless noted otherwise.
- Phase segregation to be maintained in all three phase distribution boards.
- Earthing shall be provided in each LDB's.

Miniature Circuit Breaker (MCB)

- MCB's shall have quick make and break no welding self-wiping silver alloy contacts for 10 KA short circuit both on the manual and automatic operation. Each pole of the breaker shall be provided with inverse time thermal over load and instantaneous over current tripping elements, with trip free mechanism. In case of multi-pole breakers, the tripping must be on all the poles and operating handle shall be common. Breakers must confirm to BS 3871 with facility for locking in OFF position. Pressure clamp terminals for stranded/solid conductor insertion are acceptable up to 4 sq.mm. Aluminium or 1.5 sq.mm. Copper and for higher ratings, the terminals shall be suitably shrouded. Wherever MCB isolators are specified they are without the tripping elements.

Residual Current Circuit Breaker Current Operated Type (RCCB)

- The RCCB should suffices all the requirements of IS as per code IS - 12640 - 1988. The RCA should be current operated and not on line voltage.

The RCCB should ensure mainly the following functions:

- Measurement of the fault current value.
- Comparison of the fault current with a reference value.
- The RCCB should have a torroidal transformer which has the main conductors of primary (P - N) which check the sum of the current close to zero.
- All metal parts should be inherently resistant to corrosion and treated to make them corrosion resistant.
- It should be truly current operated.
- It should operate on core balance torroidal transformer.
- Its accuracy should be $\pm 5 \%$.
- It should operate even in case of neutral failure.
- It should trip at a present leakage current within 100 mA
- Its enclosure should be as per IP 30.
- Its mechanical operation life should be more than 20,000 operations.
- It should provide full protection as envisaged by IE rules - 61-A, 71 - ee, 73 - ee, 1985 and also rule 50 of IE rule1956.
- It should conform to all national and international standards like IS: 8828-1993, IS: 12640-1988, BS 4293 - 1983, CEE 27 (International commission Rules for the approved of electrical equipment).

EARTHING

- Earthing shall be provided as per IS:3043-1987.

PAINTING

- All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivating (seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be of Siemens gray paint shade no. RAL-7032 of IS Code No.5.

LABELS

- Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the distribution panels shall be pasted on inside of the panel door and covered with transparent plastic sheet.

TESTING

- Testing of panels shall be as per following codes:
 - IV. IS: 8623 (Part -I) 1977 for factory built assemblies of switch gear for voltages upto and including 1000 VAC.
 - V. IS: 13947 : 1993 Degree of protection

WIRING

- In wiring a distribution panel it shall be insured that total load of various distribution panel and/or consuming devices is divided evenly between the phases and number of ways as per Consultants drawing.

WORKMANSHIP:

- The D.B. shall be properly grouted in the wall in concealed manner taking care that the powder coating is not scratched and dents are not formed on the D.B. The MCBs and ELCBs. In the distribution boards shall be fixed as per the circuit details provided. All the wires terminating in the MCBs and the ELCBs shall be lugged for proper contact and ferrules depicting the circuit nos shall be provided. D.B.s mounted in concealed manner shall have a groove around it so as to save the finish of the plaster and colour during future opening of the door. The distribution boards shall have circuit chart tagged on the door for future maintenance. Danger notice plates shall be fitted to the distribution boards with screws and not stuck so as to assure its presence for a longer duration.

MODE OF MEASUREMENT:

- The distribution boards shall be measured in Nos and the MCBs and ELCBs shall be measured in Nos separately.

INTERNAL WIRING

SYSTEM OF WIRING

- The system of wiring shall consist of PVC insulated copper stranded conductor flexible FRLS wires in metallic / non metallic (Rigid heavy Duty ISI -marked fire retarded PVC Conduits of minimum 2mm Wall thickness and Sizes starting from 20 mm diameter) conduits and shall be concealed or surface mounted above false ceiling as called for.

GENERAL DESCRIPTION

- Prior to laying and fixing of conduits, the contractor shall mark the conduit route, carefully examine the working drawings prepared by him and approved by the Consultant indicating the layout, satisfy himself about the non interference in the route, sufficiency of number and sizes of conduits, location of junction boxes, sizes and location of switch boxes and other relevant details. Any discrepancy found shall be brought to the notice of the Owner's site representative. Any modifications suggested by the contractor should get written approval before the actual laying of conduits is commenced.
- In laying of conduits it is important that not more than two right angle bends are provided for each circuit without a pull box. No junction box shall be provided in the entire length of conduit run for drawing of wires. Only switch outlets, lighting fixture outlets, equipment power outlets and socket outlets shall be considered for drawing of wires.

LIGHTING & POWER WIRING

- All final branch circuits for lighting and appliances shall be single conductor/ stranded/ flexible wires run inside conduits. The conduit shall be properly connected or jointed into sockets, bends, and junction boxes.
- Branch circuit conductor sizes shall be as shown in the schedule of quantities and or drawings.
- All circuits shall preferably be kept in a separate conduit up to the Distribution Board. No other wiring shall be bunched in the same conduit except those belonging to the same phase. Each lighting branch circuit shall not have more than ten outlets or 800 watts whichever is lower. Each conduit shall not hold more than three branch circuits.
- Flexible cords for connection to appliances, fans and pendants shall be 650/1100 V grade (three or four cores i.e. with insulated neutral wire of same size) with tinned stranded copper wires, insulated, twisted and sheathed with strengthening cord. Colour of sheath shall be subject to the CLIENT AND/OR ITS ARCHITECT'S approval.
- Looping system of wiring shall be used. Wires shall not be jointed. Where joints are unavoidable, they shall be made through approved mechanical connectors. No such joints shall be made unless the length of the sub-circuit, sub-main or main is more than the length of the standard coil.
- Control switches shall be connected in the phase conductors only and shall be 'ON' when knob is down. Switches shall be fixed in 3 mm. thick painted or galvanized steel boxes with cover plates as specified. Cadmium plated brass screws shall be used.
- Power wiring shall be distinctly separate from lighting wiring. Conduits not less than 25 mm. and wires not less than 1.0 sq.mm. copper shall be used.

- Every conductor shall be provided with identification ferrules at both ends matching the drawings.

TESTING

- The entire installation shall be tested for:
 - Insulation resistance.
 - Earth continuity.
 - Polarity of single pole switches.
- All the wiring switch board, outlet points shall be done in a concealed manner in wall & slab in PVC conduit of minimum 25 mm dia. (medium gauge) & with 650v / 1100v grade PVC insulated flexible copper conductor wire. The switches should be modular with moulded cover plates, blank plates for outlet boxes. The accessories, connectors, sockets, should be fixed with brass chrome / cadmium plated machine screw. For fan points the rates should be with hum - free type 300 W regulators as required to complete the point wiring. The wiring shall be as per IS: 732 and IS: 4648. The wiring shall be done in a looping manner so as to avoid junction boxes at any place. All the looping shall be done only in the switchboard and outlet points. The size of the wire shall be as per the specification. Colour code shall be strictly followed.
- The size of wires shall as follow as per BOQ and as per clients requirements:
- Light, fans, exhaust fan, 5 Amp. On board plug point, two way light points, bell point etc from switch to outlet.
 - Phase / Neutral 1.0 m m²
 - Earth 1.0 m m²
- From D.B. to switch board – lighting / 5 A socket etc – i.e. circuit mains part of point wiring
 - Phase / Neutral 1.0 m m²
 - Earth 1.0 m m²
- Separate pipes shall be laid for off wires and circuit mains.
- Circuit mains of same phase shall be drawn in one pipe with prior permission/discussion with the consultant.
- Separate phase, neutral and earthing wire of sizes recommended by consultant shall be drawn for each and every circuit mains.
- Mains for lighting and on board plug points shall be of one-size higher wires than those used in off.

COMPUTER WIRING :

- Wiring for short extensions to outlets in hung ceiling or to vibrating equipments, motors etc., shall be installed in flexible conduits. Otherwise rigid conduits shall be used. No flexible extension shall exceed 1.25 m.
- Conduits run on surfaces shall be supported on metal 12 mm. thick G.I. pressure saddles which in turn are properly screwed to the wall or ceiling. Saddles shall be at intervals of not more than 500 mm. Fixing screws shall be with round or cheese head and of rust-proof materials. Exposed conduits shall be neatly run parallel or at right angles to the walls of the building.

Unseemly conduit bends and offsets shall be avoided by using fabricated mild steel junction/pull through boxes for better appearances. No cross-over of conduits shall be allowed unless it is necessary and entire conduit installation shall be clean and neat in appearance.

- Conduits embedded into the walls shall be fixed by means of staples at not more than 500 mm. intervals. Chases in the walls shall be neatly made and refilled after laying the conduit and brought to the finish of the wall but the building Contractor will do final finish.
- Conduits buried in concrete structure shall be put in position and securely fastened to the reinforcement and got approved by the CLIENT AND/OR ITS ARCHITECT, before the concrete is poured. Proper care shall be taken to ensure that the conduits are neither dislocated nor choked at the time of pouring the concrete suitable fish wires shall be drawn in all conduits before they are embedded.
- Where conduit passes through expansion joints in the building, adequate expansion fittings shall be used to take care of any relative movement.
- Inspection boxes shall be provided for periodical inspection to facilitate withdrawal and removal of wires. Such inspection boxes shall be flush with the wall or ceiling in the case of concealed conduits. Inspection boxes shall be spaced at not more than 12 meters apart or two 90° solid bends or equal. All junction and switch boxes shall be covered by 6 mm clear plate. These junction boxes shall form part of point wiring or conduit wiring as the case may be including the cost of removing the cover for painting and re-fixing. No separate charges shall be allowed except where specially mentioned.
- Conduits shall be free from sharp edges and burrs and the threading free from grease or oil. The entire system of conduits must be completely installed and rendered electrically continuous before the conductors are pulled in. Conduits should terminate in junction boxes of not less than 32 mm. deep.
- An insulated earth wire of copper rated capacity shall be run in each conduit.

The point definition shall be conduiting and wiring from D.B. to S.B. and there from to final outlet point including switches and accessories, junction boxes, fan boxes, zarri work with cement –sand etc of approved make.

CONDUCTORS

- All PVC insulated copper conductor flexible FRLS wires shall conform in all respects to Standards as listed under sub-head Indian Standards and shall be IS approved and ISI marked.

BUNCHING OF WIRES

- Wires carrying current shall be so bunched that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not run in the same conduit. All wires shall have ferrules for identification. Lighting and power circuits shall be separate. Each Power/ Light Circuit's Neutral shall be individual per Circuit and shall not be looped from any other Circuit.

LOAD BALANCING

- Balancing of circuits in three phase installation shall be as planned by the Consultants in the tender drawings and shall be checked by the contractor before the commencement of wiring and shall be strictly adhered to.

COLOUR CODE OF CONDUCTORS

- Colour code shall be maintained as indicated by the Consultant for the entire wiring installations. Red, yellow, blue shall be for three phases, black for neutral and green with yellow band shall be for earthing.

WORKMANSHIP

Drawing Conductors

- The drawing and jointing of PVC insulated copper conductor wires shall be executed with due regard to the following precautions. While drawing wires through conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. There shall be no sharp bends. Wire reel stands to be used for pulling of wires to avoid kinks. Care shall be exercised while drawing the wires from reels, by taking appropriate measures to ensure that wires are not spread on ground, causing dust and dirt accumulation on the new wires.
- Maximum permissible number of 1100 volt grade PVC insulated wires that may be drawn into rigid non metallic or PVC Conduits are given below:

Size of wires Nominal Cross Section Area (Sq. mm.)	Maximum number of wires within conduit size(mm)				
	20	25	32	40	50
1.5	7	12	16	--	--
1.5	5	10	14	--	--
4	4	8	12	--	--
6	3	6	8	--	--
10	--	4	5	6	--
16	--	3	3	6	6
25	--	--	2	4	6
35	--	--	--	3	5

- Insulation shall be removed by insulation stripper only. Few Strands of wires shall not be cut/reduced for convenience in connecting into terminals. The terminals shall have sufficient cross sectional area to take all strands and it's connecting brass screws shall have flats ends. All looped joints shall be connected through terminal block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. All light points shall be terminated through a connector.
- Only licensed wiremen (Before doing the work or before appointing him on site contractor has to submit his wiring licence to Owner) and cable jointers shall be employed to do jointing work. Before entrusting cable jointing work to any technician, or before appointing Cable Jointers or Wiremen on Site, Contractor has to submit such Technicians' / Wireman's / Cable Jointer's licence to Owner.
- All wires and cables shall be embossed with the manufacturer's label with ISI mark and shall be brought to site in original packing. For all internal wiring. PVC insulated wires of 1100 volts grade (FRLS) shall be used.
- The sub-circuit wiring for point shall be carried out in loop system and no joints shall be allowed in the length of the conductors. No wire shall be drawn into any conduit until all defective work of conduit installation of any nature that may cause injury to wire is

completed. Care shall be taken while pulling out the wires so that no damage occurs to conduits/wire itself, the conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction. The minimum size of PVC insulated copper conductor wires for all sub-circuit wiring for light points shall be minimum 1.0 sq.mm copper. Separate neutral to be pulled for each circuit.

- Conduits shall be kept at a minimum distance of 100 mm. from the pipes of other non-electrical services. And maintain minimum 300 mm distance between telephones, TV & Computer piping.
- Separate conduits/raceways shall be used for following points as applicable and as requirements of site conditions:
 - Normal lights and 5 A 3 pin sockets on lighting circuit.
 - Separate conduit shall be laid from D.B. to switch board.
 - Power outlets - 15 A 3 pin 20 A/30 A, 2 pin scraping earth metal clad sockets.
 - Emergency lighting.
 - Telephones.
 - Fire alarm system.
 - Public address system & Music system.
 - For all other voltages higher or lower than 230 V.
 - T.V. Antenna.
 - Water level guard.

Fish Wire

- To facilitate subsequent drawing of wires in the conduit, GI fish wires of 1.0 mm (14 SWG) shall be provided along with the laying of recessed conduit.

MODE OF MEASUREMENT

- The items shall be measured on unit basis or on mtr basis as per BOQ.

LIGHTING FIXTURES & ACCESSORIES

GENERAL DESCRIPTION

- The light fixtures and fittings shall be assembled and installed in position complete and ready for service, in accordance with details, drawings, manufacturer's instructions and to the satisfaction of the Project Manager site requirements.

SCOPE

- Scope of work under this section shall include inspection at suppliers/manufacturer's premises at site, receiving at site, safe storage, transportation from point of storage to point of erection, erection and commissioning of light fittings, fixtures and accessories including all necessary supports, brackets, down rods and painting etc as required.

WORKMANSHIP:

- The fixture shall be installed on wall / ceiling as directed and as per manufacturer's instruction, with necessary accessories for surface, concealed, suspended from ceiling, bracket mounting etc. The job also includes connection of fixture with respective outlet point with heat resistant wires through heat resistance sleeve and PVC connector. The exhaust fan shall be installed complete with M.S. angle iron mounting frame/ ring, G.I. louvers, wire mesh and plug at the end of the cord including wiring & earthing etc. Proper earthing shall be provided to the fixtures.

MODE OF MEASUREMENT:

- The unit rate shall be considered for fitting one fixture. The rate shall include following
 - All fixing accessories, mounting bracket, ballast condensers and control gear wherever applicable.
 - Supplying and fixing Ball and socket joints wherever required.
 - Earthing of fittings.
 - Electrical connections to fittings/fans from the junction box/ceiling rose.
 - Installation and interconnection of Electronic regulators for ceiling fans.
 - Supplying and fixing 300 mm. GI down rod for ceiling fans.

PUBLIC ADDRESS SYSTEM

GENERAL :

- The scope of work shall cover the supply and installation of the Background music / Public address system for the whole premise.
- Each system installed shall provide for the distribution of one program diffused by a microphone, a tuner or a cassette player or a CD player.

SCOPE OF SUPPLY:

- The background music / public address system shall include the supply and installation of the following items, as well as their connection, testing and commissioning.
- The public address system of the premise shall be composed of following items.

- a) A control panel that may be incorporated in the rack or supplied separately as a desk.

It shall comprise of :

- Microphone Preamplifier
- 3 input (Microphone, cassette player / CD player) channel selector panel
- Cassette player
- Tuner
- Power amplifier
- Monitor loudspeaker
- Level meter
- Horn loud speaker selector panel with illuminated push button switches
- Power supply unit with master switch

- b) Table stand type microphone.

- The distribution circuits and connections between rack amplifiers and the control station.
- The distribution circuits and connections between the loudspeakers and the control station.
- All the accessories and materials not mentioned here above but considered necessary for the functioning of the installation.
- The level controller should be volume control cum switch type and mounted on M.K. plate after getting approval from Consultant.

CASSETTE PLAYER :

- The cassette player shall be designed for standard rack mounting and shall have the following characteristics.
- Number of tracks : 2
- Tape speed : 1 7/8 ips (4.76 cm/sec.)
- Vow and flutter 0.3%
- Signal-to-noise ratio 40 dB
- Frequency range : 60 - 10,000 Hz. \pm 3 dB
- Playing time : minimum 12 hours

POWER AMPLIFIERS AND PREAMPLIFIERS :

- All amplifiers shall be mixing type for combining speech and music.
- The power amplifiers shall have adequate continuous (RMS) power output to meet the requirement of the configuration. The unit shall be capable of delivering the rated output watts with less than 0.05% harmonic distortion in the design bandwidth. The amplifier shall have a broad band frequency response of 20 Hz to 20 KHz. The output voltage and impedance shall meet with the system requirements. Amplifiers shall be protected against over loads and output shorts and a special thermal overload on the heat sink.
- The distributed audio amplifiers shall be magnetically coupled switch mode type with two input signal sources selectable manually or automatically by the fire alarm system. Output wattage shall be as shown in the schedule of work or as required to meet the needs of the PA System.
- Power as well as audio amplifiers shall be mounted in suitable wall mounted / floor standing enclosures.
- They shall be designed for standard rack mounting.
- The preamplifier shall have the following characteristics :
 - 3 Universal input channels, all adjustable and transferable for connections to the microphone, the cassette player and the tuner.
 - Treble and bass tone control.
 - Output power to suit frequency range : 40 - 15000 Hz. \pm dB
 - Harmonic distortion : less than 0.05% at the nominal power and at 1000 Hz.
 - Noise level : 70 dB
 - Maximum consumption : 300 VA

CONTROL PANEL :

The control panel shall be equipped with :

- One loudspeaker with volume control
- One volume control for the distribution
- A VU meter
- The various selectors for branching the different sources to the preamplifier
- Selector switch for selecting different areas.
- One master switch to connect the equipment to the mains with an indicating light and a protection fuse for the whole installation.

MICROPHONE :

- The microphone shall be of the electro dynamic type. The frequency range shall be 60 - 15000 Hz.
- Type required : Gooseneck type

LOUDSPEAKER FOR PUBLIC ADDRESS SYSTEM :

- Speakers shall be especially designed for broadcasting high quality, integrated emergency fire alarm signals and voice communications and approved by an appropriate authority for use in such situations.
- Speakers shall be ceiling or Column mounted as shown in the schedule of work and shall be completed with mounting brackets accessories etc. Speakers shall be in wooden or metal enclosures.
- Speakers shall have a line-matching transformer for direct connection to amplifiers with multiple taps. Speakers shall be mounted in a rugged metal housing with vandal resistant grille if specified.
- Speakers shall be interconnected in the zone configuration.
- They shall be of a good quality having a frequency range between 150 and 9000 Hz., a power of 4/6/12 W each and a diameter of 6 inches.
- Every loudspeaker shall be installed in an appropriate casing, it shall be fitted with a decorative protection grill and a plastified cloth to protect the unit against dust and humidity. It shall be supplied with the necessary matching transformer.
- The loudspeaker should be black / white as specified and should be powder coated.

TESTING / INSPECTION :

- Tests shall comply with British Standard specifications and approved by Consultant.
- Factory inspection : the contractor shall submit inspection certificate before commencing the installation of equipment.
- Entire PA system shall be tested to establish the following.
 - a) Functionality of the PA system
 - b) Combined systems shall be tested for the overriding feature for prioritizing fire alarm and life safety requirements.
 - c) Acceptable audibility of the public address in all spaces and record sound pressure levels of the Public address viz a viz the ambient noise levels.

MAINTENANCE :

- Guarantee and maintenance period : one year from the completion date.
- When maintenance period starts the contractor should arrange special training for two employees of the user with the makers, or suppliers to deal with more good maintenance and operation.
- The contractor shall comply with the general maintenance requirements.

- The one year maintenance period and guarantee contract shall be on “NO CHARGE” basis. The contractor shall cover, all regular monthly servicing, and testing of equipment, if necessary supply and replacement of faulty parts.
- The cost of above shall be included in the main equipment and not priced separately.

SPARES :

- The contractor shall supply spare parts for the two years maintenance of complete sound system as specified in this section. The contractor shall submit alongwith his offer the list of such spare parts as recommended by the manufacturer. The recommended spares shall be supplied at “NO CHARGE” basis and the cost for each spares shall be included in the main equipment price.

P A System Wiring

- PA system wiring shall be done with 2 X 0.75sq.mm cable in 19mm dia PVC conduit including termination complete as required.
- The speakers in each zone are connected in parallel and are connected to the respective output. The cables from each zone are separately routed and terminated in the Panel.

WORKMANSHIP:

- Guarantee and maintenance period: one year from the completion date.
- When maintenance period starts the contractor should arrange special training for two employees of the user with the makers, or suppliers to deal with more good maintenance and operation.
- The contractor shall comply with the general maintenance requirements.
- The one year maintenance period and guarantee contract shall be on “NO CHARGE” basis. The contractor shall cover, all regular monthly servicing, and testing of equipment, if necessary supply and replacement of faulty parts.
- The cost of above shall be included in the main equipment and not priced separately.
- The contractor shall supply spare parts for the two years maintenance of complete sound system as specified in this section. The contractor shall submit along with his offer the list of such spare parts as recommended by the manufacturer. The recommended spares shall be supplied at “**NO CHARGE**” basis and the cost for each spares shall be included in the main equipment price.

MODE OF MEASUREMENT:

- The measurement shall be considered for quantities as per BOQ attached in the form of units for Speakers, microphone, etc and of Mtrs for Cables and Conduits.

CCTV SYSTEM

SYSTEM DESIGN AND ARCHITECTURE

CCTV system should be designed such as to cover the strategic locations and sensitive areas for comprehensive surveillance and monitoring. This shall necessarily be of High resolution IP (Network) type as per the attached specifications. Also the systems should utilize only industry standard protocols and no proprietary protocol is acceptable.

All cameras, as per the specifications mentioned below, shall be terminated using suitable grade of network cables and terminated to the main control room where it gets terminated to the network switch and .

32 Channel Embedded shall be capable to record real time video for all channels, as per the specification mentioned below, and gets integrated with the embedded matrix controller which has as capability to show the multiplexed views on the dedicated 6 monitors connected with matrix system.

