TECHNICAL SPECIFICATION OF ELECTRICAL WORKS

SECTION- I

1.0 CODES AND STANDARDS

The work shall be carried out as per the tender specifications confirming to following codes and standards for equipment and installation thereof.

STANDARDS	***TITLE***
Codes for Practice / Guide	
IS: 732 - 1989	Code of practice for electrical wiring installations
IS: 4648 – 1968	Guide for electrical layout in residential buildings
IS: 8061 - 1976	Code of practice for design, installation and maintenance of service lines upto and including 650V.
IS: 8884 - 1978	Code of practice for installation of electric bells and call system.
IS: 5578 - 1985	Guide for marking of insulated conductor.
IS: 11353 - 1985	Guide for uniform system of marking and identification of conductors and apparatus terminals.
IS: 10118 (Part-1) - 1982	Code of practice for selection, installation and maintenance of switchgear and control gear: General.
IS: 4201 - 1983	Application guide for current transformers.
IS: 2309 - 1989	Code of practice for the protection and allied structures against lightning.
IS: 3043 - 1987	Code of practice for earthing.
IS: 5216 (Part-2) - 1982	Guide for safety procedures and practices in electrical work: General.
IS: 5216 (Part-2) - 1982	Recommendation on safety procedure and practices in electrical works – life saving techniques.
IS: 374 - 1979	Electric ceiling type fans and regulators.
IS: 11037 - 1984	Electronic type fan regulators.

Low voltages switchgear and control gear

IS: 12155 - 1987	General and safety requirements for fans and regulators for household and similar purposes.
IS: 8828 - 1996	Electrical accessories – circuit breakers for over current protection for household and similar installation.
IS: 13032 - 1991	A.C.Miniature circuit breaker boards for voltages upto and including 1000 volts AC.
IS: 12640 – Part I 1988	Residual current operated circuit breakers without integral over current protection.
IS: 12640 – Part II 1988	Residual current operated circuit breakers with integral over current protection.
IS: 2959 - 1985	Contactors for voltages not exceeding 1000 V AC or 1200 V DC.
IS: 8623 (Part-2) - 1993	Particular requirements for bus bar trunking system.

Power Cable

IS: 694 - 1990	PVC insulated cables for working voltage upto and including 1100V.
IS: 1554 (Part –1) - 1988	PVC insulated (heavy – duty) electric cables: For working voltages upto and including 1100V.
IS: 3961 (Part –5) - 1968	Recommended current ratings for cables: PVC insulated light duty cables.

Electric wiring accessories

IS: 9537 (Part –1) – 1980	Conduits for electrical installations General requirements.
IS: 9537 (Part –2) - 1981	Conduits for electrical installations: Rigid steel conduits.
IS: 3480 – 1966	Flexible steel conduits for electrical wiring.
IS: 2667 - 1988	Fittings for rigid steel conduits for electrical wiring.
IS: 3837 - 1976	Accessories for rigid steel conduits for electrical wiring.

IS: 9537 (Part –3) - 1983	PVC conduit for electrical installation rigid PVC conduit.
IS: 3854 - 1997	Switches for domestic and similar purposes.
IS: 4615 - 1968	Switch socket outlets (non-interlocking type)
IS: 4160 - 1967	Interlocking switch socket outlet.
IS: 1293 – 1988	Plugs and socket outlets of rated voltage up to and including 250 volts and rated current upto and including 16 amperes.

Electrical lamps and their auxiliaries

IS: 418 - 1978	Tungsten filament general service electric lamps.
IS: 2418 (Part –1) - 1977	Tubular fluorescent lamps for general lighting service: Requirements and tests.
IS: 2215 - 1983	Starters for fluorescent lamps.
IS: 1534 (Part –1) - 1977	Ballast for fluorescent lamps: For switch start circuits.
IS: 1569 - 1976	Capacitors for use in tubular fluorescent high-pressure mercury and low-pressure sodium vapor discharge lamp circuits.

Miscellaneous

IS: 2551 - 1982	Danger notice plates.

Safety

IS: 4770 – 1991	Rubber gloves for electrical purposes.
IS: 5424 – 1969	Rubber mats for electrical purposes.

END OF SECTION – I

SECTION –II

1.0 GENERAL SPECIFICATIONS

1.1 Drawings:

The work shall be carried out in accordance with the drawings enclosed with the tender documents and also in accordance with modification thereto from time to time as approved by the Owner / Consultant/ Project Manager.

1.2 Conformity to IE Act, IE Rules and Standards:

All Electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 1910 and Indian Electricity Rules, 1956 amended up to date (Date of call of tender unless specified otherwise).

1.3 Quality of Materials:

All materials and equipments supplied by the contractor shall be new. They shall be of such design, size and materials as to satisfactorily function under the rated conditions of operation and to withstand the environmental conditions at site.

1.4 Inspection of Materials and Equipments:

a) Materials and equipments to be used in the work shall be inspected by the Owner / Consultant/ Project Manager. Such inspection will be of following categories:

   i) Inspection of materials/equipments to be witnessed at the Manufacturer's premises in accordance with relevant BIS/ Agreement Inspection Procedure.

   ii) To receive materials at site with Manufacturer's Test Certificate(s).

   iii) To inspect materials at the Authorized Dealer's Godowns to ensure delivery of genuine materials at site. .

   iv) To receive materials after physical inspection at site.

b) The Consultant /Project Manager will take adequate care to ensure that only tested and genuine materials of proper quality are used in work.

c) Similarly, for fabricated equipments, the contractor will first submit dimensional detailed drawings for approval before fabrication is taken up in the factory. Suitable stage inspection at factory also will be made to ensure proper use of materials, workmanship and quality control.

d) The tender specifications will stipulate the Inspection requirements or their waiver for various materials/equipments including norms of inspection in specific cases.

1.5 Ratings of Components:

a) All components in a wiring installation shall be of appropriate ratings of voltage, current, and frequency, as required at the respective sections of the electrical installation in which they are used. .

b) All conductors, switches and accessories shall be of such size as to be capable of carrying the maximum current, which will normally flow through them, without their respective ratings being exceeded.

1.6 Conformity to Standards:

a) All components shall conform to relevant Indian Standard Specifications, wherever existing. Materials with ISI certification mark shall be preferred.

1.7 Interchangeability:

Similar parts of all switches, lamp holders, distribution boards, switch gears, ceiling roses, brackets, pendants, fans and all-other fittings of the same type shall be interchangeable in each installation.

1.8 WORKMANSHIP:

Good workmanship is an essential requirement to be complied with. The entire work of manufacture/fabrication, assembly and installation shall conform to sound engineering practice.

1.9 Proper Supervision/Skilled Workmen:

The contractor shall be a licensed electrical contractor of appropriate class suitable for execution of the electrical work. He shall engage suitably skilled/licensed workmen of various categories for execution of work supervised by supervisors / Engineer of appropriate qualification and experience to ensure proper execution of work. They will carry out instructions of Owner / Consultant/ Project Manager during the progress of work.

1.10 Use of quality materials:

Only quality materials of reputed make as specified in the Approved List of Makes will be used in work. Any other item to be used but not specified in the list shall be approved by Client/Consultants.

1.11 Fabrication in Reputed Workshop:

Switch boards and LT panels shall be fabricated in a factory/workshop having modern facilities like quality fabrication, seven tank process, powder/epoxy paint plant, proper testing facilities, manned by qualified technical personnel.

The tender shall specify some quality makes of fabricators with modern facilities of design, fabrication and testing capable of delivering high quality LT panels and switch boards after testing as per relevant specifications.

1.12 TESTING:

All tests prescribed in these General Specifications, to be done before, during and after installation, shall be carried out, and the test results shall be submitted to the Project Manager in prescribed Performa, forming part of the Completion Certificate.

1.13 COMMISSIONING ON COMPLETION:

After the work is completed, it shall be ensured that the installation is tested and commissioned.

1.14 GUARANTEE

The installation will be handed over to the Client after necessary testing and commissioning. The installation will be guaranteed against any defective workmanship. Similarly, the materials supplied by the contractor will be guaranteed against any manufacturing defect, inferior quality.

END OF SECTION – II

SECTION – III

1.0 HT PANEL 11KV (VCB)

1.1 GENERAL

The technical specification cover the supply of 11 KV Switchboards suitable for 11 KV, 3 Phase earthed system 50 HZ AC supply with a fault level of 350 MVA at 11 KV. The equipment shall be suitable for continuous operation at the stipulated ambient conditions.

1.2 STANDARS AND CODES

The following Indian Standards Specifications and Codes of Practice shall apply to the equipment covered by this Contract. In additions, the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Ruled 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and /or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the contract in line with Government Regulations. Necessary Test Certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

11000 volt Circuit Breaker	IS 13118:1991
Metal Enclosed Switchgear and Control gear for voltages above1000 volts	IS 3427:1969
Electrical Relays for Power System Protection	IS 3231:1986
Voltage Transformers	IS 3156:1978
Current Transformers	IS 2705:1981
Rubber Mats for Electrical Works	IS 5424:1983
Danger Notice Plate	IS 2551:1982

2.0 11000 VOLTS CIRCUIT BREAKERS

2.1 Technical Parameters

The 11000 volt circuit breakers shall be triple pole Vacuum type suitable for indoor mounting and shall comply with the requirements of the relevant Indian Standards. The Circuit Breakers shall be suitable for operation at 11000 volts 3 phase 50 Hz supply system and shall have a certified symmetrical breaking capacity of 350 MVA at 11000 volts or as stipulated in schedule of quantities.

2.2 Technical Specifications.

The Circuit Breaker shall be Vacuum type and shall consist of three identical single pole vacuum interrupter units which shall comprise of a pair of butt contacts enclosed within a sealed ceramic body with SS end plates. The moving contacts shall

be sealed into the enclosure via a SS steel bellow which shall permit axial movement of the contact. The contact arrangement shall be surrounded by SS sputter shield to prevent condensation of metal on the inside of the insulating envelop and also to provide good voltage grading across the gap and the outer envelope. The contact material and the contact geometry shall be suitable for the purpose so as to attain current chopping at minimum current to prevent build-up of unduly high over voltages and to prevent the are to cause localized high sports on the contact.

The Circuits Breaker shall be suitable for switching duty of Transformers.

3.0 CIRCUIT BREAKER CONSTRUCTIONAL FEATURES.

The 11000 volt circuit breaker shall be flush front, metal clad, truck mounted, draw out type and fully interlocked. The truck that carries the Circuit Breakers shall be of rigid fabricated construction. Each Circuit Breaker shall be housed in a separate compartment enclosed on all side.

Each with draw-able truck shall have its own Circuit Breaker.

All electrical connections on the truck shall be brought to secondary plugs which engage similar sockets in the housing.

The Circuit Breakers shall be of the double break type. Interphase barriers and tank lining of insulation material shall be provided.

The draw out mechanism shall be so designed and constructed as to permit smooth withdrawal and insertion. The movement shall be free of jerks, easy to operate and positive.

All current carrying parts in the Circuit Breaker shall be silver plated and suitable arcing contacts shall be provided to protect the main contacts.

Isolating contacts of the spring loaded self aligning pattern shall be provided for the Circuit Breaker. Suitable are control devices shall be mounted around the fixed contacts.
Terminal insulators of synthetic resin bonded paper shall be provided suitable for the specified short circuit level.

Sheet steel barriers shall be provided between.
Instrument Panel and Potential Transformer.
Instrument Panel and Current Transformers.
Bus bar Chamber and Circuit Breaker compartments.

4.0 CIRCUIT BREAKER OPERATING MECHANISM.

The Circuit Breaker shall be trip free and equipped with a motor power operated closing mechanism. The operating mechanism shall be such that the Circuit Breaker is at all times free to open immediately the trip coil is energized.

Mechanical ON/OFF position indication shall be provided on the front of the circuit breaker.

The operating mechanism shall be mounted on the front panel of the truck.

The operating handle and the mechanical trip push button shall be at the front of and integral with the Circuit Breaker.

The operating mechanism shall provided four distinct and separate positions of the Circuit Breaker on the cradle.

Service
Test
Isolated
Maintenance

5.0 CIRCUIT BREAKER INTERLOCKING

Each Circuit Breaker shall be provided with the following mechanical safety interlocks to ensure protection to the equipment and the operator.

The Circuit Breaker cannot be closed unless it is in the 'PLUGGED IN' position.

The Circuit Breaker cannot be withdrawn form or pushed into the housing unless the main contacts are open.

The Circuit Breaker cannot be put into service without making the secondary connections between the truck and housing.

The cover of the draw out voltage transformer cannot be opened unless the transformer is isolated.

6.0 CIRCUIT BREAKER AUXILIARY CONTACTS.

The Circuit Breaker shall have minimum of 6 N.O and 6 N.C auxiliary contacts rated at 5 amps. These contacts shall close before the main contacts when the Circuit Breaker is plugged in and vice versa when the Circuit Breaker is lowered.

7.0 PROTECTIVE RELAYS.

The Circuit Breaker shall have over current, earth fault protection and auxiliary relay devices as specified in the Schedule of Quantities. These relays shall be mounted flush on a separate compartment with access from the rear for wiring and maintenance.

8.0 POTENTIAL AND INSTRUMENT TRANSFORMERS

A draw out type cast resin voltage transformer shall be mounted in the panel and connected to the line. The tank shall be arranged for horizontal isolation.

The Circuit Breaker shall have the required current transformers as specified in the Schedule of Quantities for metering and protection mounted outside the Circuit Breaker compartment but within the free standing cubicle. The transformers shall comply to the relevant Indian Standard. All current transformers for metering shall be Accuracy Class I and of capacity and ration as required. Separate sets of current transformers shall be provided of metering and protection.

9.0 INSTRUMENTATION

Instruments and indicating lamps as required in the Schedule of Quantities shall not be mounted on the Circuit Breaker compartment door. A separate adequate compartment shall be provided. The instruments and relays shall be accessible for testing and maintenance without danger of accidental contact with live parts in the Switchgear Panel.

Square pattern flush mounting meters and selector switches of the three way and OFF pattern complying with the requirements of the relevant Indian Standards shall be used.

The current transformers for metering and protection shall be mounted on the solid copper busbars with proper supports.

Neon type indication lamps shall be provided for phase and other operational indications.

10.0 TYPE TEST CERTIFICATES.

The Contractor shall submit type test certificates of the Circuit Breaker complying to the relevant Indian Standards form a recognized Test House.

11.0 11 KV SWITCHGEAR PANEL

11.1 General

The switchgear panels shall be suitable for operation at 11000 volt 3 phase 50 Hz supply system with a short circuit withstand of 350 MVA at 11,000 volts and a corresponding short time rating for I second.

The Switchgear panels shall comply with the requirements of the latest edition with upto date amendments of the relevant Indian Standards Specification, Indian, Electricity Rules and Regulations.

11.2 Switchgear Configuration.

The panel shall be configured with 11,000 volt Circuit Breakers, associated metering and protective devices and other equipment as called for in the Bill of Quantities.

11.3 Equipment Specifications.

All equipment used to configure the Switchgear Panel shall comply to the relevant Standards and Codes of the Bureau of Indian Standards and the detailed technical specifications as included in this tender document.

11.4 Constructional Features.

The 11000 volts Switchgear Panel shall be totally enclosed, dead front, metal clad, cubicle pattern, floor mounting, extensible on both sides and suitable for indoor use. The Switchgear Panels shall be totally enclosed and completely dust and vermin proof. Synthetic rubber gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof. All doors and covers shall also be fully gasketed with synthetic rubber and shall be lockable.

The Switchgear Panels shall be fabricated with CRCA sheet steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provided a rigid support for all components. The doors and covers shall be constructed from CRCA Sheet Steel of thickness not less than 1.6 mm. Joints of any kind in sheet steel shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and square with the frame. The holes in the panels hall be correctly positioned.

Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self threading screws shall not be used in the construction of the Switchgear Panels.

11.5 Switchgear Panel Limitations.

A base channel of 75 mm x 5 mm thick shall be provided at the bottom.

The Switchgear Panel height shall normally be restricted to a maximum of 2300 mm.

11.6 Switchgear Panel Compartmentalization.

The Switchgear Panels shall be divided into distinct separate compartments comprising.

A completely enclosed ventilated dust and vermin proof bus bar compartment for the vertical and horizontal busbars.

Each Circuit Breaker shall be housed in a separate compartment enclosed on all sides.

Separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, protective relays, control fuses etc as required. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts.

A horizontal wire way with screwed covers shall be provided at the top to take interconnecting control wiring between vertical sections.

Cable compartment shall be of adequate size for easy termination of all incoming and outgoing cables. Adequate and proper supports shall be provided in the compartment for supporting the cables.

11.7 Switchgear Panels Busbars.

The main horizontal and vertical interconnection busbars shall be of hard drawn high conductivity electrolytic copper and of rectangular cross sections suitable for full rated current. The current density for copper shall be 1.6 amps per sq. mm and suitable to withstand the electromagnetic and thermal stresses of a 350 MVA fault level at 11000 volts for 1 second.