Training on the system should be carried by the contractor after the commissioning of the system and shall essentially cover the following topics:

- A. Overview of the equipments and system design
- B. Operation of the system
- C. Programming of the system
- D. First level maintenance of the system
- E. Tips on preventive maintenance during and after the warranty period.

FULL BODIED CAMERA WITH VARIFOCAL LENS AND OUTDOOR ENCLOSURE

GENERAL SPECIFICATIONS:

The product specified shall be super high resolution day & night camera of minimum 1.3 Mega Pixel (720 P). The camera consists of 1/3" Megapixel Low light CMOS. Camera should be CE certified.

The camera shall have an outstanding Black Mask Backlight Compensation, which ensures outstanding overall image quality, by masking, when part of a subject is under especially strong light.

TECHNICAL SPECIFICATIONS

Imaging Device:	1/3" Megapixel Low light CMOS
Effective Pixel:	720P 1280*720 D1:640*480 CIF:320X240
Min. illumination:	0.1lx (30 IRE, AGC OFF)
Support Protocol:	TCP, UDP, IP, HTTP, FTP, SMTP, DHCP, DNS, ARP, ICMP, POP3, NTP, IPSec UPnP, RTP, and RTCP
BLC:	ON/OFF
AGC:	LOW/HIGH
White Balance Mode:	ATW, AWC / One Push lock
Adjustable Shutter:	1/50s ~1/100,000s
Lens Mount:	C/CS Mount include 2.8-12mm varifocal lens
Support Multi-Screen software and CMS	
Dual stream encoding (H.264/MJPEG)	

ELECTRICAL SPECIFICATIONS

Power: DC 12 V +/- 2V
output: RJ-45, Audio, alarm

ENVIRONMENTAL SPECIFICATIONS

Humidity: 0% to 90% RH non-condensing.
Operating temperature: -10°C to +50°C;
Storage temperature: -20°C to +70°C

DIGITAL VIDEO RECORDER

DIGITAL VIDEO RECORDER GENERAL DESCRIPTION

The product specified is an integrated product meeting the functional requirements of multiplexer, Network digital video recorder. The allows powerful Pentaplex features like simultaneous recording, playback, backup, remote monitoring and remote playback. It should offer internal storage on Hard disk and external storage through backup interface on e-SATA, should support instant copy media like USB compact flash memory.

NETWORK DIGITAL VIDEO RECORDER SPECIFICATIONS

The shall record multiple camera signals while simultaneously providing live multiscreen viewing and playback.

NVR should be capable of handling 32 video inputs with Dual stream encoding (H.264/MJPEG) .

NVR should have a 32bit RISC CPU Controller and Linux based Operating System.

NVR should provide a real time live display (800 fps) and should record minimum 480/400 frames per second.

NVR should support multiple resolution i.e CIF, 2CIF, 4CIF,720P.

NVR should support external storage via e-SATA interface.

NVR should be capable to control through IR remote and three-axis joystick controller.

The NVR shall provide the following two modes of recording:

1) Continuously record to the disk until it is full, and then start overwriting the oldest data.

2)Record to the disk and provide a warning when the disk is nearly full, and then stop when the disk is full. Display a disk-full alert on the main monitor and sound an alarm beeper.

The NVR shall contain an internal video motion detector function that triggers an alarm when movement within a user-defined area of the image is detected.

NVR should have PTZ controls keys on the NVR front control panel.

HDMI or YPbPr output at 1920×1080 resolution

Support 32 channels 720P 16 channels 1080P input,

And 8 channels 1080P synchronous playback

Support ID CAMs CDS threshold value setup

Windows CMS is free, software supports up to 64 NVRs connecting at the same time.

Five mobile OS supported, Build-in DDNS domain name.

Support keyboard connect.

Well-done lightning protection. No image interference.

Easy cabling and maintaince. NVR with similar functions as DVR.

ELECTRICAL SPECIFICATIONS:

- The NVR shall meet or exceed the following specifications:
 - Rated voltage: 90-240 VAC 50/60Hz.
- Video standard: NTSC or PAL unit. 32-ch 720P
- Outputs: VGA, HDMI.
- Compression: H.264/MJPEG
- Backup ports: USB
- Control Ports: RS-232 , RS-422/485
- Alarm I/O: 4 and 4
- IR Remote Controller to be provided with NVR
- Display Speed 480/400 fps, Recording 480/400 fps
- The NVR should be factory manufactured and not an assembled one to ensure product compatibility and reliability
- The NVR should be embedded and not PC based
- The NVR should be CMS windows, I mac
- The NVR should support minimum Hard disk 8 X 3TB

ENVIRONMENTAL SPECIFICATIONS:

- Temperature: Operating: +5°C to +40°C
- Relative Humidity: Operating: <93% non-condensing.
- SAFETY LISTINGS: CE/FCC

MODE OF MEASUREMENT

- The items shall be measured on unit basis or on mtr basis as per BOQ. (Rate shall include all accessories)

TELEPHONE, TELEVISION AND COMPUTER SYSTEM

GENERAL DESCRIPTION

- The work shall cover the supply and installation of the TV, Telephone and Computer data points including laying of Cables in 19/20 mm dia PVC Conduit.

SCOPE

TELEPHONE CABLES AND WIRES:

- The type of cables and the services shall be as follows:
- Indoor – Multipair PVC sheath armoured / un-armoured as specified 0.6 mm tin Cu. Cable.
- Outside -- Multipair PVC sheath armoured / jelly filled as specified 0.6 mm tin Cu. Cable.
- All multi core cables and wires shall be of tinned copper conductor of not less than 0.6 mm dia and shall be colour coded twisted pairs with rip cord.
- The conductor resistance shall be less than 150 ohms per KM and the insulation resistance between the conductors not less than 50 mega ohms and the nominal capacitance of about 0.1 microfarad per kilometre.
- Cables laid underground or locations subject to dampness and flooding shall be filled with polyethylene compound and shall have sufficient protection against moisture and water ingress.
- All armouring shall be of galvanized steel wires and protected against corrosion by an outer sheath of PVC in the case of indoor cables and polyethylene in the case of outdoor cables. Outer sheathing must be fire retarding and anti-termite.
- All un-armoured single core cables and inner sheath of armoured cables shall be provided with ripcord.

TELEPHONE TAG BLOCKS:

- The telephone tag blocks shall be suitable for the multi core telephone cables and shall have two terminal blocks, cross connect type. All incoming and outgoing cables shall be terminated on separate terminal blocks and termination shall be silver soldered. The cross connecting jumpers shall be insulated wires of same diameter and screw connected.
- The tag blocks shall be mounted inside fabricated sheet steel boxes with removable hinged covers and shall be fully accessible. The enclosure shall be painted with 2 coats of red oxide and stove enamelled.

TELEPHONE OUTLET SOCKET:

- Telephone outlet socket shall be of the same make as that of the switches and accessories. The outlet sockets shall consist of 2 A 2 Pair polyethene connector in M.S.I / PVC boxes with switch plate of the same make as that of switches and telephone socket. The telephone outlet socket unless and otherwise specified shall be jack type and not pin type.

EPABX

1) **Self Survivable Remote Communication server/ Branch Communication System (TYPE1)**

The IP communication server must support Integrated Services Digital Network (ISDN) features and support digital terminal-to-terminal through-connection of 64-Kbps channels for voice, data as well as ISDN services.

The Offered IP Communication System must support following configuration:

- (1) It should support upto 180 Nos Digital Trunks and must be configured for 30 Nos Digital Trunks i.e 1 PRI (30ch)
- (2) It should support upto 120 Nos Analog Trunks and must be configured for 08 Nos Analog Trunks
- (3) It should support upto 08 Nos IP Gateway and must be configured for 01 Nos IP Gateway for 96 Nos IP Subscribers.
- (4) It should support upto 500 Nos of station or work point clients (i.e.Analog+Digital+IP) and must be configured for 168 Nos Analog Work Point and 24 Nos Digital Work Points.

i) **Redundant Power Supply**

The system power supplies must be with (n+1) redundancy in hotstandby mode such that one power supply works in redundant mode. In case any of the main PSUs fails the redundant PSU take over the functionalities seamlessly. The power supplies must be capable of supporting both 220V AC and -48 v DC as per requirement.

ii) **System interface for remote administration/remote maintenance by the contractor's operating personnel**

The contractor's service centre must be able to access the system remotely over a LAN or V.24 interface to perform changes to the system. Remote administration/ remote maintenance includes, for example, exchanging station numbers, configuring call pickup groups, setting up a secretary system function, and changing classes of service.

The system must be able to send dependability messages to the service centre over an automatic connection.

The service centre must be able to dial into the administration server over a modem. Access must be password protected. The service centre should now check system data, perform configuration changes to improve the quality of service, and modify call processing parameters.

iii) **PC-based system administration**

Administration tasks should be performed at the communication server over Windows-based applications.

The following data must be administered by the application:

- Subscriber names
- Key programming at the telephones
- Speed- dialling destinations and numbers
- Classes of service for stations and lines
- Hunt group/group call
- Call pickup groups
- Call forwarding no answer destinations
- Display texts

- Call charge tariffs/account codes

It should be possible to save or print out the data processed. It should also be possible to administer multiple central units simultaneously in the network over the same administration application. No special knowledge should be necessary for using this application.

iv) **Connection to the communication server over IP-based infrastructures for administration and call detail recording**

TCP/IP interface for connecting the administration and call charge server.

v) **IP gateway for connecting additional locations for each communication server**

For connecting additional communication servers over the corporate IP network infrastructure It should support following features:

- IP interface for supporting up to 16 voice channels per interface
- Support for dynamic channel bundling
- IP interface for connecting IP telephones
- Remote LAN access/ telecommuting and access to the Internet
- 10/100 Base-T interface
- Support for voice-based network protocols
- QoS in accordance with IEEE 802.1p and IETF DiffServ
- Integrated echo compensation
- DTMF recognition in accordance with RFC 2833

vi) **IP- payload switching**

System software must optimize the bandwidth between IP- telephones and other components. Here, the VoIP voice data (payload) should be transferred directly between two IP telephones within the IP network. Access to all system features must be possible without restriction from IP-based voice terminals. The voice channels freed up in this way should provide for greater internal call traffic.

vii) **IP gateway**

It should support direct connection of IP telephone terminals over the corporate IP network infrastructure with the following features:

- IP interface for connecting IP phones and soft clients with 16 simultaneous channels
- 10/100 Base-T interface
- Support for the protocols TCP/IP, UDP, FTP, Telnet, H.323
- Support for voice-based network protocols over IP
- Quality of Service (IEEE 802.1p)
- Type of Service (RFC 791)
- Differentiated Services (RFC 2474)
- Echo compensation in accordance with ITU-T G.165

viii) **IP Networking**

It must be possible for upto 32 communication systems (Main+Remote) to be connected over IP links seamlessly and with feature transparency. Such a network must be possible without the need to connect external server for network management. Vendor to furnish documentary proof confirming the same.

- ix) Each system should be supplied with MDF 250+250pair along with MDF tag block and IPM modules as per the requirement.

2.2) **System Features and Station Features**

b) **System features**

i) **Standard system functions**

- (1) System software should have following call processing features:
 - Intercepting DID calls on no answer, busy and in the event of incomplete dialling
 - Special audible tones on lifting the handset when features are active
 - Operation with/without direct inward dialling
 - Reaching specific extensions in inbound traffic
 - Multiple trunk group for reaching trunks and/or tie trunk connections
 - Multiple trunk group based on code selection
 - Different ringers for internal calls, trunk calls, call back, recalls
 - Closed numbering
 - Preventing DID for specific extensions
 - Music on hold or short message for connections placed on hold
 - Presetting of digits
 - Digit repetition.
- (2) **Free numbering**

Station numbers and connection PENs must be freely assignable. Station numbers should differ in length but may not contain over six digits. Conversion must be possible, for example for a DID station number and it must be possible to assign multiple station numbers to a subscriber.
- (3) **Toll restriction in external traffic**

The toll restriction function releases CO numbers on the basis of the subscriber's class of service. It must therefore be able to evaluate up to 25 digits for each of the services, voice, fax, and data. Subscribers with restricted and unrestricted local area access must be allowed to access remote regions by assigning restricted trunk access.
- (4) **Toll restriction in dedicated line traffic**

The toll restriction function releases station numbers in the private network on the basis of classes of service for traffic over dedicated lines. It must therefore be able to evaluate up to 25 digits for each of the services, voice, fax, and data and each subscriber should be given classes of service with different station number groups.
- (5) **Prevention of unauthorized calls**

Specific traffic relationships should be enabled or disabled within and between groups of stations and trunk groups on the basis of the entries in a connection matrix.
- (6) **Automatic connection setup without dialling**

Extensions should be configured so that a connection is automatically set up to the specially programmed destination as soon as the handset is lifted (hotline).
- (7) **Automatic connection setup after timeout**

Extensions should be configured so that a connection is automatically set up to a programmed destination if a number is not dialled or not dialled completely, for example, within 20 seconds of lifting the handset.
- (8) **Sending DTMF signals**

Special devices should be dialled up over outbound external lines and operated via DTMF signals. In this case, both the digit dialling information from digital telephones and the pulses from analogue telephones are converted into DTMF signals.
- (9) **Ring no answer**

Ring no answer (RNA) should be performed on the basis of the following criteria:

RNA when free:
a call to a free extension should be forwarded to

an answering machine or voice mail system after a set timeout.

RNA on busy:

a call to a busy extension should be signalled to the caller as busy. Whether or not RNA on busy is performed should be defined in a list for each call destination.

(10) **Remote-control night service**

Subscribers with the appropriate class of service should be able to activate night service variants configured locally and network-wide.

(11) **Individual display**

It should be possible to customize the displays on digital telephones so that the right part of the second display line (max. 15 characters) should be modified when the display is idle. A company name could be entered here. Text is then inserted on the left of the date, providing this is permitted by the length of the text, for example: <123456 sampleman Corp. >

(12) **Group ringing**

It should be possible to signal calls at more than one telephone at a time. Each internal subscriber should manage a personal list and enter additional internal station numbers at which inbound calls for his or her terminal will also be signalled. It should be possible to program a key on the telephone for activating/ deactivating this feature. This key should be simultaneously activated. Up to five group ringing keys should be programmable and activate on a telephone. The assigned LED should light up when this function is active.

(13) **Group call**

Incoming external or internal calls should be signalled at the same time at the assigned group members (max. 20). The first subscriber to pick up the handset should be connected to the calling party. Subsequent calls are signalled at the free group extensions. If all group members are busy, calls are signalled by the call waiting tone. The waiting call should be routed to the first subscriber to hang up.

(14) **Logical Partitioning**

The offered system should have in-built Logical Partitioning feature such that it must be possible to program and ensure that a patch between a private trunk (such as IP) to link to a public trunk (PSTN CO/PRI) is barred in any way, be it directly or indirectly (by the way of a transfer /conference etc.)

(15) **DECT**

Offered system must support DECT (digitally enhanced cordless telephony) by addition of integrated DECT Module. It must be possible to connect upto 64 DECT base stations to the system using upto 4 integrated DECT Modules. The system must support upto 250 DECT handsets. It must be possible to support upto 12 simultaneous conversations per DECT base station. The offered DECT modules, base stations and DECT handsets must be of the same make as that of the communication system. Vendor to submit documentary proof of the same along with the bid.

c) Features for Stations

i) Standard station function

System software for all stations connected should have following functions:

- Blind and unscreened call transfer
- Call pickup
- Toggle
- Consultation
- Parking
- Call back on no answer
- Call back on busy
- Hunt group, linear
- Hunt group, circular
- Number redial
- Recall after going on-hook during consultation
- Weekday, date and time display
- Personal identification number (PIN)
- Enable/disable second calls.

ii) Multi-party conference (up to five participants)

Extensions stations must be able to add up to three additional external parties to an existing two-party connection. Each party should operate independently within the conference. Conference members should initiate a consultation call or pick up a call to add another party to the conference. The conference must be placed on hold before other functions should be performed.

iii) Team-based call pickup

Subscribers in a call pickup group must be able to answer calls on behalf of other team members at their own telephone. It must be possible to include both analogue and digital telephones in a team.

iv) Directed call pickup

The directed pickup of calls at other workstations outside call pickup groups should be possible with the function key or by dialling a prefix and the required extension.

v) Overriding call forwarding

Authorized subscribers should be able to override an active call forwarding action at a called extension.

vi) Parking in the system

Extensions stations and attendant consoles should be able to park a call in a defined parking position in the system. A call parked in this way should be picked up by any telephone. The extension station or attendant console should conduct further calls after parking a call.

vii) Do not disturb

A subscriber should be able to bar inbound calls. The caller should hear the busy tone when do-not-disturb is active. Authorized subscribers (for example attendant operators) should be able to override do-not-disturb. It should be possible to deactivate the acoustic signal in system telephones with display so that calls are only shown on the display.

- viii) Override**
Authorized positions should be able to cut in directly on existing connections of other stations
- ix) Single class of service changeover**
Every extension station should be assigned two classes of service and must be able to switch between the two classes without difficulty.
- x) Restricting automatic internal traffic**
Extensions in an ITR group should not be able to call themselves automatically but rather only over the attendant console. This function should be abolished if necessary.
- xi) Individual speed dialling**
PABX users should be able to access a station number memory containing up to ten external destinations that should be called up with function keys. The destinations are entered and modified by subscribers. Manual suffix dialling must be possible after transmitting the saved digits. The feature must be configurable for 2000 entries in the system.
- xii) Central speed dialling 1,000**
PABX users and attendant operators should be able to access the central station number memory using function keys. Each subscriber should be authorized for use of this option. Manual suffix dialling must be possible after transmitting the saved digits. All subscribers should be able to use the central speed dialling option. It must be possible to save up to 1,000 destination numbers.
- xiii) Malicious call identification**
Authorized PABX users should be able to register the station number of a caller from the public network
- xiv) Personal identification number (PIN)**
Subscriber should identify themselves at the communication system by entering a PIN at their own or a third-party telephone. It should be possible to enter the five-digit (max.) PIN manually. If the PIN is entered at the subscriber's own telephone, the single class-of-service changeover must be switched. Call charges incurred at the logged-on telephone must be assigned to the subscriber's own call number.
- xv) Moving terminals**
It should be possible to move digital and analogue telephones and fax devices without the need for administrative intervention at the operating terminal at system level. This should be done by entering a logoff code and the PIN before unplugging the device, then moving the device to the new location, plugging it back in and entering the logon code and PIN. This procedure should ensure that the terminal works as usual.
- xvi) Intercom feature: one-way voice calling**
Subscribers with digital telephones should be able to initiate a one-way voice call to another subscriber with digital telephone. This should be done by setting up a one-way connection to the other subscriber.
- xvii) Intercom feature: broadcast/internal paging**
Telephone subscribers should be able to set up a broadcast to a maximum of 20 other telephones simultaneously. Broadcast calls should automatically activate the loudspeakers (if available) at called telephones. The first subscriber to lift a handset must be able to talk to the caller while all other loudspeakers are deactivated.

xviii) Sending text messages

Subscribers should be able to send predefined or random short messages over the display.

xix) Absent messages

Subscribers should be able to leave absent messages, such as "Back at:..." , at their own telephones.

xx) Executive - Secretary system function

Digital executive and secretary telephones should be assigned the special features of a secretary system by means of system administration. This feature includes:

- Forwarding executive calls to the secretary telephone
- Camping on at the secretary telephone in the case of calls for the executive
- Executive/secretary call pickup group
- Intercept key for direct signalling at the executive telephone in the case of calls for the executive
- Executive/secretary direct station selection
- Secretarial function transfer at the secretary telephone

d) Applications

i) CTI 1st-party client software

for easy operation of telephone functions from the PC either over a serial or USB interface (TAPI 120 version 2.0) with the following functions:

- Connection setup
- Call acceptance
- Call clear down
- Display of call status, the station number, the name in the case of internal calls
- Call waiting
- Consultation hold
- Toggle
- Call transfer, speed transfer, holding and parking
- Conference
- Data exchange between TAPI applications.

ii) CTI 3rd-party interface

for operation of telephone functions using CSTA - interface.

← Wall-mountable

COMPUTER WIRES:

- The computer wires shall be of 4 pair enhanced Cat 6e category and shall be of the makes as specified in the tender. The wires used shall be as per the specifications laid down by AVAYA for the certification of the network installed.

COMPUTER DATA OUTLET SOCKETS:

- The computer sockets shall be of e Cat 5 category and of the make specified in the tender. The sockets shall be installed in the plates of the modular switches range to be used. The sockets shall be crimped using crimping tool with the Cat 6e wire.
- **For clean room application the plates shall be of SS 316 with no sharp edges.**

TELEVISION WIRING & SOCKETS:

- The Co-axial cable shall be of wide band type with operation capability upto 500 MHz. as of Delton type.
- The Co-axial cable shall comprise of inner conductor of solid bare copper insulated with Foam PE & Secondary Conductor made of poly-Aluminium film bonded Aluminium braids and having coverage of 65%, overall sheathed with black PVC Insulation.
- Twisted cables shall be electrolytic grade annealed copper conductor insulated with PE insulation twisted in to pairs with colour combination bunched together in concentric layers so as to minimise cross-talk & wrapped with FR PVC taps and sheathed with FR PVC or HFFR outer jacket suitable for indoor telephone wiring and confirming to C-DOT S/WS-113 / IEC 60189-2, UL-1581 SECTION 1080.
- The ageing resistance of the co-axial cable shall comply with DIN 47252, Part 2, i.e. max. 5% increase in attenuation at 200 MHz. measured by artificial ageing (14 days at 80 deg. C)

WORKMANSHIP

- All cables shall be on cable racks and neatly stitched together.
- The connection at the tag blocks shall be silver soldered so as to achieve minimum contact resistance.
- The final branch connections with single pair cables in conduits and the maximum number of cables in each conduit shall be as follows:

Conduit Inch	diameter mm.	Max. No. of cables
3/4"	20	2 Nos. single pair
1"	25	6 Nos. single pair
1¼"	32	12 Nos. single pair
1½"	40	18 Nos. single pair

- The tag blocks shall be mounted inside fabricated sheet steel boxes with removable hinged covers and shall be fully accessible. The enclosure shall be painted with 2 coats of red oxide and stove enamelled.

MODE OF MEASUREMENT

- The wires, conduits and raceways shall be measured in rmt whereas the outlet sockets, junction boxes and tag blocks shall be measured in units.

CABLE TRAY & FLOOR RACEWAY

SCOPE

The scope covers design and manufacture, inspection, testing and delivery of cable trays, necessary hardware, fittings & accessories.

CABLE TRAYS :

The cable trays shall be prefabricated **hot dip galvanised ladder type/ (wire mesh carbon steel hot dip galvanized)**. The ladder type trays shall consist of side runners and horizontal rungs.

The ladder type trays and its accessories shall have rigid welded construction and shall be fabricated out of 2mm thick Hot rolled sheet steel. The rungs shall be welded to the side runners.

Side runners shall be 75 x 15mm channel with the flange facing inside. Rungs shall be 35 x 15mm slotted channel type construction and shall be spaced 250mm apart. All perforated channel type tray shall be 30mm high one piece channel made out of 2 mm thick sheet steel and hot dip galvanised.

Cable trays shall be suitable for a cable weight of 100kg/mtr. running length of tray and it shall be supported @ 2m intervals.

The side runner channel and all accessories will have two holes on each end for fixing splice plates. Two splice plated (one on inside face and one on outside face) will be provided for each side runner. The side runner will also have suitable holes at every metre for cleating earthing strip. Suitable tapped holes shall be provided on the runner top and bottom for supporting and fixing tray covers at every metre.

Hot dip galvanising shall be done after fabrication as per relevant Indian Standards Specification. The amount of galvanising shall be 816 gm/m².

The type of construction shall be such as to facilitate easy handling, assembly and installation at site. The straight length of cable tray shall be min. 2.5 metres (without splice plate).

The workmanship shall be such as to ensure easy laying of cables without causing damage to cables. All surfaces shall be free from defects such as burrs, sharp edges etc.

The hardware shall conform to relevant Indian Standard specifications and shall be able to withstand the maximum loading conditions as required. All hardware fittings shall be hard chrome cadmium plated/zinc passivated. All hardwares shall include bolts, nuts and washers etc.

The bends, tees, reducers and droppers shall have bending radius of 750mm for L.T. cables respectively.

FLOOR RACEWAY AND JUNCTION BOXES :

CONSTRUCTION:

The floor raceway and accessories shall comprise of the following components.

Cable trays and accessories:

The technical specification for the floor raceway and accessories shall be as follows.

- i. **Type of floor raceway** : 2 compartment
- i. **Material of construction** : Aluminium/Steel
- iii **Dimensions**
 - Size of side member : 300 mm wide x 50 mm deep (2 compartment)
 - : 150 mm wide x 50 mm deep (2 compartment)
 - : 75 mm wide x 50 mm deep (2 compartment)
 - : 50 mm wide x 50 mm deep (2 compartment)

Maximum length of one section : 3000 mm for straight length

Specific requirements:

- All raw material and hardware to be used for manufacturing of floor raceway and accessories shall be new, unused and of best quality. GI Trunking shall be made up of Pre Galvanized sheet metal with zinc coated steel sheet double folded and arc welded. The double folding ensures that the impact resistant is high and no concrete seepage occurs. Material Specification: As per BS2989 (Indian Standards IS 277:2003).
- Floor raceway and accessories shall be supplied fully shop assembled, which includes complete assembly of each section length and individual accessory so that it shall only be necessary in the field to install the equipment, bolt together all shipping splits as required to make it ready for use.
- The copy of Test Certificate for the Type and Routine Testing as per relevant standards carried out on similar types of floor raceway at recognized laboratory during the last two years shall be produced on demand.
- All hardware sets consisting of screws, nuts, washers, spring washers, etc. required for jointing floor raceway and junction boxes sections and accessories using coupler plates shall be in supplied. Quantity of hardware shall be decided based on quantity of floor raceway and accessories and additional 10% hardware sets shall also be supplied separately as contingency provision.

Accessories for Cable Trays

Floor raceway			
Sr. No.	Size	depth	Compartments
1	300 mm	50mm	2 compartments
2	150 mm	50mm	2 compartments
3	75 mm	50mm	2 compartments
4	50 mm	50mm.	2 compartments
Floor junction boxes			
1	350mm	65 mm	With crossover
2	275mm	65 mm	With crossover
3	200 mm	65 mm	With crossover
4	125 mm	65 mm	With crossover

5	100 mm	65 mm	With crossover
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MODE OF MEASUREMENT

- The items shall be measured on unit basis or on mtr basis as per BOQ. (Rate shall include supports, joints, bends with all accessories)

EARTHING SYSTEM

GENERAL DESCRIPTION

- All the non-current carrying metal parts of the electrical installation and mechanical equipments shall be earthed properly. The metal conduits, trunking, cables armour and sheath, electric panels' boards, lighting fixtures, ceiling and exhaust fan and all other parts made of metal shall be bonded together and connected by means of specified earthing system. An earth continuity conductor shall be installed with all the feeders and circuits and shall be connected from the earth bar of the panel boards to the conduit system, earth stud of the switch box, lighting fixture, earth pin of the socket outlets and to any metallic wall plates used. All the enclosures of motors shall be also connected to the earthing system.

SCOPE OF WORK

- The scope of work shall cover supply, laying, installation, connecting, testing and commissioning of:

Earthing station.

Earthing Aluminium/copper strips from earthing station to equipotential bar.

Earthing Aluminum / copper strips / wires from equipotential bar to lay feeder mains and circuit to connect power panels, DBs, switchboards etc.

Bonding of Non-current carrying parts, and metallic parts of the electrical installation.

STANDARDS

- The following standards and rules shall be applicable:

- 1) IS: 3043 - 1966 Code of practice for Earthing.
- 2) Indian Electricity Act and Rules

All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Code of Practice or the British Standard Codes of Practice in absence of Indian standard.

TYPE OF EARTHING STATION

1). PLATE EARTHING STATIONS

- The equipment neutral earthing shall be with Cast Iron plate earthing station, Cast Iron Earth plate shall be 30 x 30 x 0.35 mm for earthing.
- The earth resistance shall be maintained with suitable soil treatment.
- The resistance of each earth station should not exceed 1 ohm.
- The earth lead shall be connected to the earth plate through Hot Dip G.I. bolts.
- The earthing conductors shall be of copper strip in case of GI earthing.
- G.I. pipe with funnel of approved quality shall be used for watering the earthing electrodes / stations.

- The block masonry chamber with chequered plate shall be provided for housing the funnel and the pipe for watering the earthing electrodes / stations.
- The hardware and other consumables for earthing installation shall be of copper/bras in case of copper earth plate and shall be hot dip galvanised iron material in case of G.I. earth plate,.
- Test link / test pit cover through chequered plate.

2). PIPE ELECTRODE EARTH STATION

- The earth station shall be as shown on the drawing and shall be used for equipment earth grid and/or street light pole earthing.
- The earth electrode shall be 150 cms long 1.5 cms dia class "A", Galvanised iron pipe.
- The earth resistance shall be maintained with a suitable soil treatment as shown on the drawing.
- The resistance of each earth station should not exceed 1 ohm.
- The earth lead shall be fixed to the pipe with a nut and safety set screws. The clamp shall be permanently accessible.
- The earthing grid and the earthing conductor shall be hot dip Galvanised iron strips of the size as shown in the drawing.
- G.I. pipe with funnel of approved quality shall be used for watering the earth electrode \ station.
- The block masonry chamber with chequered plate shall be provided for housing the above referred funnel and pipe.
- The hardware and other consumables for earthing installation shall be hot dip Galvanised iron material as shown on the drawing.

WORKMANSHIP

INSTALLATION AND CONNECTION

- The plate/pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case less than 3 M below finished ground level.
- The plate/pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall / column.
- The plate electrode shall be installed vertically and shall be surrounded with 150 mm. thick layers of Charcoal dust and Salt mixture.
- 20 mm. dia. G.I. pipe for watering, shall run from top edge of the plate / pipe electrode to the mid level of block masonry chamber.
- Top of the pipe shall be provided with G.I. funnel and screen for watering the earth / ground through the pipe.

- The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber as shown in the drawing.
- The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry.
- Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS : 3043, Code of Practice for Earthing Installation.
- The earth conductors (Strips / Wires, Hot dip G.I.) inside the building shall properly be clamped / supported on the wall with Galvanised Iron clamps and Hot Dip GI screws / bolts. The conductors outside the building shall be laid atleast 600 mm. below the finished ground level.
- The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished.
- Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long.
- The earth conductors shall be in one length between the earthing grid and the equipment to be earthed.

EARTH LEADS AND CONNECTIONS

- Earth lead shall be bare copper or Galvanised steel as specified with sizes shown on drawings. Copper lead shall have a phosphor content of not over 0.15 %. Galvanised steel buried in the ground shall be protected with bitumen and hessian wrap or polythene faced hessian and bitumen coating. At road crossing necessary hume pipes shall be laid. Earth lead run on surface of wall or ceiling shall be fixed on saddles so that strip is atleast 8 mm away from the wall surface.
- The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.
- Wherever crossing is required, earthing jumper shall be of insulated wires.

EQUIPMENT EARTHING

- All apparatus and equipment transmitting or utilising power shall be earthed in the following manner. Copper /G.I. earth strips/wires shall be used unless other-wise indicated in the Schedule.

TEST

- The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS: 3041.
- The following earth resistance values shall be measured with an approved earth megger and recorded.
 - 1) Each earthing station
 - 2) earthing system as a whole
 - 3) Earth continuity conductors
- Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 1 ohm in each case.
- Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.
- All tests shall be carried out in presence of the consultant / client.

MODE OF MEASUREMENT

- Provision of earthing station complete with excavation, electrode, watering pipe, soil treatment, masonry chamber with cast iron cover etc. shall be treated as one unit of measurement.
- The following items of work shall be measured and paid per unit length covering the cost of the earth wires / strips, clamps, labour etc.
 - a) Main equipment earthing grid and connection to the earthing station.
 - b) Connection to the switch board, power panels, DB etc.
- The cost of earthing the boq items shall become part of the cost of the item itself and no separate payment for earthing shall be made.

LIGHTNING PROTECTION SYSTEM

SCOPE

- The scope of work under this section covers the specifications for supply, installation, connection, testing and commissioning of lightning protection system of the following :
 - Air termination network.
 - Roof conductors.
 - Down conductors.
 - Testing joint.
 - Earth termination network

STANDARDS

- The lightning protection system shall comply with Indian Code of Practice 2309 : 1989 and Indian Electricity Acts and Rules.

SYSTEM

- The lightning protection system shall be installed as indicated on the drawings or in case such is not available, the contractor shall prepare one as per Indian CP 2309 and approved by Architect.
- An air terminal shall be installed on the highest roof of the building. The air terminal shall be joined to horizontal roof conductor by means of rivets / clamps.
- Roof conductor shall be laid horizontally on the roof as indicated on the drawing.
- Down conductor shall be installed on the vertical surface on the building. Down conductor shall be joined with roof conductors in the method as prescribed by the Code. A test joint shall be provided in the down conductor 100 cm. above the ground level at a place which is easily accessible for testing.
- The down conductor shall be joined with an earth termination network or to the earthing station as indicated on the drawing.
- The earthing station and the earthing conductor shall be as per section under heading "Earthing".

COMPONENT PART

PAIR TERMINALS AND ROOF CONDUCTORS

- An Air termination shall consist of vertical conductor or a system of horizontal conductors and shall be installed along the outer perimeter of the roof.
- No part of the roof shall be more than 9 mtr. From the nearest horizontal protective conductor.

- All metallic projections, chimneys, ducts, vent pipe, railings, gutters etc. on or above the main surface of the roof of the structure shall be bonded to the firm part of the Air termination network. The method and nature of fixing shall be simple, solid and permanent.
- The minimum dimension of the Air termination network shall be as follows :

G.I. : 25 x 3 mm.

- The Air terminal shall be installed vertically on the highest point of the roof and shall be clamped firmly with the structure. The roof conductor shall be laid horizontally below the finishing of the roof surface.

DOWN CONDUCTOR

- The no. of down conductors shall be as follows :
 - 1) A structure having a base area not exceeding 100 sq.mtr. shall have only one down conductor.
 - 2) For a structure having a base area exceeding 100 sq.mtr., the no. of down conductors shall equal to smaller of the following :

One plus one for every 300 sq.mtr. or part thereof in excess of the first 100 sq.mtr.

OR One for every 30 mtr. per perimeter.

- The down conductor shall be distributed round the outside wall of the structure.
- Any external metal running vertically through the structure shall be bonded to the down conductor at the top and bottom.
- A down conductor shall follow the most direct path possible between the air terminals and the earth termination.
- The size of the down conductor shall be similar to roof conductor or air termination network.
- Each down conductor shall be provided with a testing joint in such a position that, it is convenient for testing.

JOINTS AND BONDS

- The lightning protection system shall have as few joints as possible. Joints and bonds shall be mechanically and electrically effective, eg. clamped, screwed, bolted, riveted or welded. With overlooping joint the length of overlooping shall not be less than 25 mm. for all types of conductor. Contact surfaces shall be first cleaned then inhibited from oxidation with a suitable non-corrosive compound.

EARTH RESISTANCE

- The resistance from any part of the lightning protection system to earth shall not exceed 1 ohm before any bonding has been effected to metal in or on a structure or to services below ground. If the value obtained exceeds the specified one then shall be reduced by adding to the number of earth electrode.

METHOD OF MEASUREMENT

- The complete earth conductor shall be measured and paid per unit length, including Air termination network, down conductor, test joints and earthing termination network.

EXTERNAL LIGHT POLES

SPECIFICATIONS

- Street light poles, M.S. poles shall be as per the drawing given. The sections for the pipe shall be as shown in the drawing. The poles shall be welded properly and grinding shall be perfect to show smooth surface and stability shall be maintained. The light fixtures to be mounted above the poles shall be as specified in the BOQ.
- All the poles shall be treated with 2 coats of red oxide and after the putty and other works shall be spray painted with automotive category paints only. In case of powder coating 7 tank process shall be adopted. The painting or the powder coating option shall be as per the BOQ.
- Coil type Earthing to be provided for each pole with 8 SWG GI Wire.
- Typical Section details & BOQ to be followed prior procurement.

WORKMANSHIP

- All the light poles shall be brought to site and shall be stored in such a place so as to avoid rusting and brazing of the poles. The poles shall be erected as per the drawing and the top level of all the poles shall be similar.
- The poles shall be at right angle with the ground. Necessary civil works and spiral earthing shall be done as shown in drawing. No additional holes shall be drilled in poles at site for enabling the cable works. Poles with damage in colour or indentations shall be rejected and if engineering in charge approves for damage in colour the same shall be finished at the site.

MODE OF MEASUREMENT

The poles shall be measured in nos and the cabling for the same shall be measured in rmt.

ON-LINE UPS SYSTEM

DATA SHEET

INPUT

Voltage	:	380-415 Volts, 3 Phase 4 wire
Voltage Variation	:	+/- 20% at 100% load and +20 to -50% on 50% load
Frequency	:	50 / 60 Hz
Frequency Variation	:	45 Hz to 65 Hz
Power Factor	:	0.99 lag to unity
Input Current Distortion	:	2-5% THD in nominal load condition

OUTPUT

Rating	:	
Voltage	:	415Volts, 3 Phase or 230V, 1 phase as per requirement in BOQ.
Voltage Variation	:	+/- 1% with 100% unbalance
Volts Adjustment	:	+/- 2% static and +/- 5% dynamic at 100% load change with < 1 ms response time
Power Factor	:	0.9 lag to unity
Crest Factor	:	3 : 1
Frequency	:	50 Hz, Pure sine wave
Frequency Regulation	:	+/- 0.1%
Wave form	:	Sine wave
Harmonic Distortion	:	< 2% THD for linear load
	:	< 4% THD for non-linear load
Overload Rating	:	110% for 30 minutes
	:	125% for 10 minutes
	:	150% for 1 minute
Efficiency	:	> 93% online with linear load
Noise	:	< 50 dB at 1 meter
Display & interface	:	Graphical LCD / LED with RS 232 port

DC Link

DC Bus volts Ripple	:	Less than 2%
Battery isolation	:	DCCB

PROTECTIONS

Rectifier	:	I/P AC Overvoltage / Undervoltage DC Overvoltage Battery Charging Over current O/P Over Load Single Phase Failure Reverse Phase Sequence
Inverter	:	O/P Over voltage / Under voltage O/P Overload DC Undervoltage Over Temperature

AUDIO ALARM : Rectifier Trip.
Overload.
Mains Fail.
Battery Low Pre-alarm.
System Trip.

METERING DIGITAL : LCD metering to read following parameters
with users friendly mimic scheme.
I/P Voltage / Current / Frequency
Battery voltage
Battery charge / discharge current
O/P Voltage / Current / Frequency

ENCLOSURE : IP 31

ENVIRONMENT

Operating Temperature : 0 to 45 Deg. C.
Storage : -10 to 70 Deg. C.
Humidity : upto 95% RH.(non - condensing)
Cooling : Forced Air Cooling.
Altitude : No derating till 1000 m.

REFERENCE STANDARDS

IEC 62040-2, IEC 60950, EN 620401-1, EN 50091-2 (A) and IEC 146 - (IV) for testing with ISO 9001:2000 and ISO 14001 certification.

DIMENSIONS

	Width	Depth	Height	Weight
UPS ____ KVA				
Battery				
UPS ____ KVA				
Battery				

CABLES

Input Cable;
Output cable:
Earth:

BATTERY BANK

Vender shall supply maintenance free shield battery with rack with back up of 30 Min. for full load. Battery shall be of reputed make (Company with ISO) and shall be guaranteed for 3 Years. **Calculations for battery bank for 30 mins shall be provided.** The battery status indication shall be there on UPS. The recharging time shall be not more than 10 times the discharge time. The battery rack shall have proper cooling (micro processor controlled) arrangements and shall be with castors and leveling feet. The battery shall be stable till 1000 mtr altitude with no condensation from 15-90% Rh. Noise level shall be less than 50 dB.

OFFER SHALL INCLUDE

- UPS Systems.
- Battery Set with interconnections & Rack.
- Packing, Transportation, forwarding, installation & commissioning of UPS at our site.
- Excise duty, Sales Tax.
- All spares required during warranty period.

DOCUMENTS TO BE PROVIDED WITH UPS SYSTEMS

- | | | |
|---|---|--------|
| ○ Operating instruction manual | - | 2 Sets |
| ○ Installation Drawings | - | 2 Sets |
| ○ Maintenance / trouble shooting manual | - | 2 Sets |

MODE OF MEASUREMENT

The poles shall be measured in nos and the cabling for the same shall be measured in rmt. ations shall be rejected and if engineering in charge approves for damage in colour the same shall be finished at the site.

**ERECTION, TESTING &
COMMISSIONING OF
ELECTRICAL INSTALLATIONS**

SCOPE

- The intent of this specification is to define the requirements for the installation, testing and commissioning of the electrical system like H.T VCB panel, transformer, L.T. panels, Cables, earthing network, Internal and External lighting, Light fixtures etc.. Requirement of this project shall be as specified in bill of quantities / approved drawings / general specifications or as per the battery limits fixed by the owner / consultant.

STANDARDS

- The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specification / codes of practice of the Indian Standards Institution, approved drawings and the instructions issued by the authorised representative, from time to time. Some of the relevant Indian Standards are listed elsewhere in this tender document.
- In addition to the standards mentioned in 1.1, all works shall also conform to the requirement of the following :
- Indian Electricity Act and Rules framed thereunder.
- Fire Insurance Regulations.
- Regulations laid down by the Chief Electrical Inspector of the State / State Electricity Board / Union Territory.
- Regulations laid down by the Factory Inspector of the State / Union Territory.
- Any other regulations laid down by the local authorities.
- Installation & operation manuals of original manufacturers of equipment.

ERECTION

- The contractor shall make his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation. Equipment shall not be removed from packing cases unless the floor has been made ready for installing them. The cases shall be opened in presence of the client / consultant or his authorised representative. The empty packing cases shall be returned to the stores and any document if found with the equipment shall be handed over to the client's representative. Any damage or shortage noticed shall be reported to the client / consultant in writing immediately after opening of packing cases.

ONAN TYPE TRANSFORMER

ERECTION

- Transformer complete with radiators, bushings, conservator and miscellaneous accessories shall be thoroughly inspected and any damage noticed shall be reported to the client / consultant. Before erection of transformer, the level of rails on foundation shall be checked and minor corrections if necessary shall be carried out. After the completion of erection, necessary stoppers shall be provided at the wheels. All loosely supplied fittings / accessories shall be cleaned and mounted on the transformer and connections made. After completely

assembling & installation, the transformer shall be cleaned and touched up with a paint supplied by the manufacturer applied wherever necessary. All cover bolts shall be checked for proper tightness. (The foundation of transformer and rail fixing will be made by some other agency).

TESTING

- Winding insulation resistance shall be measured from primary and secondary to ground and between primary and secondary.
- Test the operation of thermister type sensor relay in accordance with the manufacturer's instructions.
- Check the polarity of terminals and the phase sequence.

Proforma for transformer tests :

- Transformer name plate.
- Insulation resistance test with 1000 V meagre.
 - a) between primary to earth
 - b) between secondary to earth
 - c) between primary and secondary
- Operation of the tap changer.
 - Operation of the tap at tap No. 1
 - Operation of the tap at tap No. 2
 - Operation of the tap at tap No. 3
 - Operation of the tap at tap No. 4
 - Operation of the tap at tap No. 5
- Polarity marking and phase sequence.

Earth resistance: Body & Neutral tank.

[This proforma shall be jointly signed by the CLIENT / CONSULTANT and the contractor in duplicate].

POWER CONTROL CENTER / MOTOR CONTROL CENTER, DISTRIBUTION BOARDS

ERECTION

- Electrical panels and bus duct shall be delivered in convenient shipping section by the manufacturer. The contractor shall make his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation. The contractor shall be responsible for final assembly and interconnection of busbars / wiring. Foundation channel shall be grouted in the flooring by the contractor. Switchgear shall be aligned and levelled on their base channels and bolted to them as per the instructions of the client / consultant. The earth bus shall be made continuous throughout the length. Loosely supplied relays and instruments shall be mounted and connected on the switchgear. The contacts of the drawout circuit breaker shall be checked for proper alignment and interchangeability.

- After erection, the switchboard shall be inspected for dust and vermin proof. Any hole which might allow dust or vermin etc. to enter the panel shall be plugged suitably at no extra cost. If the instrument transformers are supplied separately, they shall be erected as per the direction of the client / consultant. The contractor shall fix the cable glands after drilling the bottom / top plates of all switchboards with suitable holes at no extra cost.
- Range of overload relays / timers etc. shall be checked with requirement of motor actually to be connected at site and if the same is undersized / oversized, it shall be brought to the notice of the client / consultant, who shall arrange procurement of corrected components. However, the contractor shall not charge anything extra for labour for such replacements.
- The busduct shall be suitably supported between switchgear and transformer. The opening in the wall where the duct enters, the switchgear room shall be sealed to avoid rain water entry. The foundation of the switchgear shall be raised suitably for minor adjustment to ensure proper alignment and connection of the busduct at no extra cost. Expansion joints, flexible connection, etc. supplied by the manufacturer / contractor of the busduct shall be properly connected.