The busbars and interconnections shall be insulated glass sleeves.

The busbars shall be extensible on either side of the Panels.

The busbars shall be supported on non-breakable, non-hygroscopic insulated supports at regular intervals to with stand the stresses of a 350 MVA fault level.

All busbars and interconnections shall be colour coded.

The main horizontal busbars shall run through the entire length of the Switchgear Panels.

11.8 Switchgear Panel Interconnections.

All interconnections shall be with solid electrolytic copper of adequate size to carry the full rated current and fiber glass insulated.

11.9 Draw out Features.

All Circuit Breakers shall be provided in fully draw out cubicles. These cubicles shall be such that draw out is possible without disconnection of the wires and the cables. The power and control circuits shall have self aligning and self isolating contacts which shall be easily accessible for maintenance. Mechanical interlocks shall be provided on the draw out cubicles to ensure safety and compliance to the relevant Standards.

11.10 Switchgear Panel Interlocks.

Each group of busbars and feeder connections shall be fitted with automatically operated safety shutters with positive opening and closing when the Circuit Breaker is raised or lowered.
Facility shall be provided for hand operation of the shutters and latching in either open or closed position.

Padlocking provision of the shutter in the closed positions shall be included for maintenance purposes.

11.11 Instruments and Protection Relays.

Instruments, indicating lamps and all protection and control relays shall not be mounted on the Circuit Breaker compartment door. A separate adequate

compartment shall be provide. The instruments and relays shall be accessible for testing and maintenance without danger of accidental contact with live parts in the Switchgear Panel.

11.12 Switchgear Panel Internal Wiring

All wiring for relays and metering shall be with PVC insulated copper conductor wires. The wiring shall be coded and labeled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 2.5 sq. mm.

11.13 Cable Terminations.

Knock out holes of appropriate size and number shall be provided in the Panels in Conformity with the location of the incoming and outgoing cables.

The cable terminations of the Circuit Breakers shall be brought out to terminal cables sockets suitable located in the cable chamber at the rear of panels.

11.14 Space Heaters.

The Switchgear Panel shall have in each panel thermostatically controlled space heaters with a controlling 16 amp 230 volt socket outlet with MCB to eliminate condensation.

11.15 Earthing

Two main earth bars of G.I./ copper as required shall be provided throughout the length of the Switchgear Panels with a provision to make connections on both sides to the sub-station earth.

11.16 Designation Labels.

Suitable engraved white on black name plates and identification labels of metal for all Panels and circuits shall be provided. Theses shall indicate the feeder number and the designation.

11.17 Sheet Steel Treatment And Painting

Sheet steel materials used in the construction of the Switchgear Panels should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognized phosphating process. The sheet steel work shall then receive two coats of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.

All sheet steel work shall after metal treatment by spray or powder painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stored and the paint thickness shall be not less than 50 microns.

END OF SECTION – III

SECTION – IV

OIL TYPE TRANSFORMER

1.0 SCOPE :

This specification generally describes the power transformers and associated auxiliary equipment for use on the electrical power distribution system and covers the design, manufacture, testing at works, supply and delivery, site erection, testing and commissioning aspects of the same. The details are given in the data sheet.

2.0 STANDARDS :

2.1 The equipment and accessories covered by this specification shall be designed, manufactured and tested in compliance with the latest relevant standards published by the Indian Standards institution wherever available in order that specific aspects under Indian conditions are taken care of.

2.2 The equipment and accessories for which Indian Standards are not available shall be designed, manufactured and tested in accordance with the latest standards published by any other recognised national standards institution.

2.3 The equipment shall also conform to the latest Indian Electricity Rules as regards safety, earthing and other essential provisions specified therein for installation and operation of electrical plants.

2.4 Generally the transformer shall conform to IS:2026 and unless otherwise stated following standards shall be applicable.

i) IS: 1180
ii) IS: 3839
iii) IS: 6600
iv) IS: 335
v) IS: 1271
vi) IS: 2099
vii) IS: 3639
viii) IS: 2147
ix) IS: 3202
x) IS: 2705

3.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES:

3.1 All materials used shall be of best quality and of the class most suitable for working under the site conditions and shall withstand the variations of temperature and atmospheric conditions, overloads, over-excitation, short circuits as per applicable standards, 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.

3.2 The design shall be such that the risk of accidental short-circuit due to birds or vermin's are obviated. All apparatus, including bushing insulators and fittings shall be so designed that water cannot collect at any point. Marshaling kiosks, boxes etc. shall be adequately ventilated to prevent condensation of moisture and so treated internally as to prevent growth of fungi on any coils, wires and insulating materials used.

3.3 The transformers shall operate with minimum noise and vibration. The cores, tank and other structural parts shall be properly constructed so that the mechanical vibrations are kept to the minimum, thus reducing the noise.

3.4 The design of the transformer shall be such that changes in transformer connection can be made by a simple change of link connection inside the tank. The transformers shall be designed to suppress harmonic voltages, specially the third and fifth, so as to eliminate distortion in wave form, and the possibility of circulating currents between the neutrals at different transformer stations.

3.5 All transformers shall be of the latest design, oil filled as called for in the main specification. Unless otherwise specified, all transformers shall be suitable for indoor installation. The type of cooling and the corresponding ratings for each transformer shall be as indicated in the main specification.

3.6 The magnetic circuit of each transformer shall be so designed as to minimise eddy-current and hysteresis losses in the core.

3.7 All electrical connections and contacts shall be of ample section for carrying the rated current without excessive heating.

3.8 All mechanisms shall be of stainless steel, brass, gunmetal, or other suitable material to prevent sticking due to rust or corrosion.

3.9 **TANK :**

3.9.1 The transformer tank shall be made of steel plate, shaped in such a way that minimum of welding is required. The tank shall be electrically welded and all welding stresses shall be properly relieved. Tank walls shall be reinforced by adequate stiffeners to ensure mechanical rigidity permitting hoisting of complete transformers filled with oil and also to damp transformer-noise. The tank shall be sufficiently strong to withstand shocks likely to be encountered during transport of the transformer without any deformation or weakening of joints. The joints shall be oil-tight. Guides shall be welded on the inner side of the tank to facilitate tanking and untanking of the transformer core and coil assembly.

3.9.2 Tank cover shall be bolted on to the flanged rim of the tank with a suitable weather-proof, hot-oil-resistant gasket in between for oil-tightness. The bolted tank cover shall be so arranged that it can be removed and the core inspected without removal of the radiators. All requisite access and inspection holes shall be provided with bolted oil-tight, gasket-seated cover-plates. Bushing-turrets, covers of access holes, covers of pockets to prevent leakage of water into the tank shall be provided.

3.9.3 The exterior of tank and other steel surface 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. The interior of the tank shall be cleaned by shot blasting and painted with two coats of heat resistant and oil insoluble paint.

3.9.4 Steel bolts and nuts exposed to atmosphere shall be galvanised however, surfaces of the transformer or other parts of the transformer or auxiliary equipment which are in contact with oil shall not be galvanised.

3.9.5 The transformer tank, auxiliary equipment and fittings shall be provided with necessary devices for lifting and haulage facilities. The tank shall be mounted on a substantial under-carriage.

3.9.6 Unless otherwise stated the tank together with radiators, conservator, bushings and other fittings shall be designed to withstand without permanent distortion the following conditions.

a) Full vacuum of 760mm of Hg for filling oil by vacuum.

b) Internal gas pressure of 0.35 Kg/Sq.cm. with oil at operating level.

Valves shall not leak nor any welded joints sweat under above conditions.

3.9.7 Adequate space shall be provided at the bottom of the tank for collection of sediments.

3.10 CORE:

3.10.1 The magnetic circuit shall be built of transformer grade cold rolled grain oriented low loss steel stampings having high permeability and conforming to adopted standards. Stampings shall be insulated from each other with material having high inter-lamination insulation resistance and rust inhibiting property and also capable of withstanding pressure, mechanical vibration and action of heat and oil, thus reducing the possibility of sludge formation to a minimum.

3.10.2 The framework, clamping arrangement and general structure of the cores of each transformer shall be of robust construction and shall be capable of withstanding any shock to which they may be subjected during transport, installation and service. The assembled core shall be securely clamped, on the limbs and the yoke, to build up a rigid structure. The clamping pressure shall be uniform over the whole of the core and so adjusted as to minimize noise and vibration in the core when the transformer is in service. The framework and the core bolts shall be efficiently insulated from the core so as to reduce the circulating currents to a minimum.

3.10.3 The core clamping frame shall be provided with lifting eyes for the purpose of tanking and untanking the core with winding mounted thereon and shall have ample strength to take the full weight of the core and winding assembly.

3.10.4 An approved type of core grounding system shall be used; the grounding connections being located at the top of the core for easy access from the inspection hole.

3.11 WINDING:

3.11.1 The coils used for transformer winding shall be circular in shape, made of paper insulated, continuous and smooth, tinned or enameled electrolytic copper conductors of high conductivity.

3.11.2 The transformer winding shall be designed for basic impulse insulation level not lower than that specified in the main specification.

3.11.3 Liberal ducts shall be provided to prevent any hot spot temperature in the winding that may adversely affect the life of the transformer. Adequate supports, wedges and spacers of hard insulating material shall be so fitted that they will neither move nor permit relative movement of any part of winding during transit of normal service or under terminal short-circuit, nor damage the winding insulation in any way. All leads and connections shall be robust, adequately insulated, protected and clamped. The winding assembly shall be dried in vacuum with tested insulating oil of approved standard. The windings shall be subjected to a thorough shrinking and seasoning process so that no further shrinkage of windings occur during service at site. However adjustable devices shall be provided for taking up any possible shrinkage of coils in service. The assembly shall be held in position under adequate axial compression to withstand the axial thrust likely to occur under terminal short-circuit.

3.11.4 The end turns on the high voltage winding shall have reinforced insulation to take care of the voltage surges likely to occur during switching or any other abnormal system condition.

3.11.5 The transformers shall be suitable for operation at full rated power on all tappings without exceeding the specified temperature rise as indicated in the applicable standards.

3.12 INSULATING MATERIALS:

3.12.1 The insulating oil shall conform to IS-335 and shall be suitable in all respects for operating the transformer at the rating and under conditions specified in the main equipment specification. Sufficient oil shall be supplied for the first filling of transformer, the oil circulating equipment and the tank containing tap-changing mechanism and an extra 10% shall be supplied in non-returnable drums. The tender shall contain information about the grades of oil recommended by the transformer manufacturer for use in the transformer. Test certificates for the oil shall be furnished before dispatch of transformer and acceptance by owner.

3.12.2 Class A insulating materials specified in IS:1271 shall be used. Paper insulation shall be new and free from punctures. Wood insulation, where used shall be well seasoned and treated.

3.13 TRANSFORMER TAPPINGS :

Transformer shall be provided with ON load tap changer arrangement in steps of 1.25% with range from + 5% to – 15.00%.

3.14 COOLING EQUIPMENT:

3.14.1 Natural cooling by means of banks of detachable type radiators made from pressed/round tubes around transformer tank shall be provided. The tubes shall be of seamless mild steel sheet with clean bright internal surface and shall be suitably braced to protect them from shock.

3.14.2 The radiators shall be provided with butterfly type of shut off valves.

3.14.3 Cooling tubes/radiators shall permit every part of the cooling surface to be cleaned by hand.

3.15 TERMINAL ARRANGEMENT

3.15.1 High Voltage Side (11 KV)

Cable box shall be provided suitable for terminating one no. 3C x 185 sq. mm XLPE insulated armoured 11 KV cable complete with disconnecting chamber, compression glands, tinned copper lugs, Armour earth clamp and body earth terminal.

Cable box shall be fitted with bushing insulators for H.T. cable termination side.

3.15.2 Medium Voltage Side (433 V)

LT Termination shall be suitable for termination of 5 nos x 3.5 x 300 sq. mm XLPE cable.

3.15.3 Disconnecting Chamber

The disconnecting chamber shall be air insulated and complete with sealoff bushing, removable flexible connectors / links and removable covers. It shall be possible to trail out the transformer without having disconnecting the bus duct.
Phase to phase and phase to ground clearances with in the chamber shall be such as to enable either the transformer or cable to be subjected separately to H.V. test.

3.15.4 Bushing :

Bushings shall confirm to IS: 2099 and other relevant standards.

Bushings shall be supplied with terminal connector clamp suitable for connecting the bushing terminal to the owner's conductor.

Creepage distance of bushing shall be (41mm/kv phase ground) adequately,

3.16 MARSHALLING BOX

3.16.1 Whenever optional fittings, temperature indicators, with auxiliary contacts and Bushing CT's are specified then the bidder shall provide a Marshalling box and Marshall to it all the contact terminals of electrical devices mounted on the transformer. It shall be in the contractor's scope to provide:

a) The interconnection cabling between the Marshalling box and the accessory devices either by PVC insulated copper wire in G.I. conduits or PVC insulated copper conductor armoured cables.

b) Necessary compression type brass cable glands at the Marshalling box for above cables.

3.16.2 The Marshalling box shall be tank mounted, water/dust tight sheet steel (2mm thick) enclosed with hinged door having padlocking facility. All doors, covers and plates shall be fitted with neoprene gaskets. Top surface shall be sloped and bottom shall be atleast 600mm from floor and provided with gland plate and cable glands as required.

3.16.3 Terminals shall be clipon type rated for 10A. All contacts for alarm/trip indication shall be potential free, wired up to the terminal block. Wiring shall be done with stranded copper conductor wires of sizes not less than 1.5 sq.mm for control and 2.5 sq.mm for CT circuits. C.T. terminals shall be provided with shorting facility.

4.0 ELECTRICAL & PERFORMANCE REQUIREMENT :

a) Transformer shall operate without injurious heating at the rated KVA at any voltage within +/- 10% of the rated voltage of that particular tap.

b) Transformer shall be designed for 110% continuous over fluxing withstand capability.

c) The neutral terminals of the winding with star connection shall be designed for the highest over current that can flow through the winding.

d) Overloads shall be allowed with in the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, tapchangers or other auxiliary equipment shall apply.

e) Temperature Rise shall be continuously rated for full load. The temperature rise shall not exceed 45 degree C by thermometer in oil or 55 degree centigrade by resistance over an ambient of 38 degree C.

5.0 EARTHING :

5.1 Two separate earthing terminals to be provided at the bottom of the tank on opposite sides. The terminals shall be of clamp type suitable for connection to owners grounding strip (50 x 6mm G.I.).

5.2 **Internal Earthing :**

The frame work and clamping arrangements of core and oil shall be securely earthed inside the tank by adequately sized G.I. strip connections to the tank.

5.3 Neutral to be earthed with size, of copper (6mm x 50mm)

6.0 FITTINGS AND ACCESSORIES :

The transformer shall be provided with all standard fittings and accessories specified in the applicable standard for the size and type of transformer concerned. The accessories and fittings shall generally be as specified below:

Oil Conservator :

The transformer to be provided with an oil conservator with welded end plates. It is to be bolted to the cover and can be dismounted for purpose of transport. It shall be provided with plain oil level gauge with marking for minimum level and an oil filling hole with a cap which can be used for filling oil. For draining purpose a plug shall be provided. An equiliser pipe between the conservator and the main tank is to be provided, which projects inside conservator. Separate conservator shall be provided for OLTC chamber.

Breather:

The transformer shall be provided with an indicating dehydrating silica-gel breather with glass window for inspection of sufficient capacity.

Explosion Vent.

An explosion vent with diaphragm shall be provided for relieving the pressure within the transformer.

Diagram and Rating Plate:

Diagram and rating plate of stainless steel shall be provided indicating the details of transformer, connecting diagram, vector group, tap changing diagram etc.

Earthing Terminals

Two earth terminals of adequate mechanical and electrical capacity shall be provided. One separate earthing terminal shall also be provided on each separate radiator banks.

Dial type Thermometer (OTI)

Dial type thermometer (150mm dia) with maximum set pointer at 75 degrees c and electrical contacts for electrical alarm at high temperature with thermometer pocket shall be provided.

Winding Temperature Indicator (WTI)

Shall comprise of :
i) Temperature sensing element
ii) Image coil
iii)Bushing or turret mounted

iv) C.T. Local indicating instrument with electrically independent trip/alarm contact brought out to separate terminals.

Buchholtz Relay :

To be provided with double float for operation through oil pressure

Lifting Lugs :

The arrangement for lifting the active part out of the transformer tank along with cover by means of lifting lugs without disturbing the connections shall be provided.

Swivel Type Rollers :

The transformer to be provided with 4 Nos. bi-directional rollers fitted on cross channels to facilitate the movement of transformer in both directions.

Air Release Plugs :

An air release plug shall be provided on the top of the tank cover/radiators to facilitate the release of the entrapped air and filling of oil.

Drain-cum-oil Filter Valves with Plug on Cover Plate:

The transformer shall be provided with a drain-cum-oil filter valve with blanking plate & locking arrangement at the bottom of the tank.

Filter valve of at top with blanking plate.

Sample valve with blanking plate.