TESTING

- Before electrical panel is energised, the insulation resistance of each bus shall be measured from phase to ground. Measurement shall be repeated with circuit breakers in operating positions and contacts open.
- Before switchgear is energised, the insulation resistance of all control circuits shall be measured from line to ground.
- The following tests shall be performed on all circuit breakers during erection.
- Contact alignment and wipe shall be checked and adjustment where necessary in accordance with the breaker manufacturer's instructions.
- Each circuit breaker shall be drawn out of its cubicles, closed manually and its insulation resistance measured from phase to phase and phase to ground.
- All adjustable direct acting trip devices shall be set using values given by the consultant/ manufacturer.
- The dielectric strength of insulating oil wherever applicable, shall be checked.
Before switchgear is energised, the following tests shall be performed on each circuit breaker in its test position.
- Close and trip the circuit breaker from its local control switch push button or operating handle. Switchgear control bus may be energised to permit test operation of circuit breaker with A.C. closing with prior permission of the client / consultant.
- Test tripping of the electrically operated circuit breaker by operating mechanical trip device.
- Test proper operation of circuit breakers latch, check carriage limit switch if provided. Test proper operation of lockout device in the closing circuit. Wherever provided by simulating conditions which would cause a lockout to occur.

- Trip breaker either manually or by applying current or voltage to each of its associated protective release.
- Before switchgear is energised, the tests covered above shall be repeated with each breaker in its normal operating position.
- Capacitor banks shall be tested as per manufacturer's instructions. In addition, test for output and/or capacitance, insulation resistance test and test for efficiency of discharge device shall be carried out.
- All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.

PROFORMA FOR PCC, MCC, DB, CONTROL PANEL TEST

- Circuit breaker or contactor module designation / bus no.

Insulation resistance test (contacts open, breaker racked in position)

- | | | | |
|----|--|---|----------|
| a) | between each phase of bus | : | Mega ohm |
| b) | between each phase and earth | : | Mega ohm |
| c) | DC and AC control and auxiliary circuits | : | Mega ohm |
| d) | between each phase of CT / PT and between CT & PT circuit if any | : | Mega ohm |

CT checks :

- a) CT ratio
 - b) CT secondary resistance
 - c) CT polarity check
- Check for contact alignment and wipe.
 - Check / test all releases / relays.
 - Check mechanical interlocks.
 - Check electrical interlocks.
 - Check switchgear / control panel wiring.
 - Check breaker / contactor circuit for :
 - a) Closing - local & remote (wherever applicable)
 - b) Tripping - local & remote (wherever applicable)
 - Opening time of breaker / contactor.
 - Closing time of breaker / contactor.

[This proforma shall be jointly signed by the CLIENT / CONSULTANT and the contractor in duplicate].

INSTALLATION OF CABLE NETWORK

- Cable network shall include power, control and lighting cables which shall be laid in underground trenches, hume pipe open trenches, cable trays, G.I. pipes, or on building structures as detailed in the relevant drawings, cable schedules or as per the client / consultant's instructions. Supply & installation of cable trays, G.I. pipes / conduits, cable glands and sockets of both end isolators, junction boxes, remote push button stations, etc. shall be under the scope of the contractor.
- General requirements for handling cables :
- Before laying cables, this shall be tested for physical damage, continuity, absence of cross phasing, insulation resistance to earth and between conductors. Insulation resistance tests shall be carried out with 500 / 1000 V megger.
- The cables shall be supplied at site, wound on wooden drums as far as possible. For smaller length and sizes, cables in properly coiled form can be accepted. The cables shall be laid by mounting the drum of the cable on drum carriage. Where the carriage is not available, the drum shall be mounted on a properly supported axle, and the cable laid out from the top of the drum. In no case the cable will be rolled on as it produces kinks which may damage the conductor.
- Sharp bending of cable shall be avoided. The bending radius for PVC insulated and sheathed, armoured cable shall not be less than 10 D, where "D" is overall diameter of the cable.
- While drawing cables through G.I. pipes, conduits, RCC pipes, ensure that size of pipe is such that, after drawing cables, 40% area is free. After drawing cables, the end of pipe shall be sealed with cotton / bituminous compound.
- High voltage (11 KV and above), medium voltage (240 V and above) and other control cables shall be separated from each other by adequate spacing or running through independent pipes / trays.
- Armoured cables shall never be concealed in walls / floors / roads without G.I. pipes, conduits or RCC pipes.
- Joints in the cable throughout its length of laying shall be avoided as far as possible and if unavoidable, prior approval of site engineer shall be taken. If allowed, proper straight through epoxy resin tight joint shall be made, without any additional cost.
- A minimum loop of 3 mtr. shall be provided on both ends of the cable, and on both ends of straight through cable joint. This additional length shall be used for fresh termination in future. Cable for this loop shall be paid for supply and laying.
- Cable shall be neatly arranged in the trenches / trays in such manner so that criss-crossing is avoided and final take off to the motor / switchgear is facilitated. Arrangement of cable within the trenches / trays shall be the responsibility of the contractor.
- All cable routes shall be carefully measured and cable cut to the required lengths and undue wastage of cables to be avoided. The routes indicated in the drawings is indicative only and the same may be rechecked with the client / consultant before cutting of cables. While selecting cable routes interference with structures, foundations, pipelines, future expansion of buildings etc. should be avoided.

- All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulating tapes. Use of friction type or other fabric type tape is not permitted. Lead sheathed cables shall be plumbed with lead alloy.
- Wherever cable rises from underground / concrete / masonry trenches to motors / switchgears / push buttons, these shall be taken in G.I. pipes of suitable size, for mechanical protection upto 300 mm. distance of concerned cable gland or as instructed by the client / consultant.
- The cable pass through foundation / walls of other underground structures, the necessary ducts for opening will be provided in advance for the same. However, should it become necessary to cut holes in existing foundation of structures the electrical contractor shall determine the location and obtain approval of the client / consultant before cutting is done.

LAYING OF CABLES (UNDERGROUND SYSTEM)

- Cables shall be so laid in trench that this will not interfere with other underground structure. All water pipes, sewage lines or other structures which become exposed by excavation shall be properly supported and protected from injury until the filling has been rammed solidly in places under and around them. Any telephone or other cables coming in the way are to be properly shielded / diverted as directed by the owner / consultant.
- Cable shall be laid at minimum depth of 750 mm. in case of L.T. and 1200 mm. in case of H.T. from ground level. Excavation will be generally in ordinary alluvial soil. The width of trench shall be sufficient for laying of required no. of cables.
- Sand bedding 75 mm. thick shall be made below and above the cables. Layer of bricks (full size) shall be laid above sand bedding on the sides and above the of cables to cover cable completely. More than one cable can be laid in the same trench by providing a brick on edge between two cables. However, the relative location of cables in trench shall be maintained till termination. The surface of the ground after back filling the earth shall be made good so as to conform in all respects to the surrounded ground and to the entire satisfaction of the client / consultant.
- For all underground cables, route markers should be used :
 - a) Separate route markers should be used for LT, HT and telephone cables.
 - b) Route markers should be grounded in ground with 1:2:4 cement concrete pedestal size 230 x 230 x 300 mm..
 - c) Cable markers should be installed at an interval not exceeding 30 mtr. along the straight routes of cables at a distance of 0.5 mtr. away from centre of cable with the arrow marked on the cable markers plate indicating the location of cable. Cable markers should also be used to identify change in direction of cable route and for location of every joint in underground cable.
- RCC hume pipe for crossing road in cable laying shall be provided by employer. No deduction shall be made for cable laying in hume pipe for not providing bricks, sand and excavation. RCC hump pipe at the ends shall be sealed by bituminous compound after laying and testing of cables by electrical contractor without any extra charge.

LAYING OF CABLE IN MASONRY TRENCHES

- Masonry / concrete trenches for laying of cables shall be provided by employer. However, steel members such as M.S. angles / flats etc. shall be provided and grouted by electrical contractor to support the cables without any extra charge. Cables shall be clamped to these supports with minimum saddles / clamps. More than one tier of cables can be provided in the same trench if the no. of cables are more.
- Entry of cables in trenches shall be sealed with bituminous MASTIC compound to stop entry of water in trenches.

LAYING OF CABLES IN CABLE TRAYS

- Cable trays and steel members such as M.S. angle / channel / flats etc. shall be provided and fixed by the erector.
- Cable shall be fixed in cable trays in single tier formation and cables shall be clamped with aluminium flat clamps and galvanised bolts / nuts.
- Earthing flat / wire can also be laid in cable tray alongwith cables.
- After laying of cables, minimum 20% area shall be spare.

TERMINATION AND JOINTING OF CABLES

- a) For HT cables suitable size of Reychem termination kit shall be used.
- b) Use of glands :
- All PVC cables upto 1.1 KV grade, armoured or unarmoured shall be terminated at the equipment / junction box / isolators / push buttons / control accessories, etc. by means of suitable size double compression type cable glands. Armour of cable shall be connected to earth point. The contractor shall drill holes for fixing glands wherever necessary. Wherever threaded cable gland is to be screwed into threaded opening of different size, suitable galvanised threaded reducing bushing shall be used of approved type.
- In case of termination of cables at the bottom of the panel over a cable trench having no access from the bottom, a close fit holes should be drilled in the bottom plate for all the cables in one line, then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables with glands, it shall be sealed with cold sealing compound.

USE OF LUGS / SOCKETS

- All cable leads shall be terminated at the equipment terminals, by means of crimped type solderless connectors unless the terminals at the equipment ends are suitable for direct jointing without lugs / sockets.
- The following is the recommended procedure for crimped joints and the same shall be followed :
 - a) Strip off the insulation of the cable and with every precaution, not in severe or damage any strand. All insulation's to be removed from the stripped portion of the conductor and ends of the insulation should be clean and square.
 - b) The cable should be kept clean as far as possible before assembling it with the terminal / socket. For preventing the ingress of moisture and possibility of re-oxidation after crimping of the aluminium conductors, the socket should be filled

with corrosion inhibiting compound. This compound should also be applied over the stripped portion of the conductor and the palm surface of socket.

- c) Correct size and type of socket / ferrule / lug should be selected depending on size of conductor, and type of connection to be made.
- d) Make the crimped joint by suitable crimping tool.
- e) If after crimping the conductor in socket / lug, some portion of the conductor remains without insulation the same should be covered sufficiently with PVC tape.
- f) For HT cable upto 11 KV the manufacturer's recommendation should be followed.

DRESSING OF CABLE INSIDE THE EQUIPMENT

- After fixing of cable glands, the individual cores of cable shall be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Cable shall be dressed in such a manner that small loop of each core is available inside the panel.
- For motors of 20 HP and above, terminal box if found not suitable for proper dressing of aluminium cables, the erector shall modify the same without any additional cost.
- Cables inside the equipment shall be measured and paid for.

IDENTIFICATION OF CABLES / WIRES / CORES

- Power cables shall be identified with red, yellow and blue PVC tapes. For trip circuits identification, additional red ferrules shall be used only in the particular cores of control cable at the termination points in the switchgear / control panels and control switches.
- In case of control cables all cores shall be identified at both ends by their wire numbers by mean of PVC ferrules or self sticking cable markers, wire numbers shall be as per schematic / connection drawing. For power circuit also, wire numbers shall be provided if required as per the drawings of switchgear manufacturer / supplier.

TESTING OF CABLES

- Before energising, the insulation resistance of every circuit shall be measured from phase to ground. This requires 3 measurements if one side is grounded and 6 measurements for 3 phase circuits.
- Where splices or terminations are required in circuits rated above 650 volts, measure insulation resistance of each length of cable before splicing and/or terminating. Repeat measurements after splices and/or terminations are complete.

DC high voltage test shall be made after installation on the following :

- a) All 1100 volts grade cables in which straight through joints have been made.
- b) All cables above 1100 V grade.

For record purpose test data shall include the measured values of leakage current versus time.

The DC high voltage test shall be performed as detailed below :

- Cables shall be installed in final position with all the straight through joints complete. Terminations shall be kept unfinished so that motors, switchgear, transformer etc. are not subjected to test voltage.
- The test voltage and duration shall be as per relevant codes and practices of Indian Standards Institution.

PROFORMA FOR TESTING CABLES

DATE OF TEST

- | | | | |
|------|-----------------------------------|---------|----------|
| a) | Drum No. from which cable taken. | | |
| b) | Cable from | to | |
| c) | Length of run of this cable | | meter |
| d) | Insulation resistance test | | |
| i) | between core-1 to earth | | mega-ohm |
| ii) | between core-2 to earth | | mega-ohm |
| iii) | between core-3 to earth | | mega-ohm |
| iv) | between core-1 to core-2 | | mega-ohm |
| v) | between core-2 to core-3 | | mega-ohm |
| vi) | between core-3 to core-1 | | mega-ohm |
| vii) | duration used : 1 KV | | |
| e) | High voltage test | Voltage | Duration |
| i) | between core an earth. | | |
| ii) | between individual cores | | |

[This proforma shall be jointly signed by the CLIENT / CONSULTANT and the contractor in duplicate].

EARTHING NETWORK

INSTALLATION AND CONNECTION

- The plate/pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case not less than 3 M below finished ground level.
- The plate/pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall / column.
- The plate electrode shall be installed vertically and shall be surrounded with 150 mm. thick layers of Charcoal dust and Salt mixture.
- 19 mm. dia. G.I. pipe for watering, shall run from top edge of the plate / pipe electrode to the mid level of block masonry chamber.
- Top of the pipe shall be provided with G.I. funnel and screen for watering the earth / ground through the pipe.
- The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber.
- The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry.
- Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS : 3043, Code of Practice for Earthing Installation.
- The earth conductors (Strips / Wires copper / Hot dip G.I.) inside the building shall properly be clamped / supported on the wall with Galvanised Iron clamps and Mild Steel Zinc

Passivated screws / bolts. The conductors outside the building shall be laid atleast 600 mm. below the finished ground level.

- The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished.
- Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long.
- The earth conductors shall be in one length between the earthing grid and the equipment to be earthed

EARTH LEADS AND CONNECTIONS

- Earth lead shall be bare copper or Galvanised steel as specified with sizes shown on drawings. Copper lead shall have a phosphor content of not over 0.15 %. G.I. strip buried in the ground shall be protected with bitumen and hessian wrap or polythene faced hessian and bitumen coating. At road crossing necessary hume pipes shall be laid. Earth lead run on surface of wall or ceiling shall be fixed on saddles so that strip is atleast 8 mm away from the wall surface.
- The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.

TEST

- The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS : 3041.
- The following earth resistance values shall be measured with an approved earth megger and recorded.
 - 1) Each earthing station
 - 2) earthing system as a whole
 - 3) Earth continuity conductors
- Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 5 ohm in each case.
- Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.
- All tests shall be carried out in presence of the Pmc

CONCEALED / SURFACE CONDUIT WORKS

LAYING OF CONDUITS

- Conduits shall be laid before casting in the upper portion of a slab / in PCC if below flooring or otherwise, as may be instructed in accordance with approved drawings, so as to conceal the entire run of conduits and ceiling outlet boxes. Conduits shall be so laid that they are interconnected. This is required to facilitate pulling of wires from different openings

in case of any of the outlet is outlet is blocked during slab casting. Vertical drops shall be cut by the contractor to sufficient depth to allow full thickness of plaster over conduits. The width of the chases will be made to accommodate the required number of conduits. The chases will be filled with cement, coarse

- When the conduit is to be embedded in a concrete member it shall be adequately tied to the reinforcement to prevent displacement during casting. Tie wire to be supplied by the contractor.
- Cutting of chases in any RCC member / finished floor / already finished surface is not allowed unless prior approval of Site Engineer is taken in site instruction book. If a chases is cut in an already finished surface, the contractor shall fill the chases and finish it to match the existing finish including painting at his cost to Site Engineer's satisfaction.
- Contractor shall not cut any iron bars to fix the conduits. Puncher of wooden / steel shuttering for RCC slab / beams / column etc. for conduit work is also not allowed, unless Site Engineer permits in site instruction book under special conditions.
- Run of conduit pipe through expansion joints in RCC members should be avoided as far as possible and if unavoidable, flexible conduit pipe should be used with ceiling outlet box on both sides of expansion joints.
- Conduit on surface of RCC walls / RCC members shall be avoided as far as possible and if unavoidable prior approval of Site Engineer on sample saddles, clamps screws and a minimum 5 mtr. conduit laid on surface shall be taken, to achieve best possible workmanship. Distance between 2 consecutive clamps for fixing conduit on surface shall not exceed 900 mm. wooden patties for fixing saddles / clamps shall be used. Use of roll plug / steel fastener with hard setting / sealing compound is recommended.
- In case of stone masonry, necessary conduits with M.S. boxes should be placed as the masonry is in progress, since after completing masonry, it is very difficult to cut chases in wells. Special location of cement concrete shaft is also recommended to conceal conduit in stone masonry and the same shall be provided by client / consultant.
- In ground floor conduiting below the flooring should be avoided. Wherever it is unavoidable G.I. pipe should be used with prior approval of Site Engineer.

CEILING / WALL OUTLET BOXES FOR LIGHTS / FANS

- Outlet boxes shall be of steel with aluminium cover and so installed as to maintain continuity throughout. These shall be protected at the time of laying by filling with jute / earth / cotton etc. so that no cement mortar finds its way inside during concreting or plastering etc. Typical sketches for such outlet boxes shall be supplied alongwith other working draws. In beams conduit socket shall be provided in place of outlet boxes. The same shall be used for installation of luminaire.
- For fixing light fixtures / brackets, outlet boxes complete with check nut for holding conduits shall be used. For lighting fixture suitable for 20 watts fluorescent tubes / incandescent lamps / mercury vapour lamps, only one outlet box is required. For fixing lighting suitable for 40 watts fluorescent lamps, two numbers outlet boxes should be provided at a distance of 300 mm. away from the centre in the longitudinal direction of the fixture, so that the use of patties / roll plug etc. may be avoided, as well as wiring from outlet box to the light fitting is to be installed in RCC beam and due to heavy reinforcement at the bottom of beam it is not

possible to provide outlet boxes simple conduit should be provided. However alternative fixing arrangement shall be made in consultation with client / consultant.

- For fixing ceiling fans, circular outlet boxes, 100 mm. diameter, complete with 12 mm. dia. Mild Steel rod 300 mm. long, for holding 12 mm. dia. Mild Steel cover 125 mm. dia. at bottom shall be used.

DRAW OUT JUNCTION BOXES

- Steel drawout boxes at angle dimensions shall be provided at a convenient points on walls / ceilings to facilitate pulling of long runs of cables / wires. These shall be completely concealed with Anodised Aluminium, flush with plaster works. These draw boxes should be five sided. The location of these boxes is to be decided prior to fixing, as per site requirement and following should be treated as general guidance for deciding the location of these :
- These should be provided at a place where these are not in direct view. Recommended place is 400 / 450 mm. below ceiling, if conduits are running vertically.
- Junction box in the offset of bottom of RCC beam and vertical wall should not be provided.
- If junction boxes are coming side by side for two or more conduits, one common M.S. box of proper size can be used to act as junction box.
- If junction box is to be provided in ceiling, its position should be so located that it is in line with other light / fan points.
- Junction boxes should never be used for splitting one conduit into two or more. Junction box for such functions is avoidable and for this, number of conduits to be connected to one switch board should be calculated correctly as per drawing before laying conduits in ceiling.
- Locating junction boxes on outer surface of exterior walls of building should be avoided as these are in direct view and are also exposed to weather.
- Junction boxes should never be closed permanently by plaster. Removable covering of aluminium should be provided for conduit junction boxes for M.S. junction boxes removable hylem plate should be provided. This cover may be painted with wall colour.
- Junction boxes in important areas should be avoided and can be located in toilets / corridors / service shafts and stores etc.

SWITCH BOXES

- Steel boxes of required sizes, shall be provided to house speed regulators of fans, switches for lights, fans, plug sockets etc. as per requirement of drawings. These should be so designed that accessories on Anodised aluminium sheet could be mounted with tapped holes and brass machine screws, leaving ample space at the back and on the sides for accommodating wires and check nuts at conduit entries. These shall be attached to conduits by means of check nuts on all walls of the boxes through which the conduits are entering. These shall be completely connected leaving edges flush with finished wall surfaces. Anodised aluminium cover should be fixed to these switch boxes by means of brass chrome plated machine screws and cup washers. Utmost care shall be taken by contractor to ensure that all switch boxes are in line and level.

- Inside each switch box, one bolt shall be welded to receive earthing wire.

SWITCH AND SOCKET

- Switches shall be installed at 900 mm above finished floor level unless otherwise indicated on the drawings.
- The switch controlling the light point or fan shall be connect on to the phase wire of the circuit and neutral shall be continuous, having no fuse or switch installed in the line except at the D.B. All fan regulators shall be fixed inside the switch boxes on adjustable flat M.S. strips / plates with tapped holes and brass machine screws, leaving ample space at the back and side for accommodating wires.
- The cover plates to the switch box shall be fixed by means of sunk head brass cadmium screws.
- Where two or more switches and fan regulators are installed together, they shall be provided with one gang cover plate with knockouts to accommodate required number of switches, sockets and regulators.
- The switch controlling the socket outlet shall be on the phase wire of the circuit. The third pin of the socket shall be connected to the earth continuity conductor of the circuit
- The switch boxes, installed back-to-back in the same wall shall be offset from each other, 150 mm horizontally, to preclude noise transmission.

CLEANING AND PROTECTION OF CONDUIT SYSTEM

- The entire conduit system including outlet boxes, junction boxes and switch boxes shall be thoroughly cleaned after completion of erection and tested for not blockage by air / sound or steel wire prior to finishing of building by air / sound or steel wire prior to finishing of building and before drawing in of cables / wires to safeguard conduit system against filling up with the plaster / cement slurry / water etc. all the outlet and switch boxes will have to be provided with temporary jute / cotton filling, covers and plugs etc.. Within tendered cost which shall be replaced later on by hylem / sheet cover after wiring as required.

TESTING OF INSTALLATION

- Before a completed installation is put into service, the following tests shall be complied with:

INSULATION RESISTANCE

- The insulation resistance shall be measured by applying 500 volt megger with all fuses in places, circuit breaker and all switches closed.
- The insulation resistance in Mega ohms of an installation, measured shall not be less than 50 mega ohms divided by the number of points on the circuit.
- The insulation resistance shall be measured between
EARTH TO PHASE
EARTH TO NEUTRAL
PHASE TO NEURAL
PHASE TO PHASE

EARTH CONTINUITY PATH

- The earth continuity conductors shall be tested for electrical continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit-breaker measured from the connection, with the earth electrode to any point in the earth continuity conductor in the completed installation and shall not exceed one ohm.

POLARITY OF SINGLE POLE SWITCHES

- A test shall be made to verify that every no-linked, single pole switch is connected to one of the phase of the supply system.

COMPLETION CERTIFICATES

- All the above tests shall be carried out in presence of client and the results shall be recorded in a prescribed form. Any default during the testing shall be immediately rectified and that section of the installation shall be re tested. The completed test result from shall be submitted to the client for approval.
- On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.

INSTALLATION OF LIGHTING FIXTURES / FANS

INSTALLATION OF LIGHTING FIXTURES

- Scope of work under this item shall start from light point, with a 5 A Bakelite connector, 2 core 1.5 mm.² PVC insulated wires from this connector to the connector inside the lighting fixture, connections, fixing of lighting fixture complete with all accessories, lamps on wall / roof / steel truss etc. testing the lighting fixture and commissioning. If wire length of light point is enough to reach connector of light fitting, connector in light point can be deleted.