Inspection cover.

Oil filling hole with cap.

Jacking Pads

Skids

Neutral bushing terminals complete with connector for earth conductor.

7.0 DRAWINGS AND O&M MANUALS:

7.1 Four copies of manual of complete instructions for the installation, operation, maintenance and repairs circuit diagrams, foundation and trenching details shall be provided with the transformers.
List of spare parts shall also be indicated.

7.2 Two copies of the drawings incorporating the following particulars shall be submitted with the offer for preliminary study.

a) GA drawing showing dimension, net weight and shipping weight, quantity of insulating oil etc.
b) Crane requirements for assembly and dismantling of the transformer.
c) Drawing indicating GA of cable box and its dimension for cable entry cut out requirements etc.

7.3 The drawings in (four sets) to be furnished by the supplier for approval after acceptance of his order shall include the following.

a) GA showing front and side elevations and plan of transformer and all accessories and external features, detailed dimensions, oil quantity, H.T./L.T. clearances etc.

b) Drawings of Bus duct/cables termination arrangement.

c) HV cable box arrangement & disconnecting chamber GA & details drawings.

d) Drawing of each type of bushing.

e) Name plate and terminal making and connection diagram.

f) Control wiring & schematic diagram showing polarity and vector group of windings, CTs and OTI, WTI, circuits, Alarm/trip circuits etc.

7.4 Reproducible copy of the above drawings for records

8.0 TESTING:

The transformer shall be subjected to all routine tests in accordance with IS : 2026 at the factory before dispatching the same and test certificates shall be furnished.

a) Measurement of winding resistance.
b) Ratio polarity and phase relationships.
c) Impedance voltage.
d) Load losses
e) No-load losses and No load current
f) Insulation resistance (Before & after carrying out all tests)
g) Induced over voltage withstand test
h) Separate source voltage withstand test
i) Bidders may quote for the HV impulse test. Alternatively they may submit the test certificate for the test conducted on the similar transformer.
j) Test will be witnessed by Owners representative/consultant if so desired by owner/consultant.
k) Oil Test (BDV) will be done, if required.

9.0 TEST REPORTS

Four copies of the test reports in bound volume shall be submitted for approval.

10.0 SPARES

The bidder shall quote item wised prices for his recommended spares for the period of operation of transformer for 5 years.

TRANSFORMER DATA SHEET

1.0	**GENERAL**	
1.1	Application	: Distribution, Mixed lighting, power, Air-conditioning and Fire Fighting etc.
1.2	Quantity Required	: 1 No.
1.3	Installation	: Compact Unit
2.0	**RATINGS**	
2.1	Rating KVA	: 800 (Outdoor Type)
2.2	Number of phases & Frequency	: 3 PHASE, 50Hz
2.3	Type of cooling	: ONAN
2.4	No Load Voltage	
	HV	: 11000 V
	MV	: 433 V
2.5	Vector Group	: DYn11
2.6	Percentage Impedance	: 4.5%
2.7	Percentage Efficiency	: 98%
3.0	**VOLTAGE**	
3.1	Nominal System Voltage	
	HV	: 11000 V
	MV	: 433 V
3.2	Highest System Voltage	
	HV	: 12000 V
	MV	: 433 V
4.0	**TAPCHANGING GEAR**	
4.1	TAPS ON LOAD	: ON LOAD FULL RATING

4.2	Tapping on windings HV/LV	: HV
4.3	Total tapping range	: +5% to to -15.00%
4.4	Steps	: 1.25%

5.0 TEMPERATURE RISE

5.1	Ref. Ambient ^{O}C	: 45^{O}C
5.2	Ref. Elevation	: Transformer to be installed in Kanpur
5.3	Oil by thermometer ^{O}C	: 45 Degree
5.4	Winding by Resistance ^{O}C	: 55 Degree

6.0 INSULATION WITHSTAND

6.1 Impulse (1.2x50 micro second wave): 75 KV

6.2 Power Frequency (Dry & Wet)

HV : 28 KV
MV : 3 KV

7.0 NEUTRAL EARTHING

7.1	SYSTEM NEUTRAL Effectively Earthed/Resonant Non effectively Earthed/ Isolated	: Effectively Earthed
7.2	TRANSFORMER NEUTRAL	: Effectively Earthed

8.0 VACUUM WITHSTAND CAPABILITY

Main Tank with bushing,
Radiator, fittings & accessories : Full Vacuum

9.0 ACCESSORIES

9.1	Dial type thermometer with Alarm and trip contacts	: Yes
9.2	Magnetic Oil gauge with Alarm contact	: Yes
9.3	Buchholtz Relay (Double float)	: Yes
9.4	Winding Temperature Indicator	: Yes
9.5	Wheels Plain/Flanged/ bi-directional/unidirectional	: Plain, Bi-directional
9.6	Explosion Vent diaphragm	: Yes

9.7	Silicagel Breather	:	Yes
9.8	Valves	:	Drain valve, Filter valve, Sampling valve etc., complete set with blanking plate/plugs.

10.0 TERMINATION ARRANGEMENT

10.1	H.V. SIDE (CABLE BOX)	:	Cable box and disconnecting chamber suitable for 3C x 185 Sq mm 11 KV XLPE cable.
10.2	M.V. SIDE (CABLE BOX)	:	.Cable box and disconnecting chamber suitable for 5 x3.5C x 300 Sq mm XLPE cable.

DATA TO BE FURNISHED BY BIDDER:

1.0 POWER TRANSFORMER:

1.1	Name of Manufacturer	:
1.2	Standards followed in design manufacture and testing	:
1.3	Continuous maximum rating in KVA:	
1.4	Transformer no-load voltage	:
1.4.1	High voltage	:
1.4.2	Medium voltage	:
1.5	Vector group reference	:
1.6	Temperature rise over specified ambient temperature in degree C	:
1.6.1	In oil by thermometer	:
1.6.2	In winding by resistance	:
1.6.3	Maximum hot spot temperature in degree C	:
1.7	Terminal Arrangement.	
1.7.1	H.V. Side	:
1.7.2	M.V. Side	:
1.8.	One-ninute dry power frequency	

	test withstand voltage in KV	:
1.8.1	High voltage	:
1.8.2	Medium voltage	:
1.9	Impulse test withstand voltage with 1.2 x 50 microseconds wave in KV	:
1.10	Type of tap changer	:
1.10.1	No. of plus taps	:
1.10.2	No. of minus taps	:
1.11	Iron losses in KW at rated voltage and frequency	:
1.12	Copper losses in KW at rated full load current and frequency at 75 degree C	:
1.13	Reactance voltage with guaranteed tolerance in percent at rated full load current and frequency75 Deg C	:
1.14	Impedance voltage with guaranteed tolerance in percent at rated full load current and frequency at 75 Deg C	:
1.15	Regulation in percent of no-load voltage at full load current at 75 degree C and with power factors of	:
1.15.1	Unity	:
1.15.2	0.8 lagging	:
1.16	Efficiency in percent at 75 degree C and unity power factor for	:
1.16.1	100 percent load	:
1.16.2	75 percent load	:
1.16.3	50 percent load	:

1.17	No-load current in amperes at rated voltage and frequency	:
1.18	Inrush magnetizing current in percent of normal full load current.	:
1.19	Details of winding insulation	:
1.19.1	Class of insulation materials	:
	Turns insulation high voltage in meg ohm	:
1.19.3	Turns insulation low voltage in meg ohms	:
1.19.4	Insulation core to low voltage in meg ohms	:
1.19.5	Insulation high voltage to low voltage in mega ohms	:
1.20	Details of 415 V neutral current transformer	:
1.20.1	Name of manufacturer	:
1.20.2	Current ratio	:
1.20.3	VA capacity	:
1.20.4	Accuracy & performance characteristics	:
1.21	Quantity in liters and grade of oil	:
1.22	WEIGHTS :	
1.22.1	Core and windings in kg	:
1.22.2	Tank and fittings in kg	:
1.22.3	Oil	:
1.22.4	Complete transformer filled with oil	:

1.23 OVERALL DIMENSIONS :

1.23.1 Length in mm :

1.23.2 Breadth in mm :

1.23.3 Height in mm :

2.0 TESTS:

2.1 List of tests proposed to be carried out at the factory :

2.2 List of tests proposed to be carried out at the site before commissioning. :

INFORMATION TO BE FURNISHED BY THE VENDOR AFTER AWARD OF CONTRACT

Information to be furnished within 2 weeks of award of contract.

1.0 Positive sequence impedance at maximum voltage tap.

2.0 Positive sequence impedance at maximum voltage cap.

3.0 Zero sequence impedance at principal tap.

4.0 Efficiency at $75^{o}C$ winding temperature:

4.1 At full load

4.2 At 75% full load

4.3 At 50% full load

5.0 Maximum efficiency and load at which it occurs.

6.0 Regulation at full load at $75^{o}C$ winding temperature at:

6.1 Unity power factor

6.2 0.85 power factor lag.

7.0 Resistance per phase of :

7.1 H.V. winding : Ohms

7.2 M.V. winding : Ohms

8.0 Conductor area (sq.cm) and current density (Amps/cm^2)

8.1 HV winding

8.2 M.V. winding

9.0 Type of windings

9.1 HV

9.2 MV

10.0 Insulating materials for interterm insulation :

10.1 HV winding

10.2 MV winding

11.0 Insulating materials for winding insulation

12.0 Insulating materials

12.1 Winding and core

12.2 Laminations of the core.

13.0 Make, type, dial rise, number of contacts and contact ratings (current following items, if provided).

13.1 Magnetic oil level gauge.
13.2 Dial type thermometer.
13.3 Winding temperature indicator.
13.4 Gas and oil actuated relay.

14.0 Thermal withstand capability under full short circuit conditions in terms of number of times of calculation of short circuit and corresponding anticipation percentage reduction in transformer life. Relevant calculations shall be submitted.

15.0 DRAWINGS

The following drawings shall be submitted for the PURCHASER'S approval in the stipulated time.

15.1 General outline drawings showing plan, front elevation, rear elevation, cable boxes/disconnecting chamber section views, locating dimensions of cable entries, terminals foundation floor fixing details and weights.

15.2 Bushings : Plan, elevation terminals details, mounting details make and type number, current and voltage rating, Creepage distances and principal characteristics.

15.3 Rating and diagram plate

15.4 Marshalling box terminal connections, wiring diagram

16.0 TEST REPORTS

Test results shall be corrected to a reference temperature of 75 Deg C.

16.1 Two copies of test results shall be submitted for the Owner's/Consultants approval before dispatch of transformer.

16.2 Additional bound copies, as required by the Owners/Consultants contract, of complete test results including all tests on transformer, bushing, current transformer (if provided), shall be furnished with the transformer.

END OF SECTION -IV

SECTION – V

MV CABLES AND CABLE TRAY

1.0 STANDARDS OF CODES

This chapter covers the specifications for supply and laying of Medium Voltage **XLPE** cables.

All equipments, components, materials and entire work shall be carried out in conformity with applicable and relevant Bureau of Indian Standards and Codes of Practice, as amended upto date. In addition, relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and /or IEC Standards shall be applicable.

2.0 CABLES

Medium voltage cables shall be aluminum conductor XLPE insulated, PVC sheathed armoured conforming to latest IS Code. Cables shall be rated for a 1100 Volts.

All Conductor cables shall be as per BOQ.

Conductors shall be insulated with high quality XLPE base compound. A common covering (bedding) shall be applied over the laid up cores by extruded sheath of unvulcanised compound. Armouring shall be applied below outer sheath of PVC sheathing. The outer sheath shall bear the manufacturer's name and trade mark at every meter length. Cores shall be provided with following colour scheme of PVC insulation.

1 Core	:	Red/Black/Yellow/Blue
2 Core	:	Red and Black
3 Core	:	Red, Yellow and Blue
3 ½ /4 Core	:	Red, Yellow, Blue and Black

3.0 STORING, HANDLING, LAYING, JOINTING AND TERMINATION

Storing

All the cables shall be supplied in drums. On receipt of cables at site. It should be ensured that both ends of the cables are properly sealed to prevent ingress/absorption of moisture lay the insulation. The cables shall be inspected and stored in drums with flanges of the cable drum in vertical position. Whenever cable drums have to be moved over short distances, they should be rolled in the direction of the arrow, marked on the drum and while removing cables from the drums the drum shall be properly mounted on jacks or on a cable wheel or any other suitable means making sure the spindle, jack etc. are strong enough to take the weight of the drum.

Laying

Cables shall be laid as per the specifications given below :

i) Cable on Trays/Racks

a) Cable shall be laid on cable trays/racks wherever specified. Cable racks/trays shall be of ladder, trough or channel design suitable for the purpose. The nominal depth of the trays/racks shall be 150 mm. The width of the trays shall be made of steel or aluminium. The trays/racks shall be completed with end plates, tees, elbows, risers, and all necessary hardware, steel trays shall be hot dip galvanized. Cable trays shall be erected properly to present a neat and clean appearance. Suitable cleats or saddles made of aluminium strips with PVC covering shall be used for securing the cables to the cable trays. The cable trays shall comply with the following requirements :

b) The tray shall have suitable strength and rigidity to provide adequate support for all contained cables.

c) It shall not present sharp edges, burrs or projections injurious to the insulation of wiring/cables.

d) If made of metal, it shall be adequately protected against corrosion or shall be made of corrosion-resistant material.

e) It shall have side rails or equivalent structural members.

f) It shall include fittings or other suitable means for changes in direction and elevation of runs.

Installation

1. Cable trays shall be installed as a complete system. Trays shall be supported properly from the building structure. The entire cable tray system shall be rigid.

2. Each run of the cable tray shall be completed before the installation of cables.

3. In portions where additional protection is required, non combustible covers/enclosures shall be used.

4. Cable trays shall be exposed and accessible.

5. Where cables of different system are installed on the same cable tray, non combustible, solid barriers shall be used for segregating the cables.

6. Cable trays shall be grounded by two nos, earth continuity wires. Cable trays shall not be used as equipment grounding conductors.

Jointing and termination's

Cable jointing shall be done as per the recommendations of the cable manufacturer. All jointing work shall be done only by qualified/licensed cable jointer.

All jointing pits shall be of sufficient dimensions as to allow easy and comfortable working.

Jointing materials and accessories like conductor, ferrules, solder, flex, insulating and protective tapes, filling compound, jointing box etc. of right quality and correct sizes, confirming to relevant Indian Standards.

Each termination's shall be carried out using brass compression glands and cable sockets. Hydraulic crimping tool hall be used for making the end termination's. Cable gland shall be bonded to the earth by using suitable size copper wire/tape.

1.0 TESTING

a) Cable jointing shall be tested at factory as per the requirements of latest IS amendment upto date. The tests shall incorporate routine tests, type tests and acceptance tests.

b) Cable shall be tested at site after installation and the results shall be submitted to the Project Manager.

c) Insulation resistance between conductors and neutral and conductors and earth.

d) Pressure test for 15 minutes.

2.0 CABLE TRAY & LADDER SPECIFICATION

General Requirement:-

Cable Tray and Cable Ladder systems are intended for the support and accommodation of cables and possibly other Electrical equipment in Electrical/Instrumentation/Communication systems.

Design and Fabrication of Cable Trays / Ladders:-

The cable trays / ladders shall be fabricated according to the design specified by IEC 61537 and should be tested for Safe Working Load (SWL). The relevant details of SWL and the load chart with respect to SWL, supporting distance and the deflection should be according to the following chart.

Safe Working Load (SWL) with a span length up to 3 meters						
Description	Side Height (in mm)	Width (in mm)	Span length (in meters)			
			1.5m	2m	2.5m	3m
			Permitted Load (in kg/meter)			
Perforated Cable Tray	35	50 - 300	125	90	50	-
	60	50 - 600	150	100	50	-

	85	100 - 600	175	110	50	-
	110	100 - 550	185	130	75	60
Cable Ladder	45	200 - 600	180	140	100	55
	60	200 - 600	-	225	150	100
	110	200 - 600	-	310	200	140

Safe Working Load (SWL) with a span length up to 10 meters

Description	Side Height (in mm)	Width (in mm)	Span length (in meters)						
			4m	5m	6m	7m	8m	9m	10m
			Permitted Load (in kg/meter)						
Perforated Cable Tray for long span distance	110	200 - 300	160	110	75	-	20	-	-
		400 - 600	200	150	100	-	40	-	-
	160	200 - 300	230	180	140	100	70	-	-
		400 - 600	250	200	160	130	100	-	-
Cable Ladder for long span distance	110	200 - 300	160	110	80	40	-	-	-
		400 - 600	210	150	100	70	-	-	-
	160	200 - 300	230	180	140	100	70	-	-
		400 - 600	250	200	160	130	100	-	-
	200	200 - 600	-	-	300	250	200	140	100

Fabrication of Tray / Ladder and accessories at site and welding is not permitted. In unavoidable circumstances, If any cut or holes are made in the trays/Ladder/accessories, zinc spray need to be applied over the surface. The metal edge has to be protected by edge protection sleeves to avoid cable damage. Edge of the supports has to be protected with plastic END caps. Screwed connections and internal fixing Devices should not create any damage to the cable when correctly fixed. Sudden or jerky motions shall not be used to tighten reusable screw connections.