INSTALLATION OF EXHAUST FANS

- Scope of work under this system shall start from exhaust fan point, with a ceiling rose, 2 core 1.5 mm.² PVC insulated wire from ceiling rose to connector of exhaust fan, connections, making fan opening in walls including repair / finishing fixing of exhaust fan complete with accessories and louvers on walls with hold-fasts, testing the exhaust fans and commissioning.

INSTALLATION OF EXTERNAL LIGHT FIXTURES

BRACKET FOR STREET LIGHT FITTINGS

- The brackets shall be made of 38 mm. NB MS class "B" pipe approx. 1.8 mtr. long bent at the centre at an angle 120° C. with necessary holding brackets, hold fasts etc. with special reducer at the end to accommodate type of street light fitting to be fixed. Bracket shall have 1 coat of anti-corrosion paint before despatch to site and 2 coats of approved make and shade of aluminium paint. This bracket shall also be provided with one M.S. water tight box complete with the connector, neutral link, rewirable fuse etc.. See enclosed drawings of street light poles.

INSTALLATION OF POLES

- Installation of poles shall be done as per enclosed drawings of street light poles. The depth of pole to be buried in ground shall be $1/5^{\text{th}}$ of the total pole length or as specified in drawing, whichever is more. Special care shall be taken in erecting poles so that these are not strained or damaged during erection and are firmly stayed till the foundation are secured. The pole shall be grouted inside ground pit (cross-section 600 x 600 mm.) with cement concrete 1:2:4. Before the placement of concrete around pole in the pit, necessary conduit pipes (not less than 25 mm. dia.) shall be placed for facilitating drawing of cables. Separate conduit shall be provided for incoming and outgoing cables. The cement concrete shall be protected from premature drying by curing for at least 7 days after pouring. All concrete surface from 150 mm. below ground level to top shall be finished smooth with cement mortar 1:4.

INSTALLATION OF STREET LIGHT FIXTURES

- This includes fixing of street light fittings complete with accessories and lamps at the end of the pole / bracket, connecting it with 3 x 1.5 mm.² aluminium conductor, PVC insulated cable from water tight M.S. box, testing, commissioning. Third core shall be connected with earthing point of light fitting at one end and earthing point of marshalling box at the other end.

GENERAL NOTES FOR STREET LIGHTING

- For supplying and laying of cables, technical specification (wiring) shall be applicable reference shall be made under heading Cable Work elsewhere in the tender.
- For street light poles along roads, nearest finished road level shall be taken as ground level and for poles along compound wall / away from roads, existing ground / finished ground shall be taken as ground level.
- Distance of 1 mtr. shall be maintained between centre of pole and centre of curb of road. For compound wall poles, distance between compound wall and poles shall be 3 mtrs.
- A loop of 1.5 mtr. of cable shall be provided near each street light pole for all incoming and outgoing cable.

COMPLETION TESTS

- After supply and installation of complete project or a particular building / area, following tests shall be carried out by the contractor before switching on the power to installation and the results shall be recorded and submitted to the Site-Engineer. If results are not satisfactory / as per standards set herewith, the contractor shall identify the defects / short coming and shall rectify the same. Nothing extra shall be paid for carrying out these tests and contractor has to arrange all necessary instruments.

INSULATION RESISTANCE TO EARTH

- This is to be measured with all fuse links in place, all switches ON, all lamps and appliances in position by applying a voltage not less than twice the working voltage (subject to a limit of 500 V). Insulation resistance of the whole or any part of the installation to earth must not be

less than 50 mega-ohms divided by the number of outlets (points and switch positions) except that it need not exceed one mega-ohm for the whole installation.

INSULATION RESISTANCE BETWEEN CONDUCTORS

- Tests to be made between all the conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or neutral or the other pole or phase conductors of the supply. For this test, all lamps shall be removed and all switches put ON. The result of the test must be 50 mega-ohms divided by the number of outlets (points and switch positions) but need not exceed 1 mega-ohm for the whole installation.

POLARITY OF SINGLE POLE SWITCHES

- Tests shall be made to verify that all non-linked single pole switches are on phase conductor (live) and not on neutral or earth conductor. This can be done by connecting test lamps between two terminals of switch and earth. If the lamp lights up when switch is ON and either terminal is touched, the switch is correctly installed.

RESISTANCE OF METAL CONDUITS / SHEETS (EARTH CONTINUITY TEST)

- In case of cables encased in metal whether conduit of metallic sheathing, the total resistance of the conduit or sheathing from the earthing point any other position in the completed installation shall not exceed 2 ohms. This can be carried out by following circuit :
- One end of the lead is connected to the ECC and its connection with the electrode and the other to the farthest point of the ECC. First, current through the circuit is measured with the resistance of 2 ohms short circuited by the link. Next, current is measured through the two ohms resistance by disconnecting the two leads from the ECC and joining them together. If current is more in the first case, the resistance of ECC is less than 2 ohms.

HANDING OVER / TAKING OVER

- After completion of works and tests specified above, the various building of the project can be taken over by the employer as and when these are ready in all respects. However, the defect liability period of 12 months would start from the date, when all the buildings of the project have been completed and handed over, unless employer agrees for defect liability period in phased due to non-completion of civil work of few buildings for which electrical contractor is not responsible.

TOOLS AND TEST EQUIPMENT

- The Tenderer shall indicate the makes of tools, test equipment and other item listed below:

TOOLS

- a) Set of spanners of sizes 6 mm to 32 mm width across flat
 - i) Adjustable wrench of 36 mm jaw width
 - ii) Adjustable wrench of 23 mm jaw width
- b) Heavy duty screw driver with full size insulated handle and blade length of
 - i) 100 mm
 - ii) 50 mm
 - iii) 200 mm

TEST EQUIPMENT

- a) 2500 V megger motor operated
- b) 500 V megger hand operated
- c) Multimeter (Battery operated) satisfying the following
 - i) With 0-1 mA, 0-100 mA, 0-1A and 0-5A, AC & DC current ranges
 - ii) With 0-100 mV, 0-3V, 0-30 V, 0-300 V and 0-1000V AC & DC voltage ranges
 - iii) The resistance ranges shall be atleast five (0-100) m ohm, (0-1) Ohm, (0-10) Ohm, (0-100) Ohm, (0-100) mega ohm
 - iv) The Input impedance shall not be less than one mega Ohms for voltage ranges

LADDERS

- Ladder shall be made out of light aluminium alloy of good strength. They shall be of step ladder, foldable, self supporting type with spreader of metallic angles or high strength nylon straps. The ladder shall be provided with shoes on bottom of legs. Rugs shall be flat type having thickness of 30 mm in case of 3 meters long ladders and 60 mm for 6 metres long ladder.
 - i) 3 metres long
 - ii) 6 metres long
- Tong tester - ammeter range 0 to 30, 150 & 300 Amps AC and voltmeter (0-600) V, class 1.0 with leads and leather case.

PAINTING

This section covers the general requirements of Painting all the M.S. parts / structure including Panel boards, L.D.B.'s etc. and applicable to wherever require in specification and BOQ.

STANDARD

- Painting shall be done in accordance with IS :1477 (Part I) 1971 and IS : 1477 (Part II) 1971.

GENERAL

CLEANING

- All surfaces which are to be painted or otherwise treated shall be dry and thoroughly cleaned to remove all loose scale and loose rust.
- The surface should be washed with water to get rid of salts, fertilisers and other particles adhering to the surface. The surface is to be dried by air.
- The surface has to be cleaned by using hand tools such as wire brushes and scrapers. Wire brushing and scraping will produce a uniformly roughened surface which would help in improving the adhesion of subsequent paint coatings.

SEVEN TANK PROCESS

- This process applied for the Panel boards and L.D.B.'s. All sheet steel work shall undergo a process of degreasing, pickling in Acid, Cold rinsing, phosphating, passivating and then sprayed with a high corrosion resistant primer. The primer shall be backed in an oven. The finishing treatment shall be by application of coats of Powder of approved colour and shall be applied by gum and stored in dust free atmosphere.

PRECAUTIONS AND INSPECTION DETAILS

- The surface to be painted is to be prepared as per specification. No dust, grease or loosely adhering particles to be present.
- All equipments for application i.e. compressor, nozzles, hoses etc. to function properly. Brushes to be clean and free from contamination.
- In case solvent wiping is done with a swab, care to be taken that the localised grease or oil spot is removed effectively and a thin layer of the same is not spread over a large area. The same swab not to be used again.
- The painter and helper to be provided with protective clothing rubber glove, face mask, eye shields etc. to protect them against solvent vapours and over-sprays. Contact with the skin to be avoided and suitable barrier cream to be used to protect against vascular action.
- The container drums to be rolled on a wooden plank for 10-15 minutes before opening. The contents must be stirred well to get complete dispersion of pigments. Consistency to be checked and adjusted for application, if necessary.
- Base and Catalyst are to be mixed thoroughly in the given proportion only and more quantity not to be mixed keeping in mind the limited pot life of the mixture.

- Recommended interval in between the coats is to be given to get the desired inter coat adhesion.
- All painting programme are to be well planned giving the allowance for inclement weather and unfavourable atmosphere conditions.
- All other safety precaution are to be taken in compliance with regular painting practise.
- Adequate ventilation is to be provided in case painting is carried out in a confined space. Also in order to ensure that solvent is not retained in the container during the curing reaction, the ventilation to be continued for 4-6 hours after the painting is over.
- Care must be taken to see the coatings, by whatever method, is applied, produces a continuous, uniform film.
- They should be follow the instructions given by the paint manufacturer before application of paint.
- The thickness of the paint coating may be measured using paint inspection Gauge. This instrument gives the individual thickness of each coat of the paint.

AUXILIARY ITEMS FOR ELECTRICAL INSTALLATIONS

LOCAL PUSH BUTTON STATIONS

CONSTRUCTION FEATURES

- The constructional features of the local push button stations shall be as follows:
 - a. Metal enclosed, weather proof, suitable for mounting on wall or steel structures. The enclosure shall be die cast aluminium or sheet metal of 2 mm thickness.
 - b. Outdoor type push buttons shall be completely, weather, dust and vermin proof and shall be provided with canopy. Degree of protection shall be IP:55.
 - c. Metal parts shall be given tropicalising treatment as per standards and painted with one coat of epoxy primer and two coats of light gray epoxy paint.
 - d. Provided with inscription plates of rear engraved Perspex with white letters on black background. The letter size shall be 6 mm.
 - e. Provided with two earthing terminals suitable for 14 SWG G.I wire.
 - f. Provided with removable undrilled gland plate and cable glands for appropriate sizes of cable. The cable entry shall be from the bottom.
 - g. Push button contact shall be designed for extra robust both mechanical and electrical operation. High quality material shall be used in their construction to ensure mechanical life exceeding 10 million switching operations. The contact shall be of silver alloy of 10 A continuous current rating.

PUSH BUTTONS

- a) All push buttons shall be:
 - i) Fitted with one (1) normally open and one (1) normally closed contacts rated to carry and breaks 6 Amps at 415 Volts (10 A at 240 V AC)
 - ii) Provide integral escutcheon plates marked with its function.
- b) The open/close/start push buttons shall be of the momentary contact push to actuate type and shall be green in colour.

TYPE OF PUSH BUTTON STATIONS

- The following types of push button stations shall be supplied:
 - i) Push button station, suitable for indoor/outdoor installation and shall comprise two push buttons viz 'START' and 'STOP' for control of non-reversible motors with on indicating lamp. Both the P.B. shall be of lockable type with key.

APPLICABLE STANDARDS

- All applicable standards and code of practices referred to shall be the latest editions including all official amendments and revisions.

Push buttons and related control switches : IS-6875.

INSPECTION & TESTING

- The local push button stations shall be offered for inspection after assembly. Routine and acceptance tests shall be carried out during inspection.

TEST EQUIPMENTS

- Vender shall ensure to use calibrated test equipment having valid calibration test certificates from standard laboratories traceable to National Standards.

DRAWINGS

- On award of the contract, the contractor shall submit the fully dimensioned general arrangement drawings complete with plan, elevation and sectional views.

CABLE TRAY

- The scope covers design and manufacture, inspection, testing and delivery of cable trays, necessary hardware, fittings & accessories.

GENERAL REQUIREMENTS

- The cable trays shall be prefabricated hot dip galvanised ladder type. The ladder type trays shall consist of side runners and horizontal rungs.
- The ladder type trays and its accessories shall have rigid welded construction and shall be fabricated out of 2mm thick Hot rolled sheet steel. The rungs shall be welded to the side runners.
- Side runners shall be 75 x 15mm channel with the flange facing inside. Rungs shall be 35 x 15mm slotted channel type construction and shall be spaced 250mm apart. All perforated channel type tray shall be 30mm high one piece channel made out of 2 mm thick sheet steel and hot dip galvanised.
- Cable trays shall be suitable for a cable weight of 100kg/mtr. running length of tray and it shall be supported @ 2m intervals.
- The side runner channel and all accessories will have two holes on each end for fixing splice plates. Two splice plates (one on inside face and one on outside face) will be provided for each side runner. The side runner will also have suitable holes at every metre for cleating earthing strip. Suitable tapped holes shall be provided on the runner top and bottom for supporting and fixing tray covers at every metre.
- Hot dip galvanising shall be done after fabrication as per relevant Indian Standards Specification. The amount of galvanising shall be 816 gm/m².
- The type of construction shall be such as to facilitate easy handling, assembly and installation at site. The straight length of cable tray shall be min. 1.5 metres (without splice plate).
- The workmanship shall be such as to ensure easy laying of cables without causing damage to cables. All surfaces shall be free from defects such as burrs, sharp edges etc.

- The hardware shall conform to relevant Indian Standard specifications and shall be able to withstand the maximum loading conditions as required. All hardware fittings shall be hard chrome cadmium plated/zinc passivated. All hardwares shall include bolts, nuts and washers etc.
- The bends, tees, reducers and droppers shall have bending radius of 750mm for L.T. & 1250mm for HT cables respectively.

DATA SIGNAL CABLES

- Part No. 3105A, Tin Coppered (Data lane) Insulated, Twisted pair overall 100% Coverage Belofoil, Al., Polyester Shield, 22 AWG (7 x 30), Standard Tinned Copper Train Wire, Overall 90% coverage, Tin Copper braid, Shield, Black, UV resistance, PVC jacket, colour chart, Part - 1, colour White / Blue.

LIGHTING CONTROLLER

SCOPE

- The scope covers design, manufacture, supply, installation, connection, testing of relay based lighting controller as mentioned below.

GENERAL

Incomer supply	:	230 V, 50 Hz.
Outputs	:	10 Amp. Switchcted output
Channels	:	12 / 6
Protection	:	10 Amp. SP MCB
Switching Device	:	16 Amp. Contactor
Memory	:	96 scene EEPROM
Network control	:	Required
Communication port	:	RS - 485
Analog control	:	Required
Electronic Ballast control	:	Required
Key pad interface	:	Required
Panic / fire alarm input	:	Required
Fade times	:	0 - 10 seconds
Presels	:	Internal selectable
Construction	:	Steel with powder coating

Mounting : Wall mounting

JUNCTION BOX

- The junction box shall be made out of 2 mm mild steel sheet.
- The total depth of junction box shall be 65 mm while the width and length shall be 300 mm.
- The lower compartment shall accommodate the cables running through the junction box.
- The upper compartment shall be used for diverting cable out of floor trunking for further drawing through the conduit.
- The upper compartment shall be provided with knock out for conduit entry on two opposite sides perpendicular to main run of the floor trunking.
- The partition plate between upper and lower compartment shall have opening in staggered way for bringing out cable from trunking.
- The top cover of the junction box shall be hinged type and shall be made from brass / SS. So as to give decorative look to the exposed cover top.

ELBOW / TEE JOINT

- It shall be made out of 2 mm mild steel sheet.
- The total depth shall be 65 mm while the width and length shall be 300 mm.
- The lower compartment shall accommodate the cables running through the junction box.
- The upper compartment shall be used for diverting cable out of floor trunking for further drawing through the conduit.
- The upper compartment shall be provided with knock out for conduit entry on free side opposite to the direction of turn of ELBOW and free side of TEE JOINT.
- The partition plate between upper and lower compartment shall have opening in staggered way for bringing out cable from trunking.
- The top cover of the junction box shall be hinged type and shall be made from brass / SS. So as to give decorative look to the exposed cover top.

PAINTING

- The painting process shall be of seven tank process.
- The primer shall be bromite based red oxide. Two coat of red oxide shall be applied.
- The outer surface shall be coated using two coat of black coal tar compound.

TECHNICAL SPECIFICATIONS FOR INTERNAL WIRING (BOQ - POINT WIRING)

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TECHNICAL SPECIFICATIONS FOR INTERNAL WIRING

1.0 SCOPE OF WORK

- 1.1 This section covers, definition of point wiring, system of wiring and supply, installation, connection, testing and commissioning of point wiring for light points, ceiling fan points, exhaust fan points, convenience socket outlet points, power socket outlet points, bell outlet points etc. including fixing of light fixtures, ceiling fan, exhaust fan, wall fan, bell etc

2.0 CODES & STANDARDS

- 2.1 The following standards and rules shall be applicable:

Sr.	Item	Relevant IS	Relevant IEC
1	Code of practice for electrical wiring installation (System voltage not exceeding 650 V)	IS: 732	
2	Code of practice for fire safety of buildings (General) Electrical installation.	IS: 1646	
3	Rigid steel conduits for electrical wiring.	IS: 9537 (Part - 2)	
4	Fittings for rigid steel conduits for electrical wiring.	IS: 2667	
5	Flexible steel conduits for Electrical wiring.	IS: 3480	
6	Accessories for rigid steel conduit for electrical wiring.	IS: 3837	
7	PVC insulated cables.	IS: 694	
8	Rigid non-metallic conduits for electrical wiring.	IS: 9537 (Part - 3)	
9	Flexible (Pliable) non-metallic conduits for electrical installation.	IS: 6946	
10	3 pin plugs and sockets.	IS: 1293	
	Specifications of conduits for electrical installation.	IS: 8130	
	Switches for domestic purpose.	IS: 3854	
	Fittings for rigid non-metallic conduits.	IS: 3419	
	Guide for electrical layout in residential buildings Indian electricity act and rules.	IS: 4648	

3.0

TECHNICAL REQUIREMENTS

4.1 POINT WIRING

- 4.0** 4.1.1 A point shall consist of the branch wiring from the distribution board together with a switch as required, including the ceiling rose or pendant holder or swan holder, or ceiling fan box or socket or suitable termination. A point shall include, in addition, the earth continuity conductor/wire from the distribution board to the earth pin/stud of the outlet/switch box and to the outlet points

- 4.1.2 Supply, installation, fixing of conduits with necessary accessories, junction/pull/inspection/switch boxes and outlet boxes

- 4.1.3 Supplying and drawing of wires of required size including earth continuity wire

- 4.1.4 Supply, installation and connection of flush type switches, sockets, cover plates, switch plates, and fixing fan regulator etc

- 4.1.5 The point shall be complete with the branch wiring from the distribution board to the outlet point, through switch board, conduit with accessories, junction, pull, inspection boxes, control switch, socket, outlet boxes, ceiling roses, button/swan holder, connector etc

4.2 POINT RATE

- 4.2.1 The rate per point shall include supply, installation, connection, testing and commissioning of point as described under "point wiring". The measurements of the points will be enumerated

4.3 SYSTEM OF WIRING

- 4.3.1 Unless otherwise mentioned on the drawings, the system of point wiring shall be as follows:

The system of wiring shall consist of single core, FRLS insulated, 650/1100 volt grade, copper conductor wires/cables laid through exposed (surface mounted) PVC conduits as directed & wherever required, conduits shall be concealed in walls and slabs

4.4 GENERAL

- 4.4.1 Prior to laying of conduits, the contractor shall submit for approval, the shop drawing for conduit layout indicating the route of the conduits, number and size of the conduits, location of junction/inspection/pull/outlet boxes, size and location of switch boxes, number and size of wires pulled through each conduit and all other necessary relevant details. Only after the drawings are approved, the contractor shall proceed with the work of laying of conduits.

4.5 MATERIAL

4.5.1 PVC Conduit

All non-metallic PVC conduits shall conform to IS: 9537 (Part - 3). The conduit shall be planed and of type as specified in IS: 9537 and shall be used with the corresponding accessories (Refer IS: 3419 specification for fittings for rigid non metallic conduits). PVC conduits shall be rigid unplasticised, heavy gauge

having 2.0 mm. wall thickness upto 20 mm. diameter conduit and 2.5 mm. wall thickness for all sizes above 20 mm. diameter

4.5.2 M.S. Conduit

Conduits shall conform to IS: 9537 (Part - 2), finished with galvanized surface. No steel conduit less than 25 mm. in diameter shall be used. Conduits shall be solid drawn or lap welded type, with minimum wall thickness for conduits having 25 mm. and above diameter

The conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of manufacturers

The conduit accessories such bends, coupling etc. shall be conforming to the relevant Indian Standard specification

4.5.3 Boxes

1. All the boxes for switches, sockets and other receptacles, junction boxes, pull boxes and outlet boxes shall be fabricated from 2.0 mm. thick mild sheet painted with two coats of red-oxide and then two coats of enamel paints as called for. Colour of the paints shall be as approved by the client. The boxes shall have smooth external and internal finished surface
2. Boxes in contact with earth or exposed to the weather shall be of 2 mm. mild steel and hot dip galvanized after fabrication
3. Separate screwed earth terminal shall be provided in the box for earthing purpose
4. All boxes shall have adequate no. of knock out holes of required diameter for conduit entry
5. Switch boxes to receive switches, socket outlets, power outlets, telephone outlets, fan regulators, etc. shall be fabricated to the approved shape and size to accommodate all the devices without overcrowding.
6. Outlet boxes to receive ceiling fan shall be fitted with adequately sized rod
7. Hook to fix ceiling fan. The boxes shall be of minimum depth of 65 mm.
8. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers as required. Boxes for use in masonry block or tiled walls shall be square cornered tile type, or standard boxes having square cornered tile type covers. These boxes shall be installed in the center of the masonry block or tiles

Cast metal boxes installed in wet locations and boxes installed flush with the outside of exterior surface shall be gasketed

4.5.4 Cover Plate

The cover of the boxes to receive outlet points shall be of best anodized sheet cut to shape and size or plate of approved manufacturers of switches

4.5.5 Cables

1. The cables shall conform to IS: 694. For all internal wiring FRLS insulated cables of 650/1100 volts grade, single core shall be used
2. The conductors shall be plain annealed copper conductors complying with IS: 1554
3. The conductors shall be circular copper conductor
4. The insulation shall be FRLS compound complying with the requirements of IS: 694. It shall be applied by an extrusion process and shall form a compact

homogenous body.

5. The thickness of FRLS insulation shall be as set out in the relevant standards
6. The cores of all cables shall be identified by colours in accordance with the following sequence.