Cables shall run in cable tray/ladder mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures using mounting accessories

Cable Tray:-

The cable tray and all accessories shall be fabricated from sheet steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in both indoor and outdoor applications & should have a Base Perforation Class B according to IEC 61537. The cable trays shall be supplied in standard lengths of 3000mm and the width of the tray shall be as follows.

Width: 50, 100, 150, 200, 300, 400, 500, 600 & 750 mm.

All the cable tray accessories like Bend's, TEES's, Cross over's etc should be designed in accordance with IEC 61537 and shall be factory fabricated. The accessories shall be from the same material as of the tray and modular type, it should be connected with the trays by using fasteners. Typical details of trays, fittings and accessories.etc are shown in the enclosed drawings.

For Cable trays designed, tested and confirming to IEC 61537, thickness of cable tray should be according to the manufacturers catalogue. For locally fabricated and non tested tray, thickness should be 2 mm up to span length of 1.5 meter, 2.5 mm for span length between 2 to 3 meter and 3 to 4 mm for span length between 4 and 10 meter

Cable ladder:-

The cable Ladder and all accessories shall be fabricated from sheet steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in both indoor and outdoor applications & should have a Free Base Area classification Y according to IEC61537. The cable ladders shall be supplied in standard lengths of 3000/6000 mm and the width of the tray shall be as follows.

Width: 200 to 1200 mm in multiples of 100 mm

Maximum rung spacing in the ladder shall be 300mm. The rung's should be made of C profiles suitable to fix cables by special metal clamps according to the drawing. The ladder shall be of riveted and foldable type for easy transportation and to avoid damage during transportation and storage. All the ladder accessories like Bend's , TEES's, Cross over's etc should be designed in accordance with IEC 61537 and shall be factory fabricated . The accessories shall be made from the same material as of the ladder and modular type, it should be connected with the ladder by using fasteners. The details of ladders, fittings and accessories .etc are shown in the enclosed drawing.

For Cable Ladders designed, tested and confirming to IEC 61537, thickness of cable Ladder should be according to the manufacturer's catalogue. For locally fabricated and non tested Ladder, thickness should be 2.5 mm up to span length of 1.5 to 2 meter, 3 mm for span length between 2.5 to 4 meter and 3 to 4 mm for span length between 5 and 10 meter

Cover for Cable Trays / Ladders:-

Cover for trays/ladders to protect the cable insulation from falling objects, water droplets, harmful effects of ultraviolet rays and accumulation of dust. The cover shall be made either from Hot Dip Galvanized sheet steel or superior quality Double Dip Galvanized Sheets. For Outdoor application, Double dip Galvanized material shall be used. The covers should be fitted properly to the Ladder / Tray by using pre fixed

and tested locks which ensure that covers are fitted rigidly to Tray / Ladder. For outdoor application in high wind areas, additional cross over beadings to be used for fixing the cover on tray / ladder of width more than 500 mm.

Mounting Accessories (supports and Brackets):-

The mounting accessories shall be fabricated from steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in both indoor and outdoor applications and should be of completely modular type.

All supports and Brackets should be factory made, hot dip galvanized after completing welding, cutting, drilling, other machining operations and tested according to IEC 61537 according to the arrangements in the enclosed drawing. The system shall be designed such that it allows easy assembly at site by using Bolts and Nuts. The main support and brackets shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hard ware etc to form various arrangements required to support the cable trays. Welding of the components at the site shall not be allowed.

END OF SECTION V

SECTION – VI

MEDIUM VOLTAGE PANELS:

1.0 GENERAL

Medium voltage power control centres (generally termed as switchboard panels) shall be in sheet steel clad cubicle pattern, free floor standing, totally enclosed, compartmentalized design having multitier arrangement of the incomers and feeders as per details given in the schedule of quantities. All panels shall conform to the requirements of the latest addition of IS Code and shall be suitable for 415 V, 3 phase AC supply or 230 V single phase AC supply as required.

2.0 CONSTRUCTIONAL FEATURES

The Switch Boards shall be totally enclosed, sheet steel cubicle pattern, extensible on either side, dead front, floor mounting type (wall mounting if specifically asked for in BOQ) and shall have a bus bar chamber at the top and the cable entry from the bottom. (For panel requiring top cable entries if any, refer to BOQ). The cable terminations should be **inside the feeder compartment only**.

The Switch Boards shall be completely dust and vermin proof. Synthetic rubber gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of ingress protection of IP 43 for indoor & IP 55 for outdoor. All doors and covers shall also be fully gasketed with synthetic rubber. All the live parts shall be properly shrouded with FRP sheets.

The Switch Board shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be constructed from CRCA sheet steel of thickness not less than 1.6 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal. Base channel shall be fabricated from ISMC 75 and door shall be provided at the bottom with arrangement for fixing bolts in the foundation.

All panels and door covers shall be properly fitted and square with the frame. The cutouts in the panel shall be correctly positioned.

Lifting lugs of adequate strength shall be provided on each transport section of the panels.

Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self threading screws shall not be used in the construction of the Switch Boards.

3.0 SWITCHBOARD DIMENSIONAL LIMITATIONS

A base channel 75 mm x 5 mm thick shall be provided at the bottom.

The overall height of the Switch Board shall be limited to 2200 mm

The height of the operating handle, push buttons etc shall be restricted between 300 mm and 1900 mm from finished floor level.

4.0 BUS BARS

The bus bars shall be suitable for 4 wire, 415 volts, 50 Hz, system. The main bus bar shall be made of high conductivity electrolytic grade AL 91E Aluminum. The bus bars shall have uniform cross section throughout the panel. The bus bars shall be capable of carrying the rated current at 415 volts continuously. The bus bar will run in a separate busbar chamber using bus insulators made of non-deteriorating, vermin proof, non hygroscopic materials such as epoxy fiber, reinforced polyester or moulding compound (min. 25mm clearance between phase to phase & phase to neutral busbars shall be provided). The interval between the two insulators will be designed after considering the following:

a) Strength and safe load rating of the insulator,
b) The vibrating force generated during a fault,
c) A Factor of safety of 1.25
d) A set of insulators at both ends of the bus.

Bus bars shall be sized considering maximum current density of 1 Amps/ cross section sq.mm area. The size of the bus bar calculations must be approved by the consultants. The bus bars shall be designed to withstand a temperature rise of $45^{o}C$ above the ambient. To limit the temperature rise in the bus bar chamber a set of louvers can be provided at strategical places considering the air circulation.

All the bus bars shall be insulated with PVC heat shrinking sleeves throughout (except at joints) the length of the panel. The electro-galvanised high tensile steel nuts, bolts, plain or spring washers of suitable size will be used in connecting the various section of the bus bars.

5.0 SWITCH BOARD INTERCONNECTIONS

All connections between the bus bars/Breakers terminations shall be through solid Aluminum strips of adequate size to carry full rated current which shall be PVC/fibre glass insulated.

For switch unit ratings upto 63A PVC insulated copper conductor wires of adequate size to carry full load current can be used. The terminations of all such interconnections shall be properly crimped.

6.0 CABLE TERMINATIONS

Knockout holes of appropriate size and number shall be provided in the Switch Board in conformity with the location of incoming and outgoing conduits/cables. All cable entries shall be from bottom until & unless specifically asked for in the BOQ.

The cable terminations of the circuit breakers shall be brought out to terminal cable sockets suitably located in the panel.

All outgoing links for FSU\MCB feeders shall be in the feeder compartment only.

The Switch Boards shall be complete with tinned brass cable sockets, tinned brass compression glands, gland plates, supporting clamps and brackets etc for termination of 1100 volt grade aluminium conductor PVC cables.

7.0 EARTHING

The panels shall be provided with an aluminium earth bus of suitable size running through out the length of the switchboard. Suitable earthling eyes/bolts (at min. two points) shall be provided on the main earthing bus to connect the same to the earth grid at the site. Sufficient number of star washers shall be provided at the joints to achieve earth continuity between the panels and the sheet metal parts.

8.0 WIRING

All wiring for relays and meters shall be with PVC insulated copper conductor wires. The wiring shall be coded and labeled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 1.5 sq.mm except for the circuits related to current transformers or circuits with current carrying capacity more than 5 Amps (for which min. 2.5 Sq.mm copper conductor wires shall be used).

9.0 SHEET STEEL TREATMENT AND PAINTING

Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulfuric acid and a recognised phosphating process. The steel work shall then receive two coats of oxide primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.

All sheet steel shall after metal treatment shall be powder coated with shade RAL 7032 (Siemens Gray) on the outside of the panel and mounting plates shall be of orange shade. Each coat of paint shall be properly stoved and the paint thickness shall not be less than 50 microns (shade of paint may be changed if the client so desires).

10.0 NAME PLATES AND LABELS

Suitable engraved white on black name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

11.0 INSTALLATION

Installation shall be done by other agencies. However, the foundation requirements shall be submitted by the supplier. In addition the supplier shall coordinate with the erection contractor for shifting & installation of the panels.

12.0 TESTING AND COMMISSIONING

Copies of type tests and routine test as per relevant specification, carried out at manufacturer's work shall be submitted to the CLIENT as required.

Wiring and connections including earthing shall be checked for continuity and tightness.

Insulation shall be measured with a 500 V megger and insulation resistance shall not be less than 100 Mega ohms

Interlocking operation to be checked as per requirement.

Tests shall be performed in presence of authorized representative of the CLIENT for which the contractor shall give due prior notice.

13.0 HIGH VOLTAGE TEST

A high voltage test with 2.5 KV for one minute shall be applied between the poles and earth. Test shall be carried out on each pole in turn with the remaining poles earthed, all units raked in position and the breakers closed. Original test certificate shall be submitted along with panel.

14.0 PRE-COMMISSION TESTS:

Panels shall be commissioned only after the successful completion of the following tests. The tests shall be carried in the presence of Architect's/Consultant's or their representatives.

i) All main and auxiliary bus bar connections shall be checked and tightened.

ii) All wiring termination and bus bar joints shall be checked and tightened.

iii) Wiring shall be checked to ensure that it is according to the drawing.

iv) All wiring shall be tested for insulation resistance by a 1000 volts meggar.

v) Phase rotation tests shall be conducted

vii) All relays and protective devices shall be tested for correctness of settings and operation by introducing a current generator and an ammeter in the circuit.

15.0 CLIMATIC CONDITIONS:

The panels & switch gear components shall be suitable for following climatic conditions:

	Maximum	**Minimum**
DBT	$45^{O}C$	$10^{O}C$
RH	90%	40%

17.0 HEATING ARRANGEMENT:

The panel shall be provided with a thermostatically controlled heating arrangement for monsoon (200 Watt) to take care of high humidity conditions. A 6/16A service socket outlet (single phase) shall be provided in one of the compartments in all the panels.

END OF SECTION – VI

SECTION – VII

SURGE PROTECTION DEVICES (SPD) FOR 230 / 415V AC 50 HZ POWER SUPPLY

1.0 APPLICABLE STANDARDS

a) **IEC 62305** : Protection against Lightning
Part 1: Basic Principles
Part 2: Risk Assessment
Part 3: Protection of structures
Part 4: Electrical & Electronic equipments within structures

Note: IEC 61024 & IEC 61312 are old standards and are replaced by IEC 62305.

b) **IEC 61643-1**: - Surge Protective Devices Connected to Low-Voltage Power Systems:
Performance requirements and testing methods.

c) **IEC 61643-12**: - Surge Protective Devices Connected to Low-Voltage Power Systems:
Selection and application principles

Type of Network – 3 phases, 4 wires.

2.0 MAINS INCOMING PANEL

Protection at the main incomer of the power supply system – i.e. at the Main Distribution Board (after the incoming breaker)

2.1 Class B/Class I (according to IEC 61643)

3 numbers of lightning arrester for the connection between Phase and Neutral and one number of lightning arrester between Neutral and Earth with the following ratings: (1 no for each phase)

Sl. No	**Parameters**	**Specifications**	
		Line to Neutral (3 nos)	Neutral to Earth (1 no)
1.	Type	Encapsulated/Non-exhausting Spark Gap	
2.	Nominal Voltage, Un	230V, 50/60 Hz	
3.	Over Voltage withstanding capacity	400V	
4.	Lightning Impulse Current	50 KA(10/350 μsec)	125 KA(10/350 μsec)
5.	Voltage Protection Level, Up	$\leq$ 1.3 KV	
6.	Response Time	< 100 nano seconds	
7.	Operating temperature range	-40°C to +85°C	
8.	Mounting on	Din Rail	
9.	Degree of Protection	IP 20	

10.	Max. Back-up fuse	500 A gL/gG	NA

3.0 SUB DISTRIBUTION BOARD (SDB)/LT PANEL

Second Stage Protection at the Sub distribution board or in LT panel of the power supply system

3.1 Class B+C/Class I+II (according to IEC 61643)

3 numbers of pluggable type surge arrester with potential free contact, thermal disconnector & provision for inbuilt common remote indication for defective arresters to connect between Line and Neutral and one number arrester Spark Gap type to connect between Neutral and Earth of following ratings including base element & pluggable arresters.

Sl.No	**Parameters**	**Specifications**	
		Line to Neutral	Neutral to Earth
1.	Type	Single MOV with built in thermal fuse	Spark Gap Encapsulated / Non-exhausting
2.	Nominal Voltage, Un	230V, 50/60 Hz	
3.	Maximum Continuous Operating Voltage, Uc	≥ 320 Volt	255 Volt
4.	Nominal Discharge Current I_n	30 KA(8/20 μsec)	50 KA(8/20 μsec)
5.	Maximum Discharge Current I_{max}	50 KA (8/20 μsec)	
6.	Lightning Impulse Current	7 KA(10/350 μsec)	25 KA(10/350 μsec)
7.	Voltage Protection Level at 1 KA	≤ 750 volts	≤1200 Volt
8.	Response Time	< 25 nano seconds	< 100 nano seconds
9.	Operating temperature range	-40°C to +80°C	
10.	Mounting on	Din Rail	
11.	Degree of Protection	IP 20	
12.	Max. Back-up fuse	160 A gL/gG	NA

Visual Indication of the flag in the surge arrester (Line to Neutral)

Healthy condition : Green Colour
Faulty condition : Red Colour

4.0 EQUIPMENT LEVEL (UPS, MCB DB'S CNC MACHINE/DRIVES, ETC)

Protection for Sensitive Equipments at the input of the end equipments like UPS, CNC machine, VFD's or at Important MCB DB's feeding power to Computer / Server etc

4.1 Class C/Class II (according to IEC 61643)

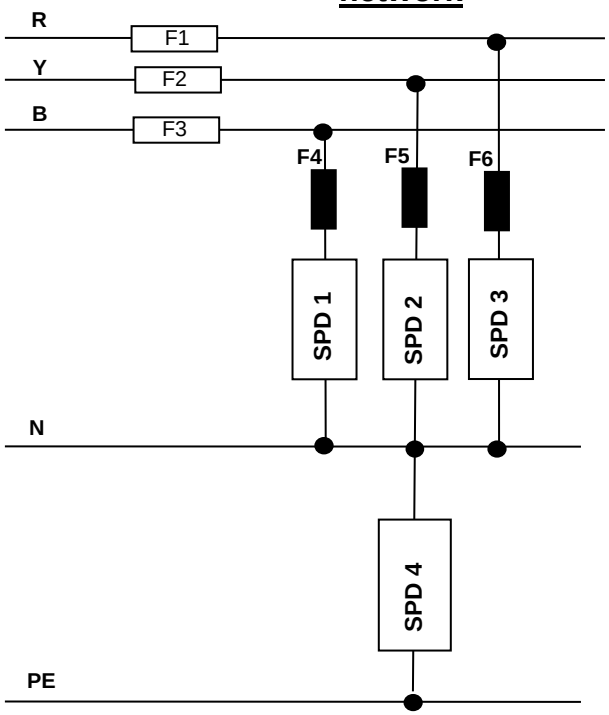
3 numbers of pluggable type surge arrester with potential free contact, thermal disconnector & provision for inbuilt common remote indication for defective arresters to connect between Line and Neutral and one number arrester Spark Gap type to connect between Neutral and Earth of following ratings including base element & pluggable arresters.

Sl.No	Parameters	Specifications	
		Line to Neutral	Neutral to Earth
1.	Type	Single MOV with built in thermal fuse	Spark Gap Encapsulated / Non-exhausting
2.	Nominal Voltage, Un	230V, 50/60 Hz	
3.	Maximum Continuous Operating Voltage, Uc	$\geq$ 320 Volt	255 Volt
4.	Nominal Discharge Current $\mathbf{I}_n$	20 KA(8/20 μsec)	50 KA(8/20 μsec)
5.	Maximum Discharge Current $\mathbf{I}_{max}$	40 KA	50 KA (8/20 μsec)
6.	Voltage Protection Level at 1 KA	$\leq$ 1000 Volts	$\leq$ 1200 Volts
7.	Response Time	< 25 nano seconds	< 100 nano seconds
8.	Operating temperature range	-40°C to +80°C	
9.	Mounting on	Din Rail	
10.	Degree of Protection	IP 20	
11.	Back-up fuse	125 A gL/gG	NA

Visual Indication of the flag in the surge arrester (Line to Neutral)

Healthy condition : Green Colour
Faulty condition : Red Colour

Connection diagram for SPD for 3 phase 4 wire network



F1, F2, F3 -: Incoming ACB/MCCB/SFU
F4, F5, F6 -: Back up fuse for Surge Arrester
R,Y,B and N -: RYB and N Bus bar or looping after the incomer
PE -: Earth Bus bar in the panel
SPD1,2,3 -: Surge Arrester to connect between Line and Neutral
SPD 4 -: SPD to connect between Neutral and Earth.

Note: In US, SPD is called as TVSS- Transient Voltage Surge Suppressor. BUT, IEEE also will be changing the name to SPD in 2009 April. Then, throughout the world, the common name will be SPD.

END OF SECTION – VII

SECTION – VIII

METERING, INSTRUMENTATION AND PROTECTION

Ratings, type and quantity of meters, instruments and protective devices shall be as per Bill of Quantities.

1.0 CURRENT TRANSFORMERS

CTs shall confirm to latest IS codes in all respects. All CTs used for medium voltage application shall be rated for 1 kV. CTs shall have rated primary current, rated burden and class of accuracy as specified in schedule of quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be 0.5 to 1 and for protection class 10. CTs shall be capable of withstanding magnetic and thermal stresses due to short circuit faults. Terminals of CTs shall be paired permanently for easy identification of poles. CTs shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each CT shall be provided with rating plate indicating :

- Name and make
- Serial number
- Transformation ratio
- Rated burden
- Rated voltage
- Accuracy class

CTs shall be mounded such that they are easily accessible for inspection, maintenance and replacement. Wiring for CT shall be with copper conductor PVC insulated wires with proper termination works and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

2.0 POTENTIAL TRANSFORMER

PTs shall confirm to latest amendment upto date IS Codes.

3.0 MEASURING INSTRUMENTS

Direct reading electrical instruments shall conform to latest IS codes in all respects. Accuracy of direct reading shall be 1.0 of voltmeter and 1.5 for ammeters. Other instruments shall have accuracy of 1.5. Meters shall be suitable for continuous operation between -10^0C and $+500^0$C. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mould . Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in colour and shall have Zero position adjustment device operable from out side. Direction of deflection shall be from left to right. Selector switches shall be provided for ammeters and volt meters used in three phase system.

4.0 AMMETERS

Ammeters shall be of digital type. Ammeters shall be manufacture and calibrated as per latest IS.
Ammeters shall normally be suitable for 5 A secondary of current transformers.
Ammeters shall be capable of carrying substantial over loads during fault conditions.

5.0 VOLTMETERS

Voltmeters shall be digital type of 3 phase 415 volt voltmeters shall be 0-500. Volt meters shall be provided with protection of 2A MCB.

6.0 KWH METER

Meter shall be of 3 phase digital type and shall be provided with a maximum demand indicator.

7.0 POWER FACTOR METERS

3 phase power factor meters shall be of digital type with current and potential coils suitable for operation with current and potential transformers provided in the panel. Scale shall be calibrated for 50% lag - 100% - 50% lead readings. Phase angle accuracy shall be +40.

8.0 ENERGY AND REACTIVE POWER METERS

Trivector meters shall be two element, integrating type, KWH, KVA, KVA hour reactive meters. Meters shall confirm to latest IS in all respects. Energy meters, KVA, and KVARH meters shall be provided with integrating registers. The registers shall be able to record energy conception of 500 hours corresponding to maximum current at rated voltage and unity power factor. Meters shall be suitable for operation with current and potential transformers available in the panel.

9.0 RELAYS

Protection relays shall be provided with flag type indicators to indicate cause of tripping. Flag indicators shall remain in position till they are reset by hand reset. Relays shall be designed to make or break the normal circuit current with which they are associated. Relay contacts shall be of silver or platinum alloy and shall be designed to withstand repeated operation without damage. Relays shall be of draw out type to facilitate testing and maintenance. Draw out case shall be dust tight. Relays shall be capable of disconnecting faulty section of network without causing interruption to remaining sections. Analysis of setting shall be made considering relay errors, pickup and overshoot errors and shall be submitted to Project Manager for approval.

10.0 OVER CURRENT RELAYS

Over current relays shall be induction type with inverse definite minimum time lag characteristics. Relays shall be provided with adjustable current and time settings.

Setting for current shall be 50 to 200 % insteps of 25%. The IDMT relay shall have time lag (delay) of 0 to 3 seconds. The time setting multiplier shall be adjustable from 0.1 to unity. Over current relays shall be fitted with suitable tripping device with trip coil being suitable for operation on 5 Amps.

11.0 EARTH FAULT RELAY

Same as over current relay excepting the current setting shall be 10% to 40% in steps of 10%.

12.0 UNDER VOLTAGE RELAY

Under voltage relays shall be of induction type and shall have inverse limit operation characteristics with pickup voltage range of 50 to 90% of the rated voltage.

13.0 POWER FACTOR CORRECTION CAPACITORS

Power factor correction capacitors shall conform to latest IS codes in all respects. Approval of insurance association of India shall be obtain if called for. Capacitors shall be suitable for 3 phase 415 volts 50 HZ supply and shall be available in single and three phase units of 25, 50 & 100 kVAR sizes as specified. Capacitor shall be usable for indoor use, permissible overloads being as below.

- Voltage overloads shall be 10% for continuous operation and 15% for six hours in a 24 hours cycle.
- Current overloads shall be 15 % for continuous operations and 50% for six hours in a 24 hours cycle.
- Over load of 30% continuously and 45% for six hours in a 24 hours cycle.

Capacitors shall be hermetically sealed in sturdy corrosion proof sheet steel containers and impregnated with non inflammable synthetic liquid. Every element of each capacitory unit shall be provided with its own built in protection. Capacitors shall have suitable discharge device to reduce the residual voltage from crest value of the rated voltage to 50 volts or less within one minute after capacitor is disconnected from the source of supply. The loss factor of capacitor shall not exceed 0.005 for capacitors with synthetic impregnants The capacitors shall withstand power frequency test voltage of 2500 volts AC for one minute. Insulation resistance between capacitors terminals and containers when a test voltage of 500 volts DC is applied shall not be less than 50 meg.ohms.

14.0 CONTROL DEVICES

a) **Push Buttons**

The push buttons used in the panels will be rated for more than 415 volts and 2 amps. All the push buttons will be mounted on the front door and the assembly will be in two parts. All the push buttons will be mounted on the front door of the cubicle in regular symmetrical fashion as per the general norms being practiced. Only one make of push buttons will be used in the assembly of all the panels. The selection of the colour of the push buttons will be as follows

Function	Colour
Starting/Switching ON	Green
Stopping/Switching OFF	Red
Resetting	Black
Forward ON	Yellow
Reverse ON	Blue
Emergency OFF	Red/Mushroom

b) **Indicating Lights**

The indicating lights used in the panel will be pleasant looking and round shape having the following features;

1. A separate front lens for it's easy replacement.
2. Facility to replace the bulb from the front.
3. Baynet pin cap bulbs of standard size to be used.
4. The shape of the lens to allow viewing from sides.
5. Series resistance with use of low voltage bulb for longer life.
6. Clear and distinct indication for light ON and OFF with differences of brightness of the lens.

The selection of the colours of the indicating lamps will be as follows:

- Red for system in operation
- Amber for system ready for operation.
- Green for system being put off.
- Red, yellow and blue for incoming supply.

15.0 TESTING

15.1 Instrument transformers shall be tested at factory as per IS:2705 & IS:3156. The test shall incorporate the following:

a) Type tests
b) Routine tests

Original test certificates in triplicate shall be provided.

15.2 Meters shall be tested as per IS: 1248. The tests shall include both type tests and routine tests. Original test certificate in triplicate shall be furnished.

15.3 a) Suitable injection tests shall be applied to the secondary circuit of every instrument to establish the correctness of calibration and working order.

b) All relays and protective devices shall be tested to establish correctness of setting and operation by introducing a current generator and an ammeter in the circuit.

END OF SECTION – VIII

SECTION – IX

MINIATURE CIRCUIT BREAKERS

The MCB's shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system. MCB’s shall be quick make and break type conforming to relevant IS. Housing shall be heat resistant and have a high impact strength. MCB’s shall be flush mounting type and shall be provided with trip free manual operating liver with ON/OFF indications

MCB’s shall be provided with magnetic thermal releases for over current and short circuit protection. The overload or short circuit device shall have a common trip bar in case of DP and TPN MCB’s. The MCB's shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection. The MCB time current characteristic shall coordinate with H.R.C. fuse/PVC cable characteristic.

The MCB's shall have a minimum breaking capacity of 10 kA at 230/415 volts in accordance with IEC : 898 - 1995 and IS : 8828 – 1996

END OF SECTION – IX

SECTION – X

MOULDED CASE CIRCUIT BREAKERS

1.0 GENERAL

Moulded case circuit breakers shall be incorporated in the switch board wherever specified. MCCB shall conform to IEC:947-II or IS:13947-II in all respects. MCCB shall be suitable for three phase 415 volts AC. Suitable discrimination shall be provided between upstream and down stream breakers in the range of 10-20 milli seconds. All MCCBs will have earth fault module (if specifically asked) and front operated. All four pole MCCB shall be suitable for three phase four wire system, with the neutral clearly identified and capable of first make last break feature.

2.0 CONSTRUCTION

The MCCB cover and case shall be made of high strength heat-resistant and flame retardant thermosetting insulating material, operating handle shall be quick make/quick break. The operating handle shall have suitable `ON' `OFF' and `TRIPPED' mechanical indicators notable from outside. All MCCBs shall have a common operating handle for simultaneous operation and tripping of all the three phases. The MCCB should be suitable for disconnection and isolation with marking on front name plate.

Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be thermal-magnetic type provided on each pole and connected by a common trip bar such that tripping of any one pole operates all three poles to open simultaneously. Thermal magnetic tripping device shall have IDMT characteristics for sustained over load and short circuits. All MCCBs above 250 Amps will also have short circuit magnetic pickup level adjustment.

MCCBs

All MCCBs shall have variable thermal overload releases which can be adjusted at site.

3.0 Contact tips shall be made of suitable arc resistant, sintered alloy for long electrical life. Terminals shall be of liberal design with adequate clearances. All MCCBs of higher ratings above 250 Amps, shall be provided with separate extended arcing contacts.

4.0 INTERLOCKING

Moulded case circuit breakers shall be provided with the following interlocking devices for interlocking the door of a switch board.

a) Handle interlock to prevent unnecessary manipulations of the breaker.
b) Door interlock to prevent the door being opened when the breaker is in ON or OFF position.
c) Defeat-interlocking device to open the door even if the breaker is in ON position.

5.0 BREAKING CAPACITY

The moulded case circuit breaker shall have a rated service. Short circuit breaking capacity of not less than 25 KA rms at 415 volts AC. Wherever required, higher breaking capacity breakers to meet the system short circuit fault shall be used.

6.0 ACCESSORIES

All the accessories like shunt, under voltage contact blocks shall be of snap fitting possible at site.

7.0 TESTING

a) Original test certificate of the MCCB shall be furnished.

b) Pre-commissioning tests on the switch board panel incorporating the MCCB shall be done as per standard specifications.

END OF SECTION – X

SECTION – XI

MEDIUM VOLTAGE AIR CIRCUIT BREAKER

1.0 GENERAL

The ACBs shall comply to IEC 60947 Part I & II and IS 13947 Part I & II and shall be suitable for operation on 415 Volts, 50 Hz 3 Phase system.

1. The breaker shall comply with Isolation function requirements of IEC 60947, Part-II, section 7.12 and shall be clearly marked as "Suitable for Isolation / Disconnection" to ensure safety of operating personnel.

2. The ACB shall provide Class –II insulation between front panel and internal power circuit as per IEC 60947 Part II Section-7.12 to avoid accidental contact with live parts during inspection & maintenance.

3. The ACB shall be 3/4 pole with modular construction, draw out, manually/electrical operated and shall be capable of providing short circuit, overload and earth fault protection with time delay through micro processor based control unit sensing the true RMS value to ensure accurate measu

4. Arc Chute covers wherever necessary shall be provided.

5. The incoming panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, digital voltmeter and ammeter of size not less than 96 mm x 96 mm. Selector switches, MCB for protection circuit and current transformers.

6. It shall be possible to bolt the draw out frame not only in connected position but alrement meeting the EMI/EMC requirement as per standard.

The circuit breakers shall be for continuous rating and service short Circuit Breaking capacity shall be ":y "{also in TEST and DISCONNECTED position to prevent dislocation due to vibrating and shocks.

END OF SECTION – XI

SECTION – XII

WIRING

1 GENERAL

Technical Specifications in this section cover the Internal Wiring Installations comprising of :

- Wiring for lights and convenience socket outlets etc. in concealed/surface conduit/raceways.
- Wiring for telephone outlets.
- Submain wiring.
- Conduiting for Low Voltage System

2 STANDARDS AND CODES

Latest upto date Indian Standard (IS) and Code of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and / or IEC Standard shall be applicable.

3 CONDUITS

3.1 Steel Conduits

These shall be of mild steel 16 gauge upto 32mm and 14 gauge for sizes above 32mm, electric resistance welded (ERW), electric threaded type having perfectly circular tubing. Conduits shall be precession welded ERW and shall be fabricated from tested steel strips of thickness as per IS by high frequency induction weld process. Weld shall be smooth and of consistent of high quality to ensure crack proof bending. The conduits shall be black enamel painted inside and outside in its manufactured form. Wherever so specified, the conduit shall be galvanized. All conduits used in this work shall be ISI embossed.

3.2 MS Conduits

The electrical wiring shall be done in recessed MS Conduits, unless mentioned otherwise.

No conduit less than 25 mm in diameter shall be used, unless otherwise specifically ask by Consultant / Project Manager.

3.3 PVC Conduits (if required)

Wiring shall be carried out in recessed /surface PVC conduits. The PVC conduits conform to latest and shall be ISI embossed. The conduits shall be heavy gauge (minimum 2 mm wall thickness) and the interiors of the conduits shall be free from all obstructions. All joints in conduits shall be sealed/cemented with approved

solvent cement. Damage conduits/fittings shall not be used. Cut ends of conduits shall not have sharp edges.

3.4 Bends

As far as possible, the conduit system shall be so laid out that it shall obviate use of tees, elbows and sharp bends. No length of conduit shall have more than the equivalent of two quarter bends from inlet to outlet.

3.5 Conduit Accessories.

3.5.1 Standard accessories

The conduit wiring system shall be complete in all respects, including their accessories. Bends, couplers etc. shall be solid type in recessed type of works and may be solid or inspection type as required, in surface type of works. The accessories shall conform in all respects to the relevant IS. Samples shall be got approved by Consultant / Project Manager before use.

3.5.2 Fabricated accessories

Wherever required, outlet/junction boxes of required sizes shall be fabricated from 1.6 mm thick MS sheets excepting ceiling fan outlet boxes which shall be fabricated from minimum 3 mm thick sheets. The outlet boxes shall be of approved quality, finish and manufacture. Suitable means of fixing connectors etc., if required, shall be provided in the boxes. The boxes shall be protected from rust by zinc phosphate primer process. Boxes shall be finished with minimum 2 coats of enamel paint of approved colour. A screwed brass stud shall be provided in all boxes as earthing terminal.