Single phase	Red
Three phase	Red, Yellow, Blue
Neutral	Black
Earth	Green or Green/Yellow

7. Means of identifying the manufacturer shall be provided throughout the length of cable
8. Unless otherwise specified in the drawings the size of the cables used for internal wiring shall be as follows:
 - In case of circuit wiring for lights, exhaust fans, ceiling fans, bell, convenience socket outlet points (P+N+E):

2.5sq.mm.	From D.B. to switch boards.
1.5sq.mm.	From switch boards to outlet points

- In case of power socket outlet circuit having not more than two 15 A power outlet (P+N+E):

4.0sq.mm.	From D.B. to first power outlet
2.5sq.mm.	From first power outlet to second power outlet

- In case of power socket outlet circuit having single 15 A power outlet (like water heater) (P+N+E):

4.0sq.mm.	From D.B. to power outlet.
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- In case of 15 A. power outlet for window Air conditioner or other likewise appliances (P+N+E):

4.0sq.mm.	From D.B. to power outlet.
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9. The earth continuity conductor shall be similar to circuit cables and shall be drawn through conduit alongwith other circuit cables. The size of the earth continuity conductor shall be as follows:

MINIMUM SIZE OF EARTH CONTINUITY CONDUCTOR NOT FORMING PART OF THE SAME CABLE AS THE ASSOCIATE CIRCUIT CONDUCTOR

Nominal cross-section area of largest associated copper circuit conductor in sq.mm.	Nominal cross-sectional area of earth continuity conductor in sq.mm.
1.5	1.5
2.5	2.5
4.0	4.0

9. Separate circuit shall run for each water heater, kitchen equipment, window air conditioner, and similar outlets at location as shown on drawing

4.5.6 Switches

1. Switches shall conform to IS: 3854, IS: 1293 and IS: 4615. The switches shall be single pole, single or two way as shown on the drawings or as specified. They shall be of moulded type rated for 250 volt, and of full 5/15 A capacity.

They shall be provided with insulated dollies and covers

2. The switches shall be rocker operated with a quiet operating mechanism with bounce free snap action mechanism enclosed in an arc resistant chamber.
3. The switches shall have pure silver and silver cadmium contacts.
4. The switches shall be flush modular type.
5. The make of the switches shall be as indicated in the drawings or BOQ or make of material or as suggested and approved by the client.

The switches installed in outdoor area shall be industrial, metal clad type, and shall be provided in weather proof enclosures, complete with weather proof gasketed covers.

4.5.7 Socket

1. The sockets shall conform to IS: 1293. Each socket shall be provided with control switch of appropriate rating. The sockets shall be moulded type, rated for 250 volts, and either of full 5 A or 15 A capacity, as mentioned on the drawings.
2. Sockets shall be of three pin type, the third in being connected to earth continuity conductor.
3. The socket shall be flush modular type.
4. The sockets installed in machine room, plant room or wet/damp area shall be metal clad weather proof type.
5. The finishing and make of all the sockets shall be same as light switch.
The socket shall have fully sprung contacts and solid brass shrouded
6. Terminals to ensure positive electrical connections.
7. The sockets shall be provided with automatic shutters, which open only when earth pin of the plug inserts in the socket.

The socket shall be provided with three pin plug top suitable to the socket and of the same make as socket.

5.0 INSPECTION AND TESTING

6.1 INSULATION RESISTANCE TEST

6.0 6.1.1 The insulation resistance shall be measured by applying 500 volt megger with all fuses in places, circuit breaker and all switches closed

6.1.2 The insulation resistance in megohms of an installation, measured shall not be less than 50 megohms divided by the number of points on the circuit

6.1.3 The insulation resistance shall be measured between

1. EARTH TO PHASE
 2. EARTH TO NEUTRAL
 3. PHASE TO NEUTRAL
- PHASE TO PHASE

6.2 EARTH CONTINUITY PATH

6.2.1 4. The earth continuity conductors shall be tested for electrical continuity and the electrical resistance of the same along with the earthing lead but excluding

any added resistance or earth leakage circuit-breaker, measured from the connection, with the earth electrode to any point in the earth continuity conductor in the completed installation and shall not exceed one ohm

6.3 POLARITY OF SINGLE POLE SWITCHES

- 6.3.1 A test shall be made to verify that every no-linked, single pole switch is connected to one of the phase of the supply system

6.4 COMPLETION CERTIFICATES

- 6.4.1 All the above tests shall be carried out in presence of client and the results shall be recorded in prescribed forms. Any default during the testing shall be immediately rectified and that section of the installation shall be re tested. The completed test result form shall be submitted to the client for approval
- 6.4.2 On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.

INSTALLATION OF THE SYSTEM

7.1 CONCEALED INSTALLATION WITH RIGID PVC CONDUIT

- 7.0 7.1.1 All the rigid PVC conduit used for concealed installation shall be as per IS : 9537 and its accessories shall be as per IS: 3419 (Small Wire Ropes).
- 7.1.2 Whenever necessary bends or diversion may be achieved by bending the conduits with the help of bending spring. No other method of bending is allowed
- 7.1.3 Conduit pipes shall be joined with the help of plain coupler fixed at the end with the help of vinyl solvent cement. No other method of joining is permissible
- 7.1.4 All other methods, no wires through conduit, bunching, etc. Shall be as specified in the concealed installation
- 7.1.5 Prior to fixing the conduits, the complete route shall be marked on site for the approval of consultant

7.2 CONCEALED WIRING SYSTEM WITH RIGID PVC CONDUIT

- 7.2.1 The rigid PVC conduits shall be used for concealed wiring system. The conduits shall be concealed in the concrete slab, floor, walls, beams, columns etc

7.2.2 FIXING OF CONDUIT

1. Conduits embedded in concrete shall be installed in the frame work before pouring concrete. The conduits shall be installed above the bottom reinforcing bars, and shall provide positive wire fastening of the conduit to the reinforcing rods at an interval of not more than one meter, but on either side of couplers or bends or putlet/pull/junction boxes or similar fittings, proper hold fast shall be fixed at a distance of 30 cm from the center of such fittings. Conduits embedded in the wall shall be fixed inside the chase . The chase in the wall shall be neatly made and be fixed in the manner desired. In the case of building under construction, chase shall be provided in the wall at the time of their construction and shall be filled up neatly with cement mortar 1:4 after erection of conduit and brought to the original finish of the wall. Cutting of horizontal chases in walls is prohibited. The conduits

shall be fixed inside the chase by means of staples or by means of saddles not more than 60 cm apart.

2. Conduits shall be so arranged as to facilitate easy drawing of wires through them. Entire conduit layout shall be done in such a way as to avoid additional junction boxes other than light points. The wiring shall be done in a looping manner. All the looping shall be done in either switch boxes or outlet boxes. Looping in junction or pull boxes are strictly not allowed. Where conduits cross building expansion joints, adequate expansion fittings or other approved devices shall be used to take care of any relative movement
3. All conduits shall be installed so as to avoid steam and hot water pipes
4. Conduits shall be installed in such a way that the junction, derivation and pull boxes shall always be accessible for repairs and maintenance work. The location of junction/pull boxes shall be marked on the shop drawings and approved by the client
5. A separation of 200 mm shall be maintained between electrical conduits and hot water lines in the building
6. No run of conduit shall exceed ten mtr. between adjacent draw in points nor shall it contain more than two right angle bends, or other derivation from the straight line
7. Caution shall be exercised in using the PVC conduits in location where ambient temperature is 50 degree cel. or above. Use of PVC conduits in places where ambient temperature is mote than 60 deg. cel. Is prohibited. The entire conduit system including boxes shall be thoroughly cleaned after completion of installations and before drawing of wires. Conduit system shall be erect and straight as far as possible. Traps where water may accumulate from condensation are to be avoided and if unavoidable, suitable provision for draining the water shall be made
8. All jointing method shall be subject to the approval of the client
9. Separate conduits shall be provided for the following system.
 - 15 A power outlets.
 - 5 A outlets and lighting system.
 - Low voltage system.
 - Telephone/intercom system.
 - C.C.T.V. system
 - Sound system
 - Computer data cabling system

Equipment wiring

7.3 CONDUIT JOINT

- 7.3.1
 1. Conduits shall be joined by means of plain couplers vinyl and/or solvent cement. Where there are long runs of straight conduit, inspection type couplers shall be provided at intervals , as approved by the client
 2. The conduits shall be thoroughly cleaned before making the joints
 - In case of plain coupler joints, proper jointing material like a vinyl solvent cement (gray in color) or any material as recommended by the manufacturer shall be used.

7.4 BENDS IN CONDUIT

7.4.1 3. Wherever necessary, bends or diversions may be achieved by bending the conduits or by employing normal bends. No bends shall have radius less than 2.5 times outside dia. of the conduit

7.4.2 Heat may be used to soften the PVC conduit for bending, but while applying heat to conduit, the conduit shall be filled with sand to avoid any damage to the conduit

7.3 OUTLETS

7.3.1 All the outlets for fittings, switches etc. shall be boxes of substantial construction

7.3.2 In order to minimize condensation or sweating inside the conduits, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects , etc.

7.3.3 Fixing between conduit and boxes, outlet boxes, switch boxes and the like must be provided with entry spouts and smooth PVC bushes.

7.3.4 Joints between conduit and any type of boxes shall be affected by means of conduit couplers in to each of which shall be coupled smooth PVC bush from inside the box. In any case all the joints shall be fully water tight.

7.4 BUNCHING OF CABLES

7.4.1 Cables of AC supply of different phase shall be bunched in separate conduits

7.4.2 The number of insulated wires/ cables that may be drawn into the conduits shall be as per the following table. In this table, the space factor does not exceed 40%. However, in any case conduits having lesser than 19 mm dia. shall not be used.

MAXIMUM PERMISSIBLE NUMBER OF 650 VOLT GRADE SINGLE
CORE CABLES THAT MAY BE DRAWN IN TO RIGID PVC CONDUITS.

CABLE SIZE IN MM SQ.	S I Z E O F C O N D U I T S (MM)			
	MAXIMUM NO. OF CABLES			
	25	32	38/40	51/50
1.5	8	15	---	---
2.5	6	10	---	---
4.0	4	8	12	---

7.5 WIRING WITH RIGID STEEL CONDUIT

7.5.1 All conduits and it's accessories shall be of threaded type and under no circumstances pin grip type or clamp type accessories be used

7.6 FIXING OF CONDUIT

7.6.1 Conduit pipes shall be fixed by heavy gauge spacer bar saddles. The saddles shall be of 3 mm x 19 mm galvanized mild steel flat, properly treated and securely fixed to support by means of nuts and bolts raw bolts, brass machine screws, as mentioned, at an interval of not more than one meter but on either side of couplers, or bends, or junction/pull/outlet boxes or similar fittings, saddles shall be fixed at a distance of 30 cm from the centre of such fittings.

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- 7.6.2 Draw boxes shall be located at convenient location for easy drawing of wires
- 7.6.3 Every mains and sub mains shall run in independent conduits with an independent earth wire of specified capacity along the entire length of conduit
- 7.6.4 The conduits to be installed shall be of ample cross section area to facilitate the drawing of wires. The diameter of the conduit shall be selected as per table specified in these specifications. But in no case it shall be less than 25 mm diameter
- 7.6.5 Entire conduit layout shall be done such as to avoid additional junctions boxes other than for outlet points. Conduits shall be free from sharp edge and burrs. Conduits shall be laid in a neat and organized manner as directed and approved by the client. Conduit runs shall be planned so as not to conflict with any other services pipe, lines/duct
- 7.6.6 The entire conduit system shall be electrically and mechanically continuous and shall be bonded, together by means of approved type earthing clamp and earthed through a bare copper conductor of 14 SWG to the earthing terminals on the nearest distribution board
- 7.6.7 If required, connection between PVC and steel conduits shall be through a junction box. Direct connection between PVC and steel conduits are not allowed
- 7.6.8 Where exposed conduits are suspended from the structure, they shall be clamped firmly and rigidly to hangers of design to be approved by client. Where hangers are to be anchored to reinforced concrete, appropriate inserts and necessary devices for their fixing shall be left in position at the time of concreting, making holes and opening in the concrete will generally not be allowed. In case, it is unavoidable, prior permission of the client shall be obtained
- 7.7 CONDUIT JOINTS
- 7.7.1 Conduit pipes shall be joined by means of screwed couplers and screwed accessories, as per IS: 2667
- 7.7.2 The threads shall be free from grease or oil
- 7.7.3 In long distanced straight runs of conduit, inspection type couplers two way junction boxes at reasonable intervals shall be provided or running threads with couplers and lock nuts shall be provided. The bare threaded portion shall be treated with anti-corrosive paints. Threads on conduit pipes in all cases shall be between 11mm to 27mm long, sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipes shall have no sharp edges nor any burrs left, to avoid damage to the insulation of conductors while pulling them through such pipes
- 7.7.4 Brass female bushes shall be used in each conduit termination in a switch box, outlet box, electrical panel or any other box
- 7.7.5 Conduit shall be secured in each outlet box switch box, electrical panel or any other box by means of one brass hexagonal lock nut and bush, outside and inside the box

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- 7.7.6 At each building, expansion joints approved oil tight double wire wound flexible steel conduit or any other approved method shall be used. This shall be united on both sides with the rigid conduits by suitable union
- 7.7.7 Conduits installed in the plant room for mechanical equipment shall be properly clamped with the mechanical supports, but in no case, it shall be fixed with the body of the equipment
- 7.7.8 The connection of conduit to the mechanical equipment shall be through oil tight double wire wound flexible steel conduit. In any case the length of the flexible conduit shall not exceed one meter. The flexible conduit shall be properly clamped with the body of the equipment. They shall not in any case be clamped with any cover or any removable parts of the equipment
- 7.8 BENDS IN CONDUIT
- 7.8.1 All necessary bends in the system including diversion shall be done by bending pipes or by inserting suitable solid or circular inspection type normal box or similar fittings. Conduit fittings shall be avoided as far as possible on conduit system exposed to weather, where necessary, solid type fittings shall be used. Radius of such bends in conduit pipes shall be not less than 75 mm. No length of conduit shall have more than the equivalent of four quarter bends from outlet, the bends at the outlets not being counted
- 7.9 PROTECTION AGAINST DAMPNES
- 7.9.1 In order to minimize condensation or sweating inside the conduit, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects, as far as possible
- 7.10 PROTECTION OF CONDUIT AGAINST RUST
- 7.10.1 The outer surface of the conduits including bends, junction boxes, etc., forming part of the conduit system shall be adequately protected against rust, particularly when such system is exposed to weather. In all cases, no bare/threaded portion of conduit pipe shall be allowed unless such bare threaded portion is treated with anti-corrosive coating or covered with approved plastic compound
- 7.11 BUNCHING OF CABLES
- 7.11.1 Unless otherwise specified, insulated conductors of different phases shall be bunched in separate conduit.
- Wires carrying current shall be so bunched in the conduit that the out going and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit

- 7.11.2 The number of insulated wires/cables that be drawn into the conduits shall be as per the following table.

MAXIMUM PERMISSIBLE NUMBER OF 650/1100 VOLTS GRADE SINGLE CORE CABLE THAT CAN BE DRAWN INTO RIGID STEEL CONDUITS.

CABLE SIZE IN MM SQ.	SIZE OF CONDUITS (MM)			
	MAXIMUM NO. OF CABLES			
	25	32	38	51
1.5	10	14	---	---
2.5	8	12	---	---
4.0	6	10	---	---

7.12 SWITCH AND SOCKET

- 7.12.1 Switches shall be installed at 900 mm above finished floor level unless otherwise indicated on the drawings
- 7.12.2 The switch controlling the light point or fan shall be connected on to the phase wire of the circuit and neutral shall be continuous, having no fuse or switch installed in the line except at the D.B. All fan regulators shall be fixed inside the switch boxes on adjustable flat M.S. strips/plates with tapped holes and brass machine screws, leaving ample space at the back and side for accommodating wires
- 7.12.3 The cover plates to the switch box shall be fixed by means of sunk head brass cadmium screws
- 7.12.4 Where two or more switches and fan regulators are installed together, they shall be provided with one gang cover plate with knockouts to accommodate required number of switches, sockets and regulators
- 7.12.5 The switch controlling the socket outlet shall be on the phase wire of the circuit. The third pin of the socket shall be connected to the earth continuity conductor of the circuit
- 7.12.6 The switch boxes, installed back-to-back in the same wall shall be offset from each other, 150 mm horizontally, to preclude noise transmission

7.13 DRAWING OF CONDUCTORS

- 7.13.1 The drawing and joining of copper conductor or wires shall be executed with due regard to the following precautions. While drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. There shall be no sharp bends
- 7.13.2 Insulation shall be shaved off for a length of 15 mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or ringing
- 7.13.3 FRLS insulated copper conductor wire ends before connection shall be properly soldered (at least 15 mm length) with soldering flux/copper solder, for copper conductor. Strands of wires shall not be cut for connecting to the terminals. All strands of wires shall be soldered at the end before connection. The connecting brass-screws shall have flat ends. All looped joints shall be soldered and connected through terminals

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- block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. Conductors having nominal cross section exceeding 4 sq. mm shall always be provided with crimping type cable sockets. At all bolted terminals, brass flat washer of large area and approved steel spring washers shall be used. Brass nuts and bolts shall be used for all connections
- 7.13.4 Only certified wire men and cable jointers shall be employed to do joining work
- 7.13.5 For all internal wiring FRLS insulated wires of 650/1100 volts grade shall be used. The sub-circuit wiring for point shall be carried out in looping system and no joint shall be allowed in the length of the conductors. No wire shall be drawn in to 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 conduits the conduits shall be thoroughly cleaned of moisture, dust, and dirt or any other obstruction by forcing compressed air through the conduits
- 7.14 JOINTS
- 7.17.1 The wiring shall be by looping back system, and hence all joints shall be made at main switches, distribution boards, socket outlets, lighting outlets and switch boxes only. No joints shall be made inside conduits and junction boxes.
- 7.17.2 Contractors shall be continuous from outlet to outlet. For joints where unavoidable, due to any specified reasons, prior permission in writing shall be obtained from the client before making such connections. Joints by twisting conductors are prohibited.
- 7.15 LOAD BALANCING
- 7.15.1 Balancing of circuit in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to
- 7.16 EARTHING
- 7.16.1 All earthing systems shall be in accordance with IS: 3043 - 1985 code of practice for earthing

TECHNICAL SPECIFICATIONS FOR LIGHTING & POWER DISTRIBUTION BOARDS (BOQ – SWITCH GEAR)

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R1				
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TECHNICAL SPECIFICATIONS FOR LIGHTING & POWER DISTRIBUTION BOARDS

1.0 SCOPE OF WORK

- 1.1 This section relates to specifications for supply of lighting distribution board (LDB) & Power distribution board (PDB) TPN/FP/DP/SP MCB isolator & ELMCB, Earthing terminal, connector strip for phase neutral and earth for each circuit, CRCA sheet steel housing and complete the item supply. Common banking of neutral and earth conductor is not allowed.

2.0 CODES & STANDARDS

- 2.1 The Distribution Board shall comply with the latest edition of relevant Indian Standards and Indian Electricity Rules and Regulations. The following Indian standards shall be complied with:

Sr.	Item	Relevant IS	Relevant IEC
1	General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V DC	IS: 4237	
2	Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.	IS: 375	
3	Terminal marking for electrical measuring instrument and their accessories.	IS: 8197	
4	Miniature circuit breakers.	IS: 8828	

4.0 TECHNICAL REQUIREMENTS

4.1 SYSTEM

- 4.1.1 The lighting distribution boards shall be suitable for operation on 415/240 volt, 50 cycle per second, A.C supply system. The lighting & power distribution boards MCB shall be capable of withstanding short circuit current of 10 KA.

4.2 CONSTRUCTION :

- 4.2.1 General arrangement lay out of the DB's shall be approved by the consultant's incharge before starting the manufacture.
- 4.2.2 The DB shall metal clad duly fabricated from 2mm. thick high quality CRCA sheet metal.
- 4.2.3 The DB shall be wall mounted and dead front operated.
- 4.2.4 The DB shall totally be enclosed and made dust, vermin and weather proof such that it meets to IP42 protection classification for installation.
- 4.2.5 A detachable cover plate of 2 mm thick CRCA sheet to be provided on front of the board such that all live parts of the electrical accessories mounted on the board can be accessible only on removal of the said cover plate.
1. The cover plate shall be fixed to the board with adequate size zinc passivated machine screws.
 2. Above the detachable cover plate, one additional hinged door of 2 mm

thick CRCA sheet shall be provided with a suitable locking arrangement.

The hinged door shall be provided with a suitable gasket capable of withstanding corrosive & humid atmosphere and to maintain degree of enclosure protection to IP 42 as per IS: 13947 for installation.

- 4.2.6 The DB shall have top/Bottom entry arrangement for incoming and out going cables/conduits.
- 4.2.7 All hardware to be used in manufacture of the DB shall be S.S 304 to prevent corrosion due to humid atmosphere prevailing at the project site.
- 4.2.8 All internal electrical connections shall be carried out using 660/1100 volt grade, FRLS insulated, Copper conductor of ISI approved make, having rated current carrying capacity to carry continuous full current of respective switch Fuse rating at operating conditions prevailing at the project site.
- 4.2.9 All non current carrying metal surface of the DB's shall adequately be treated and painted.
- 4.2.10 The surface imperfection shall then be rectified with applications of putty.
- 4.2.11 The DB's shall be provided with electric components and accessories as per the details shown in the drawing for the respective electric distribution board. The circuit connection from all the circuit MCB shall be brought to connector provided on top or bottom of the DB with suitable lugs. The connector shall be suitable to receive phase, neutral and earth wire/cable coming from each individual circuit. The connector's shall have circuit identification tag.
- 4.2.12 Use of paper/fabric base laminates is not acceptable.

4.3 PAINTING

- 4.3.1 The painting shall be Powder coated.

TECHNICAL SPECIFICATIONS FOR LT XLPE CABLE (BOQ – CABLE)

TRACK RECORD:

REV.	PREPARED BY	APPROVED BY	DATE	REMARK
R0	SP	SP	12 Aug 2016	
R1				
R2				
R3				

TECHNICAL SPECIFICATIONS FOR LT XLPE CABLE

1.0 SCOPE OF WORK

- 1.1 This section shall cover supply, laying, testing and commissioning of medium voltage XLPE cables.
- 1.2 This specification gives the general requirement of cables. However, **it is the responsibility of the vendor to take the joint measurement and obtain client's approval before the placement of orders** to the main supplier / manufacturer.

2.0 CODES & STANDARDS

- 2.1 The following standards and rules shall be applicable :

Sr. No	Item	Relevant IS	Relevant IEC
	XLPE insulated electric cables (heavy duty).	IS : 7098 Part I	
	Recommended current ratings for cables.	IS : 3961	
	Aluminium conductors for insulated cables	IS : 8130	Indian Electricity Act and Rules.