3.6 Open/Surface Conduit System with FRLS PVC Conduits:

a) Wherever specifically called for, surface conduit system shall be adopted. All conduits shall be of rigid FRLS PVC pipe. All conduits and its accessories shall be of threaded type. Conduits shall run in parallel, perpendicular, square and Symmetrical lines. Before the conduits are installed, the exact route shall be marked at the site and approval of the Construction Manager/ Consultant shall be obtained. Conduits shall be fixed by heavy duty FRLS PVC saddles (or as per standard accessories specified by the manufacturer and as approved by the Consultant), secured by suitable rawl plugs, at an interval of not more than 1 meter. Wherever, couplers, bends, or similar fittings are used saddles shall be provided at either side at a distance of 300 mm from the center of such fittings. Conduits shall be joined by means of screwed couplers and screwed accessories only. In long distance straight runs of conduit, inspection type couplers /junction boxes shall be provided. Threading shall be long enough to accommodate pipe to the full threaded portion of the couplers and accessories. Cut ends of conduits shall have neither sharp edges nor any burrs left to avoid damage to insulation of wires.

b) Bends in conduit runs shall be done by using readymade bends with inspection elbows / standard elbows as per the instructions of the Consultant / Construction Manager / as per site requirements. Sharp bends shall be accomplished by introducing solid bends, inspection bends or heavy duty PVC / FRLS PVC inspection boxes. Radius of solid bends shall not be less than 75mm. Not less than 90-degree bend shall be used in a conduit run from outlet to outlet.

c) Wherever conduits terminate into control boxes, outlet boxes, distribution boards etc, they shall be rigidly connected to the box with check nuts on either side of the entry.

d) Steel wire /fish wire shall be drawn in each conduit.

e) Separate PVC insulated copper conductor earth wire shall be drawn in each conduit.

f) Draw boxes shall be located at convenient location for easy drawing of wires.

g) Every mains and submains shall run in an independent conduit with an independent earth wire of specified capacity along the entire length of conduit.

h) The conduit 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 20 mm diameter.

i) 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 Construction Manager/Consultant. Conduit runs shall be planned so as not to conflict with any other services pipe, lines/duct.

j) The conduit shall be painted with two coats of enamel paint, color as approved by the Construction manager/ Consultant after installation.

k) If required, connection between PVC or FRLS PVC and steel conduits shall be through a junction box. Direct connection between PVC and steel conduits are not allowed.

l) Where exposed conduits are suspended from the structure, they shall be clamped firmly and rigidly to hangers of design to be approved by the Construction Manager/Consultant. Where hanger supports 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. Where inserts are not provided, contractor shall use only anchor fasteners. In case, it is unavoidable, prior permission of the Construction Manager /Consultant shall be obtained to make any openings in the concrete surface.

m) **Conduit Joints:**

Conduit pipes shall be joined by means of screwed couplers and screwed accessories, as per IS: 2667. The threads shall be free from grease or oil. In long distanced straight runs of conduit, inspection type couplers 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 or 27mm long, sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipes shall have neither sharp edges nor any burrs left, to avoid damage to the insulation of conductors while pulling them through such pipes.

Brass female bushes shall be used in each conduit termination in a switch box, outlet box, electrical panel or any other box.

Conduit shall be secure in each outlet box, switch box, electrical panel or any other box by means of one PVC / FRLS FRLS PVC/brass hexagonal lock nut and bush, outside and inside the box.

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.

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.

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 to any cover or any removable parts of the equipment.

n) **Bends of Conduits:**

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 75mm. No length of conduit shall have more than the equivalent of four-quarter bends from outlet, the bends at the outlets not being counted.

o) Protection against Dampness:

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.

p) Protection of Conduit Against Rust:

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.

All screwed and socketed connections shall be adequately made fully water tight by the use of proper joining material i.e. white lead for metal conduits.

q) Bunching of Cables:

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 outgoing and return wires are drawn in to the same conduit. Wires originating from two different phases shall not be run in the same conduit.

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

MAXIMUM PERMISSIBLE NUMBER OF 1100 VOLTS GRADE SINGLE CORE CABLE THAT CAN BE DRAWN INTO FRLS FRLS PVC CONDUITS.

CABLE SIZE IN SQ. MM	SIZE OF CONDUITS (MM) [MAX.NO. OF CABLES]				
	20	25	32	40	50
1.5	5	10	14	-	-
2.5	5	8	12	-	-
4.0	3	6	10	-	-
6.0	2	5	8	-	-
10.0	-	4	7	10	-
16.0	-	3	5	6	-
25.0	-	-	3	4	6
35.0	-	-	2	3	5
50.0	-	-	-	-	4

4. WIRES

Wiring shall be carried out with FRLS PVC insulated 660/1100 volt grade unsheathed single core wires with electrolytic annealed stranded copper (unless otherwise stated) conductors conforming to latest IS Code. All wire rolls shall be ISI

marked. All wires shall bear manufacturer's label and shall be brought to site in new and original packages. Manufacturer's certificate, certifying that wires brought to site are of their manufacture shall be furnished as required.

5 COAXIAL CABLES

The coaxial cables shall be of videband type with operation up to 300 MHz capability. Aging resistance shall comply with latest code i.e. maximum 5% increase in attenuation at 200 MHz measured by artificial aging (14 days at 80o C) cables shall meet all exceed following specifications

Center core Dia	0.8 mm
Diaelectric Dia	4.8 mm
Dielectric	PE
Outer Conductor Dia	5.4 mm
Outer Dia	7.0 mm
Bending radius	more than 30 mm
Impedance	75 ohms
D.C Resistance	50 ohms/KM
Screening factor	more than 50
Attenuation	
50 MHz	6.5
100 MHz	9
200 MHz	13
300 MHz	16

6 LAYING OF CONDUITS

- Conduits shall be laid either recessed in walls and ceilings or on surface on walls and ceilings or partly recessed and partly on surface, as required.

- Same rate shall apply for recessed and surface conduiting in this contract.

- Stranded copper conductor insulated wire of size as per schedule of quantities shall be provided in entire conduiting for loop earthing.

- GI wire of suitable size to serve as a fish wire shall be left in all conduit runs to facilitate drawing of wires after completion of conduiting.

6.1 Recessed Conduiting

Conduits recessed in concrete members shall be laid before casting, in the upper portion of slabs or otherwise as may be instructed, so as to embed the entire run of conduits and ceiling outlet boxes with a cover of minimum 12 mm concrete. Conduits shall be adequately tied to the reinforcement to prevent displacement during casting at intervals of maximum 1 meter. No reinforcement bars shall be cut to fix the conduits. Suitable flexible joints shall be provided at all locations where conduits cross expansion joints in the building.

Conduits recessed in brick work shall be laid in chases to be cut by electrical Contractor in brick work before plastering. The chases shall be cut by a chase cutting electric machine. The chases shall be of sufficient width to accommodate the required number of conduits and of sufficient depth to permit full thickness of plaster over conduits. The conduits shall be secured in the chase by means of heavy duty pressed steel clamps screwed to MS flat strip saddles at intervals of maximum 1 meter. The chases shall then be filled with cement and coarse sand mortar (1:3) and properly cured by watering.

Entire recessed conduit work in concrete members and in brick work shall be carried out in close coordination with progress of civil works. Conduits in concrete members shall be laid before casting and conduits in brick work shall be laid before plastering. Should it become necessary to embed conduits in already cast concrete members, suitable chase shall be cut in concrete for the purpose. For minimising this cutting, conduits of lesser diameter than 25 mm and outlet boxes of lesser depth than 50 mm could be used by the Contractor for such extensions only after obtaining specific approval from Consultant /Project Manager . For embedding conduits in finished and plastered brick work, the chase would have to be made in the finished brick work. After fixing conduit in chases, chases shall be made good in most workmanlike manner to match with the original finish.

Cutting chases in finished concrete or finished plastered brick work for recessing conduits and outlet boxes etc shall be done by the Contractors without any extra cost.

6.2 Surface Conduiting

Wherever so desired, conduit shall be laid in surface over finished concrete and/or plastered brickwork. Suitable spacer saddles of approved make and finish shall be fixed to the finished structural surface along the conduit route at intervals not exceeding 600 mm. Holes in concrete or brick work for fixing the saddles shall be made neatly by electric drills using masonry drill bits. Conduits shall be fixed on the saddles by means of good quality heavy duty MS clamps screwed to the saddles by counter sunk screws. Gitti not to be used for fixing the saddle. Neat appearance and good workmanship of surface conduiting work is of particular importance. The entire conduit work shall be in absolute line and plumb.

6.3 Fixing of conduit fittings and accessories

For concealed conduiting work, the fittings and accessories shall be completely embedded in walls/ceilings leaving top surface flush with finished wall/ceiling surface in a workman like manner.

Loop earthing wire shall be connected to a screwed earthstead inside outlet boxes to make an effective contact with the metal body.

6.4 Painting and Colour coding of conduits

Before laying, conduits shall be painted specially at such places where paint has been damaged due to vice or wrench grip or any other reason.

If so specified, surface conduits shall be provided with 20 mm wide and 100 mm long colour coding strips as below

Use	Code colour
Low voltage	Grey
Telephone	Black
Earthing system	Green
Control system lighting	Purple

6.5 Protection of Conduits

To safeguard against filling up with mortar/plaster etc. all the outlet and switch boxes shall be provided with temporary covers and plugs which shall be replaced by sheet/plate covers as required. All screwed and socket joints shall be made fully water tight with white lead paste.

6.6 Cleaning of Conduit Runs

The entire conduit system including outlets and boxes shall be thoroughly cleaned after completion of erection and before drawing in of cables.

6.7 Protection Against Dampness

All outlets in conduit system shall be properly drain and ventilated to minimise chances of condensation/sweating.

6.8 Expansion Joints

When crossing through expansion joints in buildings, the conduit sections across the joint shall be through approved quality heavy duty metal flexible conduits of the same size as the rigid conduit. **The expansion joint crossing shall be done as approved by Project Manager.**

6.9 Loop Earthing

Loop earthing shall be provided by means of insulated stranded copper conductor wires of sizes as per Schedule of Quantity laid along with wiring inside conduits for all wiring outlets and sub-mains. Earthing terminals shall be provided inside all switch boxes, outlet boxes and draw boxes etc.

7 LAYING AND DRAWING OF WIRES

7.1 Bunching of Wires

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

7.2 Drawing of Wires

The drawing of wires shall be done with due regard to the following precautions:-

- No wire shall be drawn into any conduit, until all work of any nature, that may cause injury to wire is completed. Burrs in cut conduits shall be smoothen before erection of conduits. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Approved type bushes shall be provided at conduit terminations.

- Before the wires are drawn into the conduits, conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction by forcing compressed air through the conduits if necessary..

- While drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which cause breakage of conductors.

- There shall be no sharp bends.

- The Contractor shall, after wiring is completed, provide a blank metal/sunmica plate on all switch / outlet / junction boxes for security and to ensure that wires are not stolen till switches / outlets etc.. are fixed at no extra cost the contractor shall be responsible to ensure that wires and loop earthing conductors are not broken and stolen. In the event of the wire been partly / fully stolen , the contractor shall replace the entire wiring alongwith loop earthing at no extra cost. No joint of any nature whatsoever shall be permitted in wiring and loop earthing .

7.3 Termination /Jointing of Wires

- Sub-circuit wiring shall be carried out in looping system. Joints shall be made only at distribution board terminals, switches/buzzers and at ceiling roses/connectors/lamp holders terminals for lights/fans/socket outlets. No joints shall be made inside conduits or junction/draw/inspection boxes.

- Switches controlling lights, fans or socket outlets shall be connected in the phase wire of the final sub circuit only. Switches shall never be connected in the neutral wire.

- Wiring conductors shall be continuous from outlet to outlet. Joints where unavoidable, due to any special reason shall be made by approved connectors. Specific prior permission from Project Manager in writing shall be obtained before making such joint.

- 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 wringing.

- Strands of wires shall not be cut for connecting terminals. All strands of wires shall be twisted round at the end before connection..

- Conductors having nominal cross sectional area exceeding 1.5 sq. mm shall always be provided with crimping sockets. Tinning of the strands shall be done wherever crimping sockets are not available as per instructions of the Project Manager

- All wiring shall be labelled with appropriate plastic ferrules for identification.

- 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.

- The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less.

- Switches controlling lights, fans, socket outlets etc. shall be connected to the phase wire of circuits only.

- Only certified valid license holder wiremen shall be employed to do wiring / jointing work.

7.4 Load Balancing

The Contractor shall plan the load balancing of circuits in 3 phase installation and get the same approved by the Project Manager before commencement of the work.

7.5 Colour Code of Conductors

Colour code shall be maintained for the entire wiring installation - red, yellow, blue for three phases, black for neutral and green for earth.

8. SWITCHES AND FIXTURES

8.1 SWITCHES

All 6 and 16 amps switches shall be of the modular enclosed type flush mounted 220 Volt AC of the best quality and standard or as approved by Interior designer/Architect/Project Manager. The switch moving and fixed contacts shall be of silver nickel and silver graphite alloy and contact tips coated with silver. The housing of switches shall be made from high impact resistant, flame retarding and ultra violet stabilized engineering plastic material.

8.2 FLUSH PLATES

Switches, receptacles and telephone system outlets in wall shall be provided with molded cover plates of shape, size and colour approved by the Project Manager made from high impact resistant, flame retarding and ultra violet stabilized engineering plastic material, and secured to the box with counter sunk round head chromium plated brass screws. Where two or more switches are installed together, they shall be

provided with one common switch cover plate as described above with notches to accommodate all switches either in one, two or three rows.

One and two gang switch cover plate, telephone outlet cover plate, 6 and 16 amps switched/unswitched plates, shall have the same shape and size. Three and four gang switch cover plates shall have the same shape and size. Six and eight gang switch cover plates shall have the same shape and size. Nine and twelve switch cover plates shall have the same shape and size. Wherever five switches, seven switches, ten switches and eleven switches are to be fixed the next higher size of gang switch cover plate to be used and extra openings shall be provided with blank-off.

8.3 EXTERNALLY OPERATED SWITCHES

Externally operated switches, shall be of general purpose type, 250 volts of the proper size and rating and shall be provided in weather proof enclosures, complete with weather proof gasketed covers. The MCB's for all externally operated switches shall be separate and of proper rating.

8.4 WALL SOCKET OUTLETS

All 6/16 Amps wall socket outlets unless otherwise mentioned on the drawings shall be switched, five/six round pin and fitted with automatic linear safety shutters to ensure safety from prying fingers. Un-switched 6/16 amp wall socket outlets where called for in the drawings shall be of five/six round pin type. The socket outlets shall be made from high impact resistant, flame retarding and ultra violet stabilized engineering plastic material.

The switch and sockets shall be located in the same plate. The plates for 6 amp switched/un-switched plugs and telephone outlets shall be of the same size and shape.

All the switched and un-switched outlets shall be of the best standard.

An earth wire shall be provided along the cables feeding socket outlets for electrical appliances. The earth wire shall be connected to the earthing terminal screw inside the box. The earth terminal of the socket shall be connected to the earth terminal provided inside the box.

8.5 LIGHTING FIXTURES

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

Wires brought out from junction boxes shall be encased in GI flexible pipes for connecting to fixtures concealed in suspended ceiling. The flexible pipes shall be provided with a checknut at the fixture end.

Pendant fixtures specified with overall lengths are subject to change and shall be checked with conditions of the job and installed as directed.

All suspended fixtures shall be mounted rigid and fixed in position in accordance with drawings, instructions and to the approval of the Project Manager.

Fixtures shall be suspended true to alignment, plumb, level and capable of resisting all lateral and vertical forces and shall be fixed as required.

All suspended light fixtures etc. shall be provided with concealed suspension arrangement in the concrete slab/roof members. It is the duty of the Contractor to make these provisions at the appropriate stage of construction.

All switch and outlet boxes shall be bonded to earth with insulated stranded copper wire as specified.

Wires shall be connected to all fixtures through connector blocks.

Flexible pipes, wherever used, shall be of make and quality approved by the Project Manager.

9. MEASUREMENT AND PAYMENT OF WIRING

Wiring for lights, fans, convenience socket outlets and telephone outlets etc. shall be measured and paid for on **POINT BASIS** as itemized schedule of quantities and as elaborated as below unless otherwise stated.

9.1 Primary and Secondary light point wiring

In respect of group control of lights (more than one light controlled by one switch or MCB), wiring upto the first light in the group shall be measured and paid for as a primary light point. Wiring for other lights looped in one group for switch controlled as also MCB controlled lights shall be measured and paid for as secondary light points. Primary light points for switch controlled lights shall include the cost of control switch whereas primary light points controlled by MCBs shall not include the switch cost. The cost of MCB controlling such lights shall not be included in the primary light point rate since the MCB shall be paid for in the item of DB.

The point wiring basis shall assume average wiring length and average conduiting length per point based on parameters stipulated in para 9.2 below. The average wiring length and average conducting length forming the basis of point wiring payment, shall take the electrical layouts of the entire project into consideration. Tenderers are advised to seek clarifications, if they so desire, on this aspect before submitting their tenders. No claim for extra payment on account of electrical layouts in part or whole of the project requiring larger average wiring and conduiting length per point, whether specifically shown in tender drawings or not, shall be entertained after the award of contract.

9.2 **Parameters:** Wiring shall be carried out as per following parameters in recessed/ surface conduit system.

- Only looping system of wiring shall be adopted throughout. No joints excepting at wiring terminals shall be permitted.

- All accessories shall be flush type unless otherwise stated.

- Lights, fans and 6 amp socket outlets shall be wired as per the item given in the Bill of Quantities.

- Power circuits shall normally have maximum two/one 16 amps socket outlet unless otherwise stated. Separate circuit shall be run for each Geyser, Window/Split air conditioners and similar appliances.

- Wiring rates shall include painting of conduits and other accessories as required.

- Wiring rates shall include cleaning of dust, splashes of colour wash or paint from all fixtures, fans, fittings etc. at the time of taking over of the installation.

- Wiring rates shall include blanking of outlet boxes to prevent damage/pilferage of wires.

- Wiring rates shall include circuit wiring from DB to first control switch & shall be done as per Bill of Quantities.