4.0 TECHNICAL REQUIREMENTS

4.1 GENERAL CONSTRUCTIONAL FEATURES

- 4.1.1 The medium voltage cables shall be supplied, laid, connected, tested and commissioned in accordance with the drawings, specifications, relevant Indian Standards specifications, manufacturer's instructions. The cables shall be delivered at site in original drums with manufacturer's name, size, and type, clearly written on the drums.

MATERIAL :

- 4.2 Medium voltage cable shall be XLPE insulated. PVC sheathed, aluminium or copper conductor, armoured conforming to IS: 7098 Part I.

Type:

- 4.2.1 The cables shall be circular, multi core, annealed copper or aluminium conductor, XLPE insulated and PVC sheathed, armoured or unarmoured.

Conductor:

- 4.2.2 Uncoated, annealed copper / aluminium, of high conductivity upto 4 mm.² size, the conductor shall be solid and above 4 mm.², conductors shall be concentrically stranded as per IEC : 228.

Insulation:

- 4.2.3 XLPE rated 70° c. extruded insulation

Core Identification:

- 4.2.4
- | | | |
|-------------|---|-----------------------------|
| Two core | : | Red and Black |
| Three cor | : | Red, Yellow and Blue |
| Four core | : | Red, Yellow, Blue and Black |
| Single core | : | Green, Yellow for earthing |

Black shall always be used for neutral.

Assembly:

- 4.2.5 Two, three or four insulated conductors shall be laid up, filled with non-hygroscopic material and covered with an additional layer of thermoplastic material.

Armour:

- 4.2.6 Galvanised steel flat strip / round wires applied helicaly in single layers complete with covering the assembly of cores.

For cable size upto 25 Sq. mm. : Armour of 1.4 mm dia G.I. round wire

For cable size above 25 Sq. mm. : Armour of 4 mm wide 0.8 mm thick G.I strip

4.2.7 **Sheath:**

XLPE 70 deg.c. rated extruded.

Inner sheath shall be extruded type and shall be compatible with the insulation provided for the cables.

Outer sheath shall be of an extruded type layer of suitable PVC material compatible with the specified ambient temp. 50 deg. C and operating temperature of cables. The sheath shall be resistant to water, ultraviolet radiation, fungus, termite and rodent attacks. The colour of outer sheath shall be black.

Sequential length marking required at every 1.0 mtr. interval on outer sheath

Vendor has to furnish resistance / reactance / capacitances of the cable

4.2.8 **Rating:** Up to and including 1100 Volts.

5.0 **DRAWINGS & INFORMATION**

5.1 Contractor shall submit the as built drawing of the cable laying drawing.

5.2 **HANDINGOVER DOCUMENTS**

The supplier shall submit following:

1. Data sheet indicating results of tests
2. Test reports

6.0 **INSPECTION AND TESTING**

6.1 All cables shall be adequately protected against any risk of mechanical damage to which they may be liable in normal conditions of handling during transportation, loading, unloading etc.

The cable shall be supplied in single length i.e. without any intermediate joint or cut unless specifically approved by the client.

The cable ends shall be suitably sealed against entry of moisture, dust, water etc. with cable compound as per standard practice.

6.2 **Finished Cable Tests at Manufacturer's Works:**

The finished cables shall be tested at manufacturer's works. Following routine tests for each and every length of cable and copy of test results shall be furnished for each length of cable along with supply. If specified, the cables shall be tested in presence of client's representative.

6.2.1 **Voltage Test:**

Each core of cable shall be tested at room temperature at 3 KV A.C. R.M.S. for duration of 5 minutes.

6.2.2 **Conductor Resistance Test:**

The D.C. Resistance of each conductor shall be measured at room temperature and the results shall be corrected to 20° c. to check the compliance with the values specified in IS 8130 - 1976.

6.3 Cable Test Before and After Laying of Cables at Site

- 6.3.1 Insulation Resistance test between phases and phase to Neutral and phase to earth.
- 6.3.2 Continuity test of all the phases, neutral and earth continuity conductor.
- 6.3.3 Sheathing continuity test.
- 6.3.4 Earth resistance test of all the phases and neutral.

TECHNICAL SPECIFICATIONS FOR EXTERNAL LIGHTING (BOQ – STREET LIGHTING)

TRACK RECORD:

REV.	PREPARED BY	APPROVED BY	DATE	REMARK
R0	SP	SP	12 Aug 2016	
R1				
R2				
R3				

TECHNICAL SPECIFICATIONS FOR SUPPLY OF EXTERNAL LIGHTING

1.0

SCOPE OF WORK

- 1.1 This section relates to specifications for supply (wherever called for), installation, connection, testing and commissioning of street lighting and flood lighting installation of the project.

The job comprises of the following:

1. Lighting pole
2. Cable lying
3. Wiring to the fixture
4. Earthing

2.0

CODES & STANDARDS

2.1

Sr.	Item	Relevant IS	Relevant IEC
1	General and safety requirements for light fittings	IS 1913	
2	Code of practice for lighting public thoroughfares	IS 1944	
3	Water proof electric lighting fittings	IS 3528	
4	Water tight electric lighting fittings	IS 3553	
5	M.S. tubular and other wrought steel pipe fittings	IS 1239	
6	Luminaries for street lighting. (Parts/Sec. 3)	IS 10322	

4.0

TECHNICAL REQUIREMENTS

4.1 SYSTEM

- 4.1.1 The street lighting installation for the project shall be carried out by use of outdoor type, weather proof luminaries, to be mounted on tubular steel pole.
- 4.1.2 Electric power supply at 415 volt, three phase, four wire, 50 Hz. to be tapped from the street lighting panel.
- 4.1.3 The electric power shall be distributed to the street lighting poles through electric cables and shall be distributed equally on three phase of the electric power supply system.
- 4.1.4 Individual control fuse with junction box shall be provided on each poles. The junction box shall be weather proof, having gasketed hinged cover.
- 4.1.5 The street light poles shall be earthed individually with coil type earth station using 8 SWG G.I wire.
- 4.1.6 Electric cable required for the street lighting installation shall be 1100 volt grade, PVC insulated and sheathed, armoured cable having stranded Al. conductor of rating as mentioned in the drawing/BOQ.

4.2 LIGHTING POLES

- 4.2.1 The street light poles shall be fabricated from heavy duty cold-rolled steel tubes conforming to IS: 1239 and hot dip galvanized or painted as specified.
- 4.2.2 The street light pole shall be fabricated as per the details and dimensions shown in the drawing.
- 4.2.3 The street light poles shall have base plate, a large access panel, and necessary fixture mounting bracket at top.
- 4.2.4 The access panel shall provide easy access to a multiway connector and MCB, to be mounted inside the pole. The access shall be specially fabricated with adequate reinforcement and weather protection gasket to prevent ingress of moisture and vandal proofed.
- 4.2.5 Poles shall have large diameter entries for incoming and outgoing cables and two earth studs.
- 4.2.6 The poles fabricated shall conform to the drawings and where such drawing is not available, the contractor shall make such drawing and have it approved before fabricated.
- 4.2.7 The pole shall house a multiway ELMEX type terminal block and MCB as shown on the drawings. Poles shall have concrete coping.

4.3 CABLE LAYING

- 4.3.1 Electric cable for the street lighting installation shall follow specification under the heading "L.T XLPE cable".
- 4.3.2 Cable shall be terminated in a 4-way terminal block inside the pole or to the attached junction box as shown on drawings.
- 4.3.3 Cable route shall be as shown on the drawings or the contractor shall mark out the route and lay the cables only upon approval of the route.
- 4.3.4 Cable laying shall be done with excavation, backfilling of trench with sand & bricks at bottom & top.

4.4 EARTHING

- 4.4.1 All street light fixtures and poles shall be earthed as specified under section "EARTHING".
- 4.4.2 Earth electrode shall be of 8 SWG coil type and shall otherwise meet to the specification given under heading "Earthing".

5.0 INSTALLATION OF SYSTEM

Street lighting installation shall be carried out as per details shown in the drawing.

The poles shall be erected in perfect plumb with concrete foundation at a location shown in the drawing. The foundation shall be designed to withstand the static load as well as wind velocity and bending moment of the pole and shall be approved by the client prior to execution.

The junction box shall then be clamped to the erected pole as per details shown in the drawing.

The luminaries shall also be installed on the pole and be electrically wired to the respective junction box.

The cable lay out shall follow the tentative route as shown in the drawing. In case of any constraint on the cable route the same shall be brought to notice of the client.

The cable lay out shall be carried out in an underground manner and the said installation complete with electric connections.

Earthing installation shall follow the details for the same shown in the drawing.

The earthing station (coil type) and the earthing grid installation shall be carried out as per the specification for the said works given in section under title "Earthing" of this tender document.

On completion of the installation, the street light poles shall be painted with two coats of metal primer (Red Oxide) followed by two coats of Synthetic enamel of the shade as approved by the Engineer-in-charge.

The brackets shall be made of 38 mm. NB MS class "B" pipe approx. 1.8 mtr. long bent at the centre at an angle 120° C. with necessary holding brackets, hold fasts etc. with special reducer at the end to accommodate type of street light fitting to be fixed. Bracket shall have 1 coat of anti-corrosion paint before despatch to site and 2 coats of approved make and shade of aluminium paint. This bracket shall also be provided with one M.S. water tight box complete with the connector, neutral link, rewirable fuse etc.. See enclosed drawings of street light poles.

Installation of poles shall be done as per enclosed drawings of street light poles. The depth of pole to be buried in ground shall be 1/5th of the total pole length or as specified in drawing, whichever is more. Special care shall be taken in erecting poles so that these are not strained or damaged during erection and are firmly stayed till the foundation are secured. The pole shall be grouted inside ground pit (cross-section 600 x 600 mm.) with cement concrete 1:2:4. Before the placement of concrete around pole in the pit, necessary conduit pipes (not less than 25 mm. dia.) shall be placed for facilitating drawing of cables. Separate conduit shall be provided for incoming and outgoing cables. The cement concrete shall be protected from premature drying by curing for atleast 7 days after pouring. All concrete surface from 150 mm. below ground level to top shall be finished smooth with cement mortar 1:4.

This includes fixing of street light fittings complete with accessories and lamps at the end of the pole/bracket, connecting it with 3 x 2.5 mm.² aluminium conductor, PVC insulated cable from water tight M.S. box, testing, commissioning. Third core shall be connected with earthing point of light fitting at one end and earthing point of marshalling box at the other end.

Distance of 1 mtr. shall be maintained between centre of pole and centre of kerb of road. For compound wall poles, distance between compound wall and poles shall be 3 mtrs.

A loop of 1.5 mtr. of cable shall be provided near each street light pole for all incoming and outgoing cable.

TECHNICAL SPECIFICATIONS FOR INSTALLATION OF INTERNAL WIRING (BOQ – INTERNAL WIRING)

TRACK RECORD:

REV.	PREPARED BY	APPROVED BY	DATE	REMARK
R0	SP	SP	12 Aug 2016	
R1				
R2				
R3				

TECHNICAL SPECIFICATIONS FOR INSTALLATION OF INTERNAL WIRING

1.0 SCOPE OF WORK

- 1.1 This section covers, definition of point wiring, system of wiring and, installation, connection, testing and commissioning of point wiring for light points, ceiling fan points, exhaust fan points, convenience socket outlet points, power socket outlet points, bell outlet points etc. including fixing of light fixtures, ceiling fan, exhaust fan, wall fan, bell etc.

2.0 CODES & STANDARDS

- 2.1 The following standards and rules shall be applicable :

IS : 732	Code of practice for electrical wiring installation (System voltage not exceeding 650 V)
IS : 1646	Code of practice for fire safety of buildings (General) Electrical installation.
IS : 9537 (Part - 2)	Rigid steel conduits for electrical wiring.
IS : 2667	Fittings for rigid steel conduits for electrical wiring.
IS : 3480	Flexible steel conduits for Electrical wiring.
IS : 3837	Accessories for rigid steel conduit for electrical wiring.
IS : 694	PVC insulated cables.
IS : 9537 (Part - 3)	Rigid non-metallic conduits for electrical wiring.
IS : 6946	Flexible (Pliable) non-metallic conduits for electrical installation.
IS : 1293	3 pin plugs and sockets.
IS : 8130	Specifications of conduits for electrical installation.
IS : 3854	Switches for domestic purpose.
IS : 3419	Fittings for rigid non-metallic conduits.
IS : 4648	Guide for electrical layout in residential buildings Indian electricity act and rules

All standards and codes mean the latest.

4.0 INSTALLATION OF THE SYSTEM

4.1 CONCEALED INSTALLATION WITH RIGID PVC CONDUIT

- 4.1.1 All the rigid PVC conduit used for concealed installation shall be as per IS; 9537

and its accessories shall be as per IS: 3419 (Small Wire Ropes).

- 4.1.2 Whenever necessary bends or diversion may be achieved by bending the conduits with the help of bending spring. No other method of bending is allowed
- 4.1.3 Conduit pipes shall be joined with the help of plain coupler fixed at the end with the help of vinyl solvent cement. No other method of joining is permissible
- 4.1.4 All other methods, no wires through conduit, bunching, etc. Shall be as specified in the concealed installation
- 4.1.5 Prior to fixing the conduits, the complete route shall be marked on site for the approval of consultant

4.2 **CONCEALED WIRING SYSTEM WITH RIGID PVC CONDUIT**

- 4.2.1 The rigid PVC conduits shall be used for concealed wiring system. The conduits shall be concealed in the concrete slab, floor, walls, beams, columns etc

4.2.2 **FIXING OF CONDUIT**

1. Conduits embedded in concrete shall be installed in the frame work before pouring concrete. The conduits shall be installed above the bottom reinforcing bars, and shall provide positive wire fastening of the conduit to the reinforcing rods at an interval of not more than one meter, but on either side of couplers or bends or putlet/pull/junction boxes or similar fittings, proper hold fast shall be fixed at a distance of 30 cm from the center of such fittings. Conduits embedded in the wall shall be fixed inside the chase . The chase in the wall shall be neatly made and be fixed in the manner desired. In the case of building under construction, chase shall be provided in the wall at the time of their construction and shall be filled up neatly with cement mortar 1:4 after erection of conduit and brought to the original finish of the wall. Cutting of horizontal chases in walls is prohibited. The conduits shall be fixed inside the chase by means of staples or by means of saddles not more than 60 cm apart.
2. Conduits shall be so arranged as to facilitate easy drawing of wires through them. Entire conduit layout shall be done in such a way as to avoid additional junction boxes other than light points. The wiring shall be done in a looping manner. All the looping shall be done in either switch boxes or outlet boxes. Looping in junction or pull boxes are strictly not allowed. Where conduits cross building expansion joints, adequate expansion fittings or other approved devices shall be used to take care of any relative movement
3. All conduits shall be installed so as to avoid steam and hot water pipes
4. Conduits shall be installed in such a way that the junction, derivation and pull boxes shall always be accessible for repairs and maintenance work. The location of junction/pull boxes shall be marked on the shop drawings and approved by the client
5. A separation of 200 mm shall be maintained between electrical conduits and hot water lines in the building
6. No run of conduit shall exceed ten mtr. between adjacent draw in points nor shall it contain more than two right angle bends, or other derivation

from the straight line

7. Caution shall be exercised in using the PVC conduits in location where ambient temperature is 50 degree cel. or above. Use of PVC conduits in places where ambient temperature is mote than 60 deg. cel. Is prohibited. The entire conduit system including boxes shall be thoroughly cleaned after completion of installations and before drawing of wires. Conduit system shall be erect and straight as far as possible. Traps where water may accumulate from condensation are to be avoided and if unavoidable, suitable provision for draining the water shall be made
8. All jointing method shall be subject to the approval of the client
9. Separate conduits shall be provided for the following system.
 - 15 A power outlets.
 - 5 A outlets and lighting system.
 - Low voltage system.
 - Telephone/intercom system.
 - C.C.T.V. system
 - Sound system
 - Computer data cabling system
 - Equipment wiring

4.3 CONDUIT JOINT

- 4.3.1
 1. Conduits shall be joined by means of plain couplers vinyl and/or solvent cement. Where there are long runs of straight conduit, inspection type couplers shall be provided at intervals , as approved by the client
 2. The conduits shall be thoroughly cleaned before making the joints
 3. In case of plain coupler joints, proper jointing material like a vinyl solvent cement (gray in color) or any material as recommended by the manufacturer shall be used.

4.4 BENDS IN CONDUIT

- 4.4.1 Wherever necessary, bends or diversions may be achieved by bending the conduits or by employing normal bends. No bends shall have radius less than 2.5 times outside dia. of the conduit
- 4.4.2 Heat may be used to soften the PVC conduit for bending, but while applying heat to conduit, the conduit shall be filled with sand to avoid any damage to the conduit

4.3 OUTLETS

- 4.3.1 All the outlets for fittings, switches etc. shall be boxes of substantial construction
- 4.3.2 In order to minimize condensation or sweating inside the conduits, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects , etc.

4.3.3 Fixing between conduit and boxes, outlet boxes, switch boxes and the like must be provided with entry spouts and smooth PVC bushes.

4.3.4 Joints between conduit and any type of boxes shall be affected by means of conduit couplers in to each of which shall be coupled smooth PVC bush from inside the box. In any case all the joints shall be fully water tight.

4.4 BUNCHING OF CABLES

4.4.1 Cables of AC supply of different phase shall be bunched in separate conduits

4.4.2 The number of insulated wires/ cables that may be drawn into the conduits shall be as per the following table. In this table, the space factor does not exceed 40%. However, in any case conduits having lesser than 19 mm dia. shall not be used.

MAXIMUM PERMISSIBLE NUMBER OF 650 VOLT GRADE SINGLE
CORE CABLES THAT MAY BE DRAWN IN TO RIGID PVC
CONDUITS.

CABLE SIZE IN MM SQ.	SIZE OF CONDUITS (MM)			
	MAXIMUM NO. OF CABLES			
	25	32	38/40	51/50
1.5	8	15	---	---
2.5	6	10	---	---
4.0	4	8	12	---

4.5 WIRING WITH RIGID STEEL CONDUIT

4.5.1 All conduits and it's accessories shall be of threaded type and under no circumstances pin grip type or clamp type accessories be used

4.6 FIXING OF CONDUIT

4.6.1 Conduit pipes shall be fixed by heavy gauge spacer bar saddles. The saddles shall be of 3 mm x 19 mm galvanized mild steel flat, properly treated and securely fixed to support by means of nuts and bolts raw bolts, brass machine screws, as mentioned, at an interval of not more than one meter but on either side of couplers, or bends, or junction/pull/outlet boxes or similar fittings, saddles shall be fixed at a distance of 30 cm from the centre of such fittings.

4.6.2 Draw boxes shall be located at convenient location for easy drawing of wires

4.6.3 Every mains and sub mains shall run in independent conduits with an independent earth wire of specified capacity along the entire length of conduit

4.6.4 The conduits to be installed shall be of ample cross section area to facilitate the drawing of wires. The diameter of the conduit shall be selected as per table specified in these specifications. But in no case it shall be less than 25 mm diameter

- 4.6.5 Entire conduit layout shall be done such as to avoid additional junction boxes other than for outlet points. Conduits shall be free from sharp edge and burrs. Conduits shall be laid in a neat and organized manner as directed and approved by the client. Conduit runs shall be planned so as not to conflict with any other services pipe, lines/duct
- 4.6.6 The entire conduit system shall be electrically and mechanically continuous and shall be bonded, together by means of approved type earthing clamp and earthed through a bare copper conductor of 14 SWG to the earthing terminals on the nearest distribution board
- 4.6.7 If required, connection between PVC and steel conduits shall be through a junction box. Direct connection between PVC and steel conduits are not allowed
- 4.6.8 Where exposed conduits are suspended from the structure, they shall be clamped firmly and rigidly to hangers of design to be approved by client. Where hangers are to be anchored to reinforced concrete, appropriate inserts and necessary devices for their fixing shall be left in position at the time of concreting, making holes and opening in the concrete will generally not be allowed. In case, it is unavoidable, prior permission of the client shall be obtained
- 4.7 CONDUIT JOINTS
- 4.7.1 Conduit pipes shall be joined by means of screwed couplers and screwed accessories, as per IS: 2667
- 4.7.2 The threads shall be free from grease or oil
- 4.7.3 In long distanced straight runs of conduit, inspection type couplers two way junction boxes at reasonable intervals shall be provided or running threads with couplers and lock nuts shall be provided. The bare threaded portion shall be treated with anti-corrosive paints. Threads on conduit pipes in all cases shall be between 11mm to 27mm long, sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipes shall have no sharp edges nor any burrs left, to avoid damage to the insulation of conductors while pulling them through such pipes
- 4.7.4 Brass female bushes shall be used in each conduit termination in a switch box, outlet box, electrical panel or any other box
- 4.7.5 Conduit shall be secured in each outlet box switch box, electrical panel or any other box by means of one brass hexagonal lock nut and bush, outside and inside the box
- 4.7.6 At each building, expansion joints approved oil tight double wire wound flexible steel conduit or any other approved method shall be used. This shall be united on both sides with the rigid conduits by suitable union
- 4.7.7 Conduits installed in the plant room for mechanical equipment shall be properly clamped with the mechanical supports, but in no case, it shall be fixed with the body of the equipment

- 4.7.8 The connection of conduit to the mechanical equipment shall be through oil tight double wire wound flexible steel conduit. In any case the length of the flexible conduit shall not exceed one meter. The flexible conduit shall be properly clamped with the body of the equipment. They shall not in any case be clamped with any cover or any removable parts of the equipment

4.8 BENDS IN CONDUIT

- 4.8.1 All necessary bends in the system including diversion shall be done by bending pipes or by inserting suitable solid or circular inspection type normal box or similar fittings. Conduit fittings shall be avoided as far as possible on conduit system exposed to weather, where necessary, solid type fittings shall be used. Radius of such bends in conduit pipes shall be not less than 75 mm. No length of conduit shall have more than the equivalent of four quarter bends from outlet, the bends at the outlets not being counted

4.9 PROTECTION AGAINST DAMPNES

- 4.9.1 In order to minimize condensation or sweating inside the conduit, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects, as far as possible

4.10 PROTECTION OF CONDUIT AGAINST RUST

- 4.10.1 The outer surface of the conduits including bends, junction boxes, etc., forming part of the conduit system shall be adequately protected against rust, particularly when such system is exposed to weather. In all cases, no bare/threaded portion of conduit pipe shall be allowed unless such bare threaded portion is treated with anti-corrosive coating or covered with approved plastic compound

4.11 BUNCHING OF CABLES

- 4.11.1 Unless otherwise specified, insulated conductors of different phases shall be bunched in separate conduit.

Wires carrying current shall be so bunched in the conduit that the out going and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit

- 4.11.2 The number of insulated wires/cables that be drawn into the conduits shall be as per the following table.

MAXIMUM PERMISSIBLE NUMBER OF 650/1100 VOLTS GRADE SINGLE CORE CABLE THAT CAN BE DRAWN INTO RIGID STEEL CONDUITS.