9.3 Definitions

9.3.1 Wiring for Lights

Primary Light Points : Wiring for primary light points, as defined in para 9.1 above, shall commence at the Distribution Board terminals and shall terminate at the ceiling rose/connector in ceiling box/lamp holder via the control switch (for switch controlled lights). Rates for primary light point wiring shall be deemed to be inclusive of the cost of entire material and labour require for completion of primary light point thus defined including : .

- Recessed / surface conduting system with all accessories, junction/draw/inspection boxes, bushes, check nuts etc. complete as required,

- Wiring with stranded copper conductor PVC insulated 660/1000 volt grade wires including terminations etc. complete as required.

- Control switch with switch box and cover plate of specified type including fixing screws, earth terminal etc. complete as required. Cost of this switch is applicable only for switch controlled points. This cost shall not be applicable for DB controlled points.

- Loop earthing with insulated copper wires.

Secondary Light points :

Secondary light points, as defined in para 9.1 above, shall cover the cost of interconnection wiring between group controlled light fittings and shall be deemed to be inclusive of the
cost of entire materials and labour required for completion of the secondary light point thus defined including

- Recessed / surface conduting system with all accessories, junction/draw/inspection boxes, bushes, check nuts etc. complete as required.

- Wiring with stranded copper conductor PVC insulated 660/1000 volt grade wires including terminations etc. complete as required.

- Loop earthing with insulated copper wires.

9.3.2 Wiring for Ceiling Fans

Wiring for ceiling fan points shall be same as for primary light points.

9.3.3 Wiring for Exhaust Fans

Wiring for exhaust fan points shall be same as for primary light points and shall in addition include the cost of providing a 3/5 pin 6 amp socket outlet near the fan alongwith plug top and a 6 amp control switch at convenient location near the room entry.

9.3.4 Wiring for Call Bell Points

Wiring for call bell points shall be the same as for primary light points. A call bell switch which include in lieu of the control switch at a convenient location as required.

9.3.5 Wiring for Telephone Outlets

Wiring for telephone outlets points shall include the entire wiring and conduiting from the telephone tag block to the telephone outlet including the telephone outlet complete as required and as itemized in the Schedule of Quantities

9.3.6 Wiring for TV Outlets

Wiring for TV outlet points shall include the entire wiring and conduiting from the central point to the TV outlet including the TV outlet complete as required and as itemized in the Schedule of Quantities

9.3.7 Wiring for Convenience Socket Outlets

3/5 pin 6 amps and 3/6 pin 16 amps single phase switched convenience socket outlets shall be provided in the building as indicated in the layout drawings. In addition, combined 3 pin 6 / 16 amps socket outlets at modular intervals in special PVC raceway over the work tables in laboratories shall be provided. Wherever required, 20/32/50 amps single phase and 32/50 amps 3 phase outlets shall also be provided.

Wiring for 3/5 pin 6 amps convenience socket outlets

Point wiring for 3/5 pin 6 amps socket outlets (in locations other than over the laboratory work tables) on point wiring basis shall be the same as primary light point defined in para 8.3.1 and shall in addition include 3/5 pin 6 amp socket outlet with 6 amp control switch in MS box with cover including loop earthing of the third pin complete as required as as itemised in scheduled of quantities.

Wiring for 3/6 pin 16 amps convenience socket outlets

Point wiring for 3/6 pin 16 amps socket outlets (in locations other than over the laboratory work tables) on point wiring basis shall be the same as primary light point defined in para 8.3.1 and shall in addition include 3/6 pin 16 amp socket outlet with 16 amp control switch in MS box with cover including loop earthing of the third pin complete as required as itemised in scheduled of quantities.

Wiring for special socket outlets

In addition to the above, special convenience outlets of 20/32/63 Amps single phase and 32/63 Amps three phase, required in few locations as indicated in the layout drawings, shall be paid for on linear basis as itemised in schedule of quantities. Outlets only shall be paid separately in numbers as per actuals. Wiring alongwith loop earthing shall be paid separately on running meter basis and conduiting /PVC raceway shall be paid separately on running meter basis.

9.3.8 Submains wiring

Submains wiring shall be measured from outer end of the boxes. Extra Loop length shall be left at each end as required.

10. ROUTINE AND COMPLETION TESTS

10.1 Installation Completion Tests

At the completion of the work, the entire installation shall be subject to the following tests:

1. Wiring continuity test
2. Insulation resistance test
3. Earth continuity test
4. Earth resistivity test

Besides the above, any other test specified by the local authority shall also be carried out. All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the contractor at his own cost.

10.2 Wiring Continuity Test

All wiring systems shall be tested for continuity of circuits, short circuits, and earthing after wiring is completed and before installation is energized.

10.3 Insulation Resistance Test

The insulation resistance shall be measured between earth and the whole system conductors, or any section thereof with all protection in place and all switches closed and except in concentric wiring all lamps in position of both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 1100 volts for medium voltage circuits. Where the supply is derived from AC three phase system, the neutral

pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 megaohms divided by the number of points provided on the circuit the whole installation shall not have an insulation resistance lower than one megaohm.

The insulation resistance shall also be measured between all conductors connected to one phase conductor of the supply and shall be carried out after removing all metallic connections between The two poles of the installation and in those circumstances the insulation shall not be less than that specified above.

The insulation resistance between the frame work of housing of power appliances and all live parts of each appliance shall not be less than that specified in the relevant Standard specification or where there is no such specification, shall not be less than half a Megaohm or when PVC insulated cables are used for wiring 12.5 Megaohms divided by the number of outlets. Where a whole installation is being tested a lower value than that given by the above formula subject to a minimum of 1 Megaohms is acceptable.

10.4 Testing Of Earth Continuity Path

The earth continuity conductor including metal conduits and metallic envelopes of cable in all cases shall be tested for electric continuity and the electrical resistance of the same alongwith the earthing lead but excluding any added resistance of earth leakage circuit breaker measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

10.5 Testing Of Polarity Of Non-Linked Single Pole Switches

In a two wire installation a test shall be made to verify that all non-linked single pole switches have been connected to the same conductor throughout, and such conductor shall be labeled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply. In the three of four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Project Manager as well as the local authorities.

10.6 Earth Resistivity Test

Earth resistivity test shall be carried out in accordance with latest IS Code of Practice for earthing.

10.7 Performance

Should the above tests not comply with the limits and requirements as above the contractor shall rectify the faults until the required results are obtained. The contractor shall be responsible for providing the necessary instruments and subsidiary earths for carrying out the tests. The above tests are to be carried out by the contractor without any extra charge.

10.8 Tests And Test Reports

The Contractor shall furnish test reports and preliminary drawings for the equipment to the Project Manager for approval before commencing supply of the equipment. The Contractor should intimate with the tender the equipment intended to be supplied with its technical particulars. Any test certificates etc., required by the local Inspectors or any other Authorities would be supplied by the Contractor without any extra charge. All test reports shall be approved by the Project Manager prior to energizing of installation.

END OF SECTION – XII

SECTION – XIII

EARTHING & LIGHTNING PROTECTION

1.0 EARTHING

1.1 The scope of this section covers supply, installation and testing of earthing system for all non-current carrying metal parts of electrical installation.

1.2 Installation of earthing system for electrical equipment shall be carried out in accordance with IS 3043 - code of Practice for earthing and conforming to Indian electricity Rules 1956 as ammended upto date.

1.3 Earthing System & Equipment Bonding:

1.3.1 Earthing system shall comprise earth electrodes at each building. Test link boxes shall be provided at each earth electrodes for periodical resistance measurement. All such earth electrodes shall be interconnected forming a main loop - (MEL).

1.3.2 The entire conduit installation, cable sheaths and cable armour shall also be bonded to earth at both ends. It must be ensured that the conduit installations maintain electrical continuity throughout its entire length. Conduits shall be effectively bonded together at each joint, such as couplings, junction boxes, draw boxes or any other accessories and equipments. Where conduits and screwed cable glands are terminated at equipment enclosures with slip-holes, an earthing/bonding washer (e.g. star-washer) shall be used to maintain electrical continuity.

1.3.3 All earth connections with solid conductors shall be made by means of soldered cable lugs. Connections with G. I. copper tapes shall be directly bolted type. All hardware used shall be galvanised steel, brass or passivated to prevent corrosion. Spring washer or lock washers shall be used to make all connections secure and vibration-proof. All contact surfaces shall be thoroughly cleaned and coated with conducting petroleum jelly to prevent corrosion.

1.3.4 Earth connections from Switch Boards shall be taken as directly as possible to the earth buses or test links
Main earth conductors from earth bus or test-link to the Earth Electrode shall be coated with bitumastic to reduce straddle potential.

1.3.5 All earth terminations on all switch board/switch panels shall be with suitable size crimped lugs of Dowel or equivalent make.

1.4 Earth Electrodes:

Earth electrodes shall consist of Copper/G.I. plates burried in ground or G.I. pipes laid in ground. The type of electrodes shall be as specified in the BOQ. The method of installation earth electrode shall be in accordance with IS:3034. Earth plates shall be buried minimum 3 meters below virgin ground. Salt or charcoal shall

be filled around the electrode to reduce the resistively of the soil and 20mm dia G.I. pipes (class heavy) shall be suitably installed to treat it with water. Every earth electrode shall have earth test link. Additional earth electrode shall be provided if necessary to bring down earth resistance within one-ohm.

1.5 Main Earth Conductor:

Main earth conductors shall be Galvanised Iron or copper strip as specified in BOQ or solid conductors with or without PVC sheath as specified. They shall be connected at one end to the earth electrode and to the earth bus or test link at the other end. All connections below ground shall be made by bolting or rivetting and brazing or welding. Sizes of main earth conductors shall be as specified. All connections to the test-link or earth bus shall be securely bolted. Contact surfaces shall be tinned and suitably protected with Petroleium Conducting Jelly to prevent corrosion.

1.6 Installation :

1.6.1 All joints shall be revetted and sweated. Jointes in the earth bar between the switch gear units or to
cable sheaths shall be bolted at the joints.

1.6.2 Where the diameter of the bolt for connecting earthbar to apparatus exceeds one quarter of the width of the earth-bar, the connection to the bolt shall be made with a wider piece to earth bar. These shall be tinned at the point of connection to equipment and special care taken to ensure a permanent low resistance contact to iron or steel. All bolts, nuts, washers, etc. shall be cadmium plated.

1.6.3 Main earth-bars shall be spaced sufficiently away from the surface to which they are fixed, such as walls or the side of trenches, to allow for ease of connections.

1.6.4 The earthing lead shall be suitably protected from mechanical injury by galvanised iron pipe wherever it passes through wall and floor. The portion within ground shall be buried at least 60 cm deep.

1.6.5 The earthing lead shall be securely bolted and soldered to the plate or pipe as the case may be. In the case of the plate, the lead shall be connected by means of a cable socket, with two bolt and nuts. All washers shall be of the same material as the plate or pipe. All iron bolt, nuts and washers shall be galvanized.

1.6.6 The earthing plate shall be surrounded by alternate layer of charcoal or coke and salt. There shall be a 20mm G.I. pipe running from the top of the plate or pipe. The top of this pipe shall provided with a funnel and mesh for watering the earth. This will be housed in a masonary enclosure not less than 30cm x 30cm x 30cm deep. A cast iron frame with 10 mm thick cover shall be suitably embeddeed in the masonry.

1.6.7 Earth electrode resistance shall be measured as per IS 3043. No earth electrode installed shall have a greater ohmic resistance than 1.0 ohms as measured by an approved earth testing apparatus.

1.7 CHEMICAL EARTHING

In maintenance free earthing copper bonded earthing rod electrode shall be of 14.35 mm in diameter and 3 meter length. The rod shall be placed in a 150 mm dia an augured hole in the ground and then surrounded by ground enhancement material in either a dry form or pre mixed in a slurry. Once set, ground enhancement material becomes hard and as such holds positively to the rod as well as surrounding ground.

Earth rod offered shall have passed the test required of BS7430/ANSI/UL-467 and confirm to the adhesion of the copper coating to the steel core (Design feature that prevents the ingress of moister and subsequently the integrity of the rod.

Minimum 0.25 mm thickness of copper shall be deposited over the steel core as per BS 7430/UL 467. Average life of the ground rod shall be 30 years in most soil.

Ground enhancement material shall be as per IEEE-80 clause 14.5 with a resistivity of less than 0.12 ohm – meter. The ground enhancement material shall be permanent and not leach any chemicals in to the ground. The pH value of the ground enhancement material shall be 6.9 to 7.2 of 100gm / lit@20 deg.C.

Minimum 30 Kg of ground enhancement material shall provided for each earth electrode.

Inspection chamber shall be of 400 x 500 mm with concrete base CI manhole cover with frame painted with bitumastic paint. 2 Nos.of 50 x 6 mm cross section & 300 mm long copper strip to be cjamped with copper claded rod electrode have sufficient nos. (But not less than 4 Nos.) of 10Φ mm GI nuts & bolts for connection to the equipment / interconnection to the other pits to form equi-potential boonding.

2.0 LIGHTNING PROTECTION SYSTEM:

2.1 Advanced LIGHTNING ARRESTOR Generation-2

2.1.1 Technical specification

Advanced Proactive -Early Streamer Emission(ESE) without aid of any primary power, to provide optimum protection against any negative Lightning in its zone of protection. Model DP 25/ 45/60 , dameks, Turkey.

2.1.2 Special features of Protector ESE sensor type Lightning protector

1. The active conductor should be ESE (Early Streamer Emission) type certified by High Volt Test Lab for 8/20 wave form at over 100kA.

2. As well as tested by CPRI Bangalore, India as per their available capacity.

3. The active conductor should derive the energy from the electrostatic field intensity variations that is formed in the air , for which no extra energy source like wind energy, solar energy or kinetic energy that is created by the vibrations are required. The inner structure should not consist of either coils or condensers which could be flammable or explosive during the discharge nor should it use Piezo crystals that might be broken during the discharge or vibration.

4. The active conductor should be made from special materials to prevent the system from chemical corrosion.

5. The conductor should have a protection mechanism that prevents any internal damage due to the lightning discharge.

6. The active conductor should be designed as compact and small (weight below 3kg)to maintain installation and transportation advantage.

7. The Basic Model of the Air terminal should have Protection Radius of 42 m at 5 meter clear height above highest structure. Data on other ranges if required shall be furnished on case to case basis .

2.2 PROTECTOR LIGHTNING COUNTER(optional)

Specifications:

Dimensions	: 173 x 82 x 44 mm
Weight	: 740 gr
Temperature range	: -20 to +50oC
Counter	: 6 digits
Protection	: IP 65
Starting treshold	: 1 100 kA in 8/20 wave
Min. Time between 2 discharges	: 100 ms
Connection	: □8 30x2 30x3 available
RES M	

WORKING PRINCIPLE

The lightning counter is to count the lightning strike discharges that goes through the conductor down to the ground. The counter is to be installed on the down conductor. It can either be installed serial or parallel.

No maintenance should be required. The device should be a high technology product and conform to the working and laboratory test conditions.

2.3 PROTECTOR TESTER(optional)

Specifications:

Dimensions	: 107 x 148 x 44 mm
Weight	: 930 gr
Operation Frequency	: Standard
Power	: 6 V battery
RES M	

WORKING PRINCIPLE

The tester is developed for specific use where it is required to maintain the highest security and make sure that the lightning conduction system works properly such as in remote installed areas, where services may not be available on demand.
The tester enables to verify that the Air terminal conductor is in standard operation by making a connection both to the upper tip and the lower shaft. By using the tester, the lightning conductor is tested in addition to the ground resistivity tests and these two tests together creates a common and proper control on the system.

2.4 ESE LIGHTNING CONDUCTOR PROTECTION RADIUS CALCULATION (NF C 17-102 S 2.2.3.2) FOR ALL MODELS OF PROTECTOR

The protection radius of air terminal is calculated by the standard formula given in the French Standard NF C 17-102.

The formulation is based on the lightning conductor triggering advance (□T), installation height (h) and the triggering distance (□L).

Rp = √h(2D-h) +Δ □L(2D+Δ □L) h ≥ 5m.

ΔL = V x □Δ T

Rp : Conductor protection area radius

h : The distance between the point of the conductor and the area to be protected

ΔT : Triggering time

D : Triggering distance according to the NF C 17 102 standard

ΔL(m) = v (m/□μs)..ΔT(m/□μs)

The values of Triggering advance & triggering distance for each model should be stated against the requirement given in the table below. Deviations if any must be explained

TYPE	(ΔT)	(D)
DP 25	25 μs	20 M.
DP 45	40 μs	45 M.
DP 60	60 μs	60 M.

INSTALLATION SCHEME

DP type / model select

	h = Conductor tip height (m)								
ESE CONSUCTORS	2	4	5	7	10	15	20	45	60

LEVEL -1

DP 25	17	34	42	43	44	45	45	45	45
DP 40	26	50	63	64	64	65	65	65	65
DP 60	32	64	79	79	79	80	80	80	80

LEVEL -2

DP 25	23	46	57	59	61	63	65	70	70
DP 40	34	64	76	77	78	80	82	85	85
DP 60	40	78	97	98	100	101	103	105	105

LEVEL -3

DP 25	26	52	65	66	70	72	75	84	85
DP 40	36	72	89	90	92	95	97	104	105
DP 60	44	87	107	108	110	111	114	119	120

Components of LPS

ESE lightning conductor

1. Mast to ensure desired free height
2. Down Conductor for grounding
3. Protector lightning strike counter
4. Test joint
5. Protection guard
6. Earthing

END SECTION – XIII

SECTION – XIV

MEDIUM VOLTAGE DISTRIBUTION BOARDS:

1 GENERAL

This section covers specification of DBs.

2. STANDARDS AND CODES

The latest and amended upto date Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

3. MINIATURE CIRCUIT BREAKERS

- The MCB's shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system.
- The MCB's shall have a rupturing capacity of 10 KA at 0.5 p.f.
- The MCB's shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection. The MCB time current characteristic shall coordinate with XLPE cable characteristic.
- Type test certificates from independent authorities shall be submitted with the tender.

4. FINAL DISTRIBUTION BOARDS

- **Final distribution boards shall be flush mounting, totally enclosed, dust and vermin proof and shall comprise of miniature circuit breakers, earth leakage circuit breakers, neutral link etc as detailed in the schedule of quantities.**

- The distribution equipment forming a part of the Distribution Boards shall comply to the relevant Standards and Codes of the Bureau of Indian.

- The board shall be fabricated from 16 gauge CRCA sheet steel and shall have a hinged lockable spring loaded cover. All cutouts and covers shall be provided with synthetic rubber gaskets. The entire construction shall give a IP 42 (double door and four tier-arrangement) degree of protection.

- The bus-bar shall be of electrical grade copper having a maximum current density of 1.6 ampere per square mm and PVC insulated throughout the length. The minimum spacing between phases shall be 25 mm and between phase and earth 19 mm

- Separate neutral link for each phase shall be provided.

- All the internal connections shall be with either solid copper PVC insulated or copper conductor PVC insulated wires of adequate rating.

- All the internal connections shall be concealed by providing a hinged protective panel to avoid accidental contact with live points.

- All outgoing equipment shall be connected direct to the bus bar on the live side. The equipment shall be mounted on a frame work for easy removal and maintenance.

- The sheet steel work shall undergo a rigorous rust proofing process, two coats of filler oxide primer and final powder coated paint finish.

- All the circuits shall have an independent neutral insulated wire, one per circuit, and shall be numbered and marked as required by the Project Manager.

- A sample of the completed board is to be got approved by the Project Manager before commencement of supply and erection.

- Before commissioning, the distribution boards shall be megger tested for insulation and earth continuity.

5 SHEET STEEL TREATMENT AND PAINTING

- Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognized phosphating process. The steel work shall then receive two costs of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.

- All sheet steel shall after metal treatment be given powder coated finish painted with two coats of approved shade on the outside and white on the inside. Each coat of paint shall be properly stoved and the paint thickness shall not be **less than 50 microns**.

6. NAME PLATES AND LABELS

- Suitable engraved white on black name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

END OF SECTION – XIV

SECTION – XV

1.0 TELEPHONES / MATV/DATA SYSTEM WIRING

1.1 Scope:

The scope of this section covers the supply, laying and testing of conduits and cables for Telephones, Computer Data and MATV System Wiring. The supply of associated equipments are not included in the scope of this tender.

1.2 Telephone Cables:

1.2.1 The telephone cables shall be of copper conductor, PVC insulated and PVC sheathed armored or unarmored as specified. The telephone cables shall comply with as specified. The telephone cables shall comply with I.T.I. or I.T.L. specifications and in case of armoring, to IS - 1554 Part -I - 1964. Copper conductors shall be of 0.51 mm, 0.61 mm diameters, as specified, where specified cat 5 LAN Cable shall be used.

1.2.2 Each conductor shall be PVC insulated with a different colour as per the colour and shall be twisted together with its mate conductor to form a pair. All pairs shall be PVC insulated and supplied
with Nylon Rip Cord to felicitate easy unsheathing without damaging the PVC insulation.

1.2.3 The raw material used in the manufacture shall be of high grade and quality. The conductors shall be drawn from high purity electrolytic copper and shall be annealed and tinned. The PVC insulation shall be of high grade and shall be resistant to ageing and fading, to ensure identification of colours etc., after prolonged use.

1.2.4 The type, size and pairs shall be as given in the Bill of Quantities.

1.2.5 All multi-pair cables and 2-core telephone distribution unarmored cables shall be laid in steel or PVC conduits, as per BOQ. Wherever multi-pair cables are to be laid in the open on walls and ceilings, these cables shall be of the armored type. Separate conduits shall be used for external and intercommunication system. The conduits shall be coloured as per the ITD colour code. The extended rims of conduits shall be fitted with 150mmx 150mm x 75mm MS pull boxes. The pull boxes shall be suitably painted for easy identification and shall be provided at intervals of 10 meters. The pull-boxes can be of the surface mounting type or flush=mounting type as specified.

1.3 Tag Boxes:

The tag boxes shall be of sheet steel, suitably painted suitable for multi-core telephone cables. For single pair telephone cables, suitable terminal connections shall be provided.

1.5 MATV System Wiring:

Wiring for MATV system equipment shall be carried out with insulated coaxial cable to Delton specified Model laid in surface/recessed conduit as shown in the drawings. RG6 and RG 11 coaxial cables shall be used final distribution and main feeders/risers.

1.6 DATA CABLE SYSTEM

1.6.1 Data cables for LAN shall be Cat-6 or Cat-6a as specified.

1.6.2 The cables shall be laid in conduits or channels as specified in BOQ.

1.6.3 Data cables shall be terminated in RG 45 Complete terminals.

END OF SECTION – XV

SECTION – XVI

CONVENTIONAL FIRE ALARM SYSTEM / PA SYSTEM

1.0 CONVENTIONAL FIRE ALARM SYSTEM

1.1 Control Panel : (With Pre Alarm)

The fire detector control panel must be designed according to EN 54-2 and EN 54-4.

The control panel must have the following features:

CE identification Microprocessor controlled
Programmable using existing keypad without additional auxiliary equipment
On primary lines that are monitored for short-circuit and interruption
2 , 4 or 6 primary lines for connecting automatic detectors and manual fire detectors using limit-line technology
Each having a potential-free relay contact as an output for
- Alarm Total
- Pre-Alarm Total
- malfunction total, also functions during total power failures, can withstand 5 A / 30 V

Two fixed, assigned open collector outputs for each detector zone for alarm and malfunction, each output can withstand at least 20 mA / 40 V
24 V operating voltage, suitable for controlling existing external signaling devices
One monitoring output for signaling devices, able to withstand up to 1 ampere
24 V output for powering external consumption units
Separate, monitored fuse for external consumption units
Battery monitoring
Separate, monitored battery circuit protection
Monitoring of mains voltage
Switch-off of individual detector zones
Programmable 2 detector dependency for each detector zone
Adjustable delay times of 30 to 120 seconds for subsequent alarm
Simple switching to temporary cancellation of 2 detector dependency for maintenance purposes
Automatic reset of the control panel after trouble shooting
Manual day/night switchover
Manual control of the signaling devices using buttons without there being an alarm to the fire detector control panel
on/off of the signaling device from the control panel during an alarm

Individual display for each detector zone for

- Zone switch off
- Alarm
- Test
- Malfunction

Cumulative displays for Pre-alarm

- Alarm
- System error
- Zone switch off

3 Authorization levels for various operational processes, higher priority levels with password

Level 0:	Message processing, testing Display elements
Level 1:	Testing of detector zones
Level 2:	Maintenance

Technical data:

- Power supply of 230 V AC, +10 % / -15 %
- Second power supply with a backup time of at least 45 hours
- Protection category: min. IP30

1.2 Control Panel : (With 2 sounder outputs "Monitored")

The fire detector control panel must be designed according to EN 54-2 and EN 54-4.

The control panel must have the following features:

- Microprocessor controlled

- Manual day/night switchover

- Each having a potential-free contact for

  - Alarm
  - Malfunction- Two monitored outputs for signaling devices each capable of with standing up to 100 mA

- Individual outputs per detector zone

- Option for creating 3 message levels

- Restriction of access to the message levels using password protection

- Ability to switch off individual zones

- Individual display for each zone for

- Zone switch-off
- Alarm
- Test
- Malfunction

- Cumulative displays for

- Alarm
- System error
- Zone switch-off

- Evacuation function

- Control of the signaling devices using buttons without there being an alarm to the fire detector control panel

- Ability to switch the signaling device on/off (silence function)

One-man test

- Power supply with a backup time of max. 59 hours in normal operating condition

- IP 30

- Final expansion to 2, 4 or 6 detector zones, using limit-line technology

Individual switch-off of detector zones

2.0 Fire Alarm Detectors / Devices

2.1 Optical Smoke Detector :

- Smoke detector in compliance with DIN EN 54 part 7 with equal response sensitivity for all fires with smoke development.

- Response sensitivity independent of air pressure and ambient temperature.

- Alarm LED can be seen from all angles

- Detector and transmission electronics in the detector head for easy exchange in the event of a malfunction. Therefore, no electronics are permitted in the base.

- Standby value updating

- High level of immunity to electromagnetic influences,

- Detector socket/detector with bayonet connection for detector exchange using dismount tool reaching up to 8m

- The base is compatible with any detector in the Same series, thus enabling a simpler exchange of detectors during usage changes in the conventional system and subsequent upgrading to LSN Technology

-Theft protection to protect against unauthorized removal of the detector from the socket, included in the standard version and can be activated as desired.

- Smoke-repelling covers and labyrinth design, optimized for smoke reception.

- Option to connect a remote External detector alarm display.

2.2 Thermal Heat Detector :

- Heat detector compliant with DIN EN 54 part 54 to detect fires with rapid rises in temperature and/or a maximum temperature value.

- Alarm LED can be seen from all angles

- Detector and transmission electronics in the detector head for easy exchange in the event of a malfunction. Therefore, no electronics are permitted in the base.

Maximum trigger temperature is 58°C

- Differential unit 1C/min – 30 C/min

- High level of immunity to electromagnetic influences,

- Detector socket/detector with bayonet connection for detector exchange using dismount tool reaching up to 7.5m

- The base is compatible with any detector in the Same series, thus enabling a simpler exchange of detectors during usage changes in the conventional system and subsequent upgrading to LSN Technology.

- Theft protection to protect against unauthorized removal of the detector from the socket, included in the standard version and can be activated as desired.

- Option to connect a remote External detector alarm display

2.3 Multiple Optical – Thermal detector :

- Smoke detector in compliance with DIN EN 54 part 7 with equal response sensitivity for all fires with smoke development.

- Heat detector compliant with DIN EN part 5 for detecting fires with rapid rises in temperature and/or a maximum temperature value.

- Protection against deception alarms via the evaluation of the fire characteristics smoke and heat with selected algorithm.

- Detection of smoke and heat

- Response sensitivity independent of air pressure and ambient temperature.

- Alarm LED can be seen from all angles.

- Detector and transmission electronics in the detector head for easy exchange in the event of a malfunction. Thus, no electronics permitted in the base.

- Standby value recalibration in optical unit.

- Maximum trigger temperature is 58°C Differential unit 1C/min – 30C/min.

- High level of immunity to electromagnetic influences,

- Detector socket/detector with bayonet connection for detector exchange using dismount tool reaching up to 8m

- The base is compatible with any detector in the MAGIC.SENS series, thus enabling a simpler exchange of detectors during usage changes in the conventional system and subsequent upgrading to LSN Technology.

- Theft protection to protect against unauthorized removal of the detector from the socket, included in the standard version and can be activated as desired.

- Smoke-repelling covers and labyrinth design, optimized for smoke reception.

- Option to connect a remote External detector alarm display.

2.4 Multiple Optical – Chemical Detector :

- Smoke detector in compliance with DIN EN 54 part 7 with equal response sensitivity for all fires with smoke development.

- Chemo sensors to detect combustible gas.

- High level of protection against deception alarms via an evaluation of the fire characteristics gas and smoke using a selected fire characteristic pattern algorithm (comparison).

- Detection of smoke and combustible gas.

- Reliable detection of fires via the additional detection of combustible gas.

- Response sensitivity independent of air pressure and ambient temperature.

- Alarm LED can be seen from all angles

- Detector and transmission electronics in the detector head for easy exchange in the event of a malfunction. Thus, no electronics are permitted in the base.

- Standby value recalibration in the optical and chemical unit

- High level of immunity to electromagnetic influences,

- Detector socket/detector with bayonet connection for detector exchange using dismount tool reaching up to 8m.

- The base is compatible with any detector in the MAGIC.SENS series, therefore enabling easy detector exchange during usage changes in the conventional system and subsequent upgrading to LSN Technology.

- Theft protection to protect against unauthorized removal of the detector from the socket, included in the standard version and can be activated as desired.

- Smoke-repelling covers and labyrinth design, optimized for smoke reception.

- Option to connect a remote External detector alarm display.

2.5 Detector Base :

- suitable for surface and flush mounting
- Intended for mounting on 55-type switch box for flush mount cable routing
- Anti-removal protection can be activated on-site without tools
- Sufficient connection room also for cable while maintaining function

- Direction of mounting can be selected as desired because the detector display can be read from all sides

- Cable in and out feed separated into different directions, yet can be jointly routed in one direction

- Terminal technology for the connection technology for mounting that is easy on the cable Connection for parallel detector display (Response indicator)

2.6 Beam Type Smoke Detectors :

With transmission, receiver, and evaluation units, for detecting light and dark smoke over a distance of min. 10 m and max. 100 m with extra width of up to 14 m.

- Stable metal housing.
- Volume control with 15 increments for self-activated compensation for contamination and intentional aging.
- Separate outputs for alarm and malfunction.
- Measurement output for calibration and service mode.
- Connection to detector's primary line using potential-free relay double-throw contacts.

Protection category		:	IP 54
Operating temperature range		:	-20 C to +55 C
Response sensitivity		:	40% VdS compliant
Response time:	Alarm	5s	
	Malfunction	1s	

2.7 Manual call points :

Intended for Indoor/ Outdoor mounting, Surface-mounted, in plastic housing, Color is red, can be labeled using overlays, with display of the alarm feedback (illuminated in red)
and second potential-free switch contact.

2.8 Signaling Devices :

a) Sounders :

12 V and 24 V, red,

- 28 programmable tones,
- Maximum 111 dB (A), at 24V-

Max. current consumption : 33 mA at 24V-
Starting current : 30 mA

intended for flush-mount cable feed.

Flat design: Sounder includes base for flush-mount cable feed, 63 mm depth

Protection category : IP 54
Temperature range : -25° C to +80°C

b) Strobes :

to issue a local alarm in interior rooms and out in the open

Strobe energy	:	2 Joule
Protection category	:	IP54 (IEC) with flat base (Indoor)
Protection category	:	IP65 (IEC) with flat base (Outdoor)
Housing color	:	ABS, red
Operating voltage	:	24 V-

c) Sounder Base :

Sounder for sounding a local alarm, designed for and can also be used as a base for detectors with integrated tone generator and sound converter. Monitored control and voltage supply via the ring bus system; function is maintained if there is a short circuit or interruption in the loop. Designed for surface and flush mounting cable feed. Individual control of base sounders via assignment to any desired detector in the fire detector system.

11 tones programmable from the fire detector control panel;

at least one of these tones can be selected to comply with with at least 110 dB (A)Frequency range of 440 Hz to 2 850 Hz

Volume can be adjusted from the fire detector control panel
Various signals for pre-alarm and alarm.

2.0 PUBLIC ADDRESS SYSTEM

2.1 Amplifiers 240 Watts

This product shall be manufactured by a firm whose quality system is in compliance with the ISO 9001, QUALITY SYSTEM.

2.2 General Requirements

a. 240 Watts Power Amplifier with at least 4 mic level inputs.

b. All input channels have a power supply to provide power to condenser microphones, 2 input channels should also be switched to line sensitivity. Separate music inputs are available with their own input selector and volume control.

c. The power is directly available on 70V and 100V constant voltage connections and on allows impedance connection for an 8ohm load. Moreover the amplifiers have separate 70V/100V call-only output channel for addressing areas where only priority announcement are required, and 70V/100V mix only output channels for areas where no priority announcement should be heard.

d. for more output power than the built-in power stage can deliver additional Plena power amplifiers can be connected to the balanced line output in a loop-through arrangement.

e. It should have two front panel switches to direct the amplifier output to two seprate zones, so that certain announcement or background music should not be heard in part of building. Priority calls are always routed to both zones.

f. Provision shall be made to connect the PA System to Lift Car Speaker.

2.3 Technical Specifications

- Electrical
  - Mains Power Supply Voltage - 230/115VAC+/- 10%

- Performance
  - Frequency response - 50Hz to 20 kHz
  - Distortion - <1% at rated output power,1 kHz
  - Bass Control - -8/+8dB at 100Hz