CABLE SIZE IN MM SQ.	SIZE OF CONDUITS (MM)			
	MAXIMUM NO. OF CABLES			
	25	32	38	51
1.5	10	14	---	---
2.5	8	12	---	---
4.0	6	10	---	---

4.12 SWITCH AND SOCKET

- 4.12.1 Switches shall be installed at 900 mm above finished floor level unless otherwise indicated on the drawings
- 4.12.2 The switch controlling the light point or fan shall be connected on to the phase wire of the circuit and neutral shall be continuous, having no fuse or switch installed in the line except at the D.B. All fan regulators shall be fixed inside the switch boxes on adjustable flat M.S. strips/plates with tapped holes and brass machine screws, leaving ample space at the back and side for accommodating wires
- 4.12.3 The cover plates to the switch box shall be fixed by means of sunk head brass cadmium screws
- 4.12.4 Where two or more switches and fan regulators are installed together, they shall be provided with one gang cover plate with knockouts to accommodate required number of switches, sockets and regulators
- 4.12.5 The switch controlling the socket outlet shall be on the phase wire of the circuit. The third pin of the socket shall be connected to the earth continuity conductor of the circuit
- 4.12.6 The switch boxes, installed back-to-back in the same wall shall be offset from each other, 150 mm horizontally, to preclude noise transmission

4.13 DRAWING OF CONDUCTORS

- 4.13.1 The drawing and joining of copper conductor or wires shall be executed with due regard to the following precautions. While drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. There shall be no sharp bends
- 4.13.2 Insulation shall be shaved off for a length of 15 mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or ringing
- 4.13.3 FRLS insulated copper conductor wire ends before connection shall be properly soldered (at least 15 mm length) with soldering flux/copper solder, for copper conductor. Strands of wires shall not be cut for connecting to the terminals. All strands of wires shall be soldered at the terminals. All strands of wires shall be soldered at the end before connection. The connecting brass-screws shall have flat ends. All looped joints shall be soldered and connected through terminals block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. Conductors having nominal cross section exceeding 4 sq. mm shall always be provided with crimping type cable sockets. At all bolted terminals, brass flat washer of large area and approved steel spring washers shall be used. Brass nuts and bolts shall be used for all connections
- 4.13.4 Only certified wire men and cable jointers shall be employed to do joining work
- 4.13.5 For all internal wiring FRLS insulated wires of 650/1100 volts grade shall be used. The sub-circuit wiring for point shall be carried out in looping system and no joint shall be allowed in the length of the conductors. No wire shall be drawn in

to 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 conduits the conduits shall be thoroughly cleaned of moisture, dust, and dirt or any other obstruction by forcing compressed air through the conduits

4.14 JOINTS

- 4.14.1 The wiring shall be by looping back system, and hence all joints shall be made at main switches, distribution boards, socket outlets, lighting outlets and switch boxes only. No joints shall be made inside conduits and junction boxes.
- 4.14.2 Contractors shall be continuous from outlet to outlet. For joints where unavoidable, due to any specified reasons, prior permission in writing shall be obtained from the client before making such connections. Joints by twisting conductors are prohibited.

4.15 LOAD BALANCING

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

TECHNICAL SPECIFICATIONS FOR INSTALLATION OF DBs (BOQ – SWITCH GEAR)

TRACK RECORD:

REV.	PREPARED BY	APPROVED BY	DATE	REMARK
R0	SP	SP	12 Aug 2016	
R1				
R2				
R3				

TECHNICAL SPECIFICATIONS FOR INSTALLATION OF LIGHTING DBs

1.0 SCOPE

- 1.1 This section relates to specifications for installation, connection, testing and commissioning of lighting distribution board (LDB) using TPN/FP/DP/SP MCB isolator & ELMCB, Earthing terminal, connector strip for phase neutral and earth for each circuit, CRCA sheet steel housing and complete the item installation. Common banking of neutral and earth conductor is not allowed.

3.0 INSTALLATION OF SYSTEM

- 3.1 The DB's shall be assembled and aligned together and be installed at site as per installation manual/instruction of the DB manufacturer.
- 3.2 The DB shall be installed in surface manner at the various location.
- 3.3 All minor electrical and mechanical work required to be attended to on the DB shall be completed in an approved manner after installation but before energizing the DB's.
- 3.4 The M.S. angle/channel iron frame used for installation of D.B. shall be hot dip galvanized (816 g/m²).
- 3.5 The DB shall be mounted on angle/channel frame with Anchor fastening only. Civil grouting is not acceptable.

TECHNICAL SPECIFICATIONS FOR INSTALLATION OF EXTERNAL LIGHTING (BOQ – STREET LIGHTING)

TRACK RECORD:

REV.	PREPARED BY	APPROVED BY	DATE	REMARK
R0	SP	SP	12 Aug 2016	
R1				
R2				
R3				

TECHNICAL SPECIFICATIONS FOR INSTALLATION OF EXTERNAL LIGHTING

1.0 SCOPE

- 1.1 This section relates to specifications for installation, connection, testing and commissioning of street lighting and flood lighting installation of the project.

The job comprises of the following:

1. Lighting pole
2. Cable lying
3. Wiring to the fixture
4. Earthing

2.0 CODES & STANDARDS

- 2.1 The following standards and rules shall be applicable:

IS 1913: General and safety requirements for light fittings.

IS 1944: Code of practice for lighting public thoroughfares.

IS 3528: Water proof electric lighting fittings.

IS 3553: Water tight electric lighting fittings.

IS 1239: M.S. tubular and other wrought steel pipe fittings.

IS 10322: Luminaire for street lighting. (Parts/Sec. 3)

Indian Electricity Act and rules.

All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Code of Practice or the British Standard Code of Practice in the absence of Indian Standard.

3.0 MATERIALS REQUIRED

- 3.1 As per BOQ.

4.0 INSTALLATION OF SYSTEM

- 4.1 Street lighting installation shall be carried out as per details shown in the drawing.
- 4.2 The poles shall be erected in perfect plumb with concrete foundation at a location shown in the drawing. The foundation shall be designed to withstand the static load as well as wind velocity and bending moment of the pole and shall be approved by the client prior to execution.
- 4.3 The junction box shall then be clamped to the erected pole as per details shown in the drawing.
- 4.4 The luminaires shall also be installed on the pole and be electrically wired to the respective junction box.
- 4.5 The cable lay out shall follow the tentative route as shown in the drawing. In case of any constraint on the cable route the same shall be brought to notice of the client.
- 4.6 The cable lay out shall be carried out in an underground manner and the said installation complete with electric connections.

- 4.7 Earthing installation shall follow the details for the same shown in the drawing.
- 4.8 The earthing station (coil type) and the earthing grid installation shall be carried out as per the specification for the said works given in section under title "Earthing" of this tender document.
- 4.9 On completion of the installation, the street light poles shall be painted with two coats of metal primer (Red Oxide) followed by two coats of Synthetic enamel of the shade as approved by the Engineer-in-charge.
- 4.10 The brackets shall be made of 38 mm. NB MS class "B" pipe approx. 1.8 mtr. long bent at the centre at an angle 120° C. with necessary holding brackets, hold fasts etc. with special reducer at the end to accommodate type of street light fitting to be fixed. Bracket shall have 1 coat of anti-corrosion paint before despatch to site and 2 coats of approved make and shade of aluminium paint. This bracket shall also be provided with one M.S. water tight box complete with the connector, neutral link, rewirable fuse etc.. See enclosed drawings of street light poles.
- 4.11 Installation of poles shall be done as per enclosed drawings of street light poles. The depth of pole to be buried in ground shall be 1/5th of the total pole length or as specified in drawing, whichever is more. Special care shall be taken in erecting poles so that these are not strained or damaged during erection and are firmly stayed till the foundation are secured. The pole shall be grouted inside ground pit (cross-section 600 x 600 mm.) with cement concrete 1:2:4. Before the placement of concrete around pole in the pit, necessary conduit pipes (not less than 25 mm. dia.) shall be placed for facilitating drawing of cables. Separate conduit shall be provided for incoming and outgoing cables. The cement concrete shall be protected from prematured drying by curing for atleast 7 days after pouring. All concrete surface from 150 mm. below ground level to top shall be finished smooth with cement mortar 1:4.
- 4.12 This includes fixing of street light fittings complete with accessories and lamps at the end of the pole/bracket, connecting it with 3 x 2.5 mm.² aluminium conductor, PVC insulated cable from water tight M.S. box, testing, commissioning. Third core shall be connected with earthing point of light fitting at one end and earthing point of marshalling box at the other end.

TECHNICAL SPECIFICATION

TECHNICAL SPECIFICATION FOR LIGHTNING ARRESTORS

1. SCOPE :

- 1.1. This Specification covers design, manufacture, testing at manufacturer's Works, packing, supply, delivery of 42 KV & 12 KV classes of gapless Lightning Arrestors complete with fittings and accessories.
- 1.2. These arrestors shall be of Heavy Duty, Station Class / Distribution Class and Gapless Zinc Oxide type.
- 1.3. Arrestors shall be hermetically sealed units suitable for outdoor installation on self-supporting base or structures.

2. STANDARD :

Arrestors shall conform in general to IEC-99-4 document or its latest amendment and IS/IEC as follows:

- i) IEC-99-4 : Gapless Lightning Arrestor
- ii) IS 3070 P-III : Metal Oxide Surge Arrestors without gaps for AC Systems.
- iii) IEC 99 P-III : Artificial Pollution Testing of Lightning Arrestor
- iv) IEC 270 : Partial Discharge Measurement.
- v) IS 2071 : Methods of H V Testing
- vi) IS 6209 : Methods for Partial Discharge Measurement
- vii) IS 5621 : Hollow Insulators for use in electrical equipment

3. DEVIATION :

Normally the offer should be as per Technical Specification without any deviation. But any deviation felt necessary to improve performance, efficiency and utility of equipment must be mentioned in the 'Deviation Schedule' with reasons duly supported by documentary evidences and advantages of such deviation. Such deviations suggested may or may not be accepted. But deviations not mentioned in Deviation Schedule will not be considered.

4. DUTY REQUIREMENT :

The Surge Arrestors are being provided to protect the following equipment whose insulation levels are indicated in the table given below:

Equipment to be protected	L I for 42 KV system (KVp)	L I for 12 KV system KVp)
Power Transformer	+/-170	+/-75
Instrument Transformer	+/-170	+/-75
CB/Isolator Phase to ground	+/-170	+/-75
Across open poles	+/-195	-

- 4.1. The Lightning Arrestors shall be capable of discharging Lightning and switching surges and temporary power frequency over voltages .The Surge Arrestor shall be capable of discharging over voltages occurring during switching of unloaded transformers and long lines.
- 4.2. The Arrestors shall be capable of withstanding Maximum Continuous Operating Voltages (M.C.O.V).

- 4.3. The Arrestors supplied shall be suitable for heavily polluted atmosphere.
- 4.4. The reference current of the Arrestors shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltages.

5. FITTINGS & ACCESSORIES :

- 5.1 Arrestor rating upto 42 KV shall be directly mounted on structure as there is no surge counter.
- 5.2 Each single pole arrestor shall be provided with suitable name plate, at the base with the following data :
- i) Name of device
 - ii) Manufacturer's name and trade mark, type and identification
 - iii) Year of manufacture
 - iv) Voltage rating & frequency rating.
 - v) Nominal discharge current
 - vi) MCOV (Maximum Continuous Operating Voltage in KV).
 - vii) Discharge class.
 - viii) Energy Discharge capability (KJ/KV rating)
 - ix) Purchase Order reference.
 - x) Applicable Standard.
 - xi) Pressure Relief rated current in KA rms (for arrestors fitted with Pressure Relief device)
 - xii) Serial Number
- 5.3 Clamp type terminal connector shall be suitable for either ACSR DOG Conductor for 42 KV and WEASEL / RABBIT Conductor for 12 KV system voltage class L.A. having horizontal/ vertical take off. Detailed particulars have been indicated in the specification for Clamps and Connector in this bid document.
- 5.4 Two ground terminal connectors suitable for G.I strip of required size shall be provided on diagonally opposite sides.
- 5.5 Necessary hardware such as nuts, bolts, spring washers, etc. shall be supplied for different units.
- 5.9 12 KV Lightning Arrestor should be of **Distribution Type** and should have suitable **Fault Indicator**.

6 CONSTRUCTIONAL FEATURES :

- 6.1 The arrestor elements shall be designed in such a way as to obtain robust construction with excellent mechanical and electrical properties even after repeated operation. The lightning arrestors should be adequately designed to operate satisfactorily under temporary power frequency over voltage as given in Specific Technical Parameters, after discharging two shots of respective long duration surges. Uniform density of zinc oxide element shall be maintained to provide uniform current distribution.
- 6.2 The lightning Arrestors shall be of adequate Pressure Relief Class as per IEC-99-4 , fitted with Pressure Relief Devices and Arc diverting ports to minimise possibilities of shattering of porcelain housing.
- 6.3 Sufficient creepage distance shall be provided to reduce excessive uneven voltages over the porcelain due to contamination, for which the arrestor shall not fail.
- 6.4 Seals shall be provided in such a way that these are always effectively maintained even when discharging the maximum rated lightning current.

- 6.5 Housing of Insulators shall be of **Porcelain**, glazed and completely vitrified and free from blow holes, micro-cracks or void. **Porcelain**, housing shall be so coordinated that external flashover will not occur due to application of any impulse or switching surge voltage up to the maximum design value for the arrester.
- 6.6 The end fittings shall be made of non-magnetic and corrosion proof material. It is preferable that the LAs shall be hermetically sealed with inert gas (Nitrogen).
- 6.7 Arrestors shall be suitable for mounting on a support structure.
- 6.8** 12 KV Class Distribution Type Lightning Arrester should have provision for **Fault Indicator/Disconnecter**.

7 APPLICATION :

The lightning Arrestors are used for protection of incoming and outgoing line and also of the power transformers from lightning surge as well as from power frequency over voltage.

8 TENDER DRAWINGS, CATALOGUES:

General outline drawing giving plan, elevation, side view and sectional view, top and bottom connection arrangement with pitch circle diameter and other dimensions of the complete assembly with surge counter and leakage current measuring meter where applicable, Size of terminals and lifting lugs, shipping weight etc are to be indicated.

9 CONTRACT DRAWINGS AND MANUALS :

- 9.1 In the event of placement of Order, six (6) copies of drawings and descriptive literatures shall be furnished to the Chief Engineer, P&CD, Vidyut Bhavan (4th floor), Salt Lake, Kolkata - 700 091 for approval :
- i) General Outline Drawing showing plan, elevation and end views with dimensions and showing full mounting details with weights.
 - ii) Dimensional Drawing showing the Arrester mounted on its base and where applicable with surge counter and leakage current measuring meter.
 - iii) Details of Bushing top terminals & terminal connectors.
 - iv) Shipping Dimensional Drawings with weights.
 - v) Position of Centre of gravity and clearances with adjacent grounded metallic structures.
 - vi) Diagram Plate showing electrical connections of the surge counter and leakage current measuring meter where applicable.
 - vii) Rating Plate.
 - viii) Complete foundation drawings for the structure of Lightning arrester, where applicable.
- 9.2 Ten (10) sets of approved drawings and operation and maintenance manuals shall be submitted for our record and distribution to site.

10 TEST REPORTS AND TYPE TESTS :

The Bidder should submit the Complete Test Reports (including Dynamic Short Circuit Test Report) & Reports of Type Tests as stipulated in latest relevant IS/IEC with complete Identification, Date & Sl.No., carried out within 5(Five) Years from Due Date of Tender, from CPRI/ NABL accredited/Govt. Recognized Test House or Laboratory on Tendered Item of identical design, With Tender Documents failing which their offer may not be technically accepted.

11 TEST AT FACTORY AND TEST CERTIFICATES :

- i) Each LA. shall comply with the requirements of routine test as specified in the relevant IEC:99-4 & IS:3070 (Part - III).
- ii) Routine test at manufacturer's works shall be carried out in presence of representative of WBSEDCL.
- iii) All routine & acceptance tests shall be carried out at the manufacturer's works on every lot offered for inspection as per relevant IEC & IS. Selection of samples for acceptance test as well as rejection and retesting shall be guided by relevant IEC & IS. Six (6) copies of Test Reports shall be submitted to the Chief Engineer (P&CD), Vidyut Bhavan (4th floor), Salt Lake, Kolkata - 700 091 for approval. Adequate extra copies should also be submitted to Chief Engineer (P&CD) Vidyut Bhavan (4th floor), Salt Lake, Kolkata - 700 091 for distribution to site.
- iv) The Tenderer shall give at least 15 (fifteen) days' advance notice intimating the actual date of inspection and details of all tests that are to be carried out. Relevant Type & Routine Tests' Certificates obtained from the competent Authorities for all accessories/ bought out items shall have to be furnished.

12. TYPE TESTS after issuance of order :

Besides submission of Type Test Report, carried out within five years as per Tender Specification, Type Test at the discretion of Ordering authority, shall have to be arranged by the successful contractor from any lot offered for inspection, sample chosen at random after successful Routine Test by our Inspection Team, as per relevant ISS from NABL accredited/Govt. Recognized Test House or Laboratory in presence of WBSEDCL'S representative. In case of failure of the materials after type test the WBSEDCL will have the right to reject the total supplied lot of the said materials and the party have to replace the complete lot of materials at his own cost including transportation of materials at site.

However the necessary cost of the Type Test charges will be reimbursed to the party on production of necessary supporting documents.

13. Documents to be submitted at the time of physical delivery at consignee stores :

The following documents to be submitted by the vendors to the consignee Stores at the time of despatch to stores by the vendors:-

- a) Copy of Purchase Order.
- b) Copy of Despatch Instruction.
- c) Inspection Test Certificate.
- d) Guarantee Certificate.
- e) Proforma Invoice.
- f) Calculation Sheet for price Variation on the basis of IEEMA or CACMAI as applicable with base date of order.
- g) Seal list and packing list.
- h) Challan in triplicate.
- i) Way bill, if applicable.

SPECIFIC TECHNICAL PARAMETERS- I

<u>TYPE OF ARRESTOR</u>		<u>STATION CLASS</u> <u>HEAVY</u> <u>GAPLESS</u>	<u>DUTY</u> <u>CLASS</u>
i)	Nominal system voltage (KV)	33	11
ii)	Highest system voltage (KV)	36	12
iii)	System Neutral Earthing	NEE(Grounded Through Earthing Transformer)	EE
iv)	BIL of transformers (KVp)	170	75
v)	System fault level (KA)	25	16
vi)	Maxm. System BIL (KVp)	170	75
<u>LA RATINGS :</u>			
i)	Rated Voltage (KV)	42	12
ii)	Maxm. Continuous operating voltage (KVrms)	36	10
iii)	Nominal Discharge Current (KAp)	10	5
iv)	Line discharge class	2	Distribution Class
v)	Minimum Energy Discharge capability (KJ/KV)	5	5
	[If there is any Deviation the same may be mentioned in the Deviation Sheet]		
vi)	Temporary over voltage withstand capability (KVrms) for 10.0 secs	42	12
vii)	Insulation Housing withstand voltages		
	i) Lightning Impulse(Dry)		
	ii) Power frequency(wet)	Minimum values as per IEC	
	for 10 KA		
	for 5 KA		
viii)	Minimum creepage Distance acceptable (mm)	1100	300
	i) Pressure Relief Class	To be tested in accordance with IEC	
ix)	(Minimum) High Current Impulse withstand (4/10) KA (peak)	100	65
x)	Maxm.Lightning Impulse (8/20 micro-second impulse) residual voltage (KVp) :		
	5 KA	112	40
	10KA	-	-
xi)	Maxm. switching surge (30/60 micro-second wave) protective level (KVp)		
	500 Amps	98	21
	1000 Amps	-	-
	2000 Amps	-	-
xii)	Maxm. Steep Impulse (1/20 micro-seconds impulse) residual voltage at 10 KA (KVp)	130	45
xiii)	RIV/Partial Discharge (micro-volt / pico-coulomb) when energised at 1.05 times its continuous operating voltage shall not exceed	250 microvolt/ less than 50 pico-coulomb	1000 microvolt/ less than 500 pico-coulomb
xiv)	Terminal connection	Suitable for ACSR Dog Conductor	Suitable for Weasel/Rabit ACSR Conductor
xv)	Rated Frequency (Hz)	50	50
xvi)	Minimum Visible Corona Discharge voltage(KV rms)	-	-

GUARANTEED TECHNICAL PARAMETERS

<u>TYPE OF ARRESTOR</u>		<u>STATION CLASS HEAVY DUTY GAPLESS (42KV)</u>	<u>DISTRIBUTION CLASS (12KV)</u>
i)	Nominal system voltage (KV)		
ii)	Highest system voltage (KV)		
iii)	System Neutral Earthing		
iv)	BIL of transformers (KVp)		
v)	System fault level (KA)		
vi)	Maxm. System BIL (KVp)		
<u>LA RATINGS :</u>			
i)	Rated Voltage (KV)		
ii)	Maxm. Continuous operating voltage (KVrms)		
iii)	Nominal Discharge Current (KAp)		
iv)	Line discharge class		
v)	Minimum Energy Discharge capability (KJ/KV)		
	[If there is any Deviation the same may be mentioned in the Deviation Sheet]		
vi)	Temporary over voltage withstand capability (KVrms) for 10.0 secs		
vii)	Insulation Housing withstand voltages		
	i) Lightning Impulse(Dry)		
	ii) Power frequency(wet)		
	for 10 KA		
	for 5 KA		
viii)	Minimum creepage Distance acceptable (mm)		
	i) Pressure Relief Class		
ix)	(Minimum) High Current Impulse withstand (4/10) KA (peak)		
x)	Maxm.Lightning Impulse (8/20 micro-second impulse) residual voltage (KVp) :		
	5 KA		
	10KA		
xi)	Maxm. switching surge (30/60 micro-second wave) protective level (KVp)		
	500 Amps		
	1000 Amps		
	2000 Amps		
xii)	Maxm. Steep Impulse (1/20 micro-seconds impulse) residual voltage at 10 KA (KVp)		
xiii)	RIV/Partial Discharge (micro-volt / pico-coulomb) when energised at 1.05 times its continuous operating voltage shall not exceed		
xiv)	Terminal connection		
xv)	Rated Frequency (Hz)		
xvi)	Minimum Visible Corona Discharge voltage(KV rms)		

Make List		
Sr. no.		
1	Wire / Cable	RR / POLYCAB / FINOLEX
2	Switch Plate Accessory	ANCHORE / HONEY WELL /MK
3	PVC Pipe	ASTRAL / POLYCAB / FINOLEX
4	CAT 6 / Telephone	D – LINK / FINOLEX
5	LED Light	CROMPTON / BAJAJ / HAVELLS
6	MCB / DB / VTPN DB	LEGRAND / MK / L& T

Sign of Contractor

**EXECUTIVE ENGINEER (C)
DPA – OOT , VADINAR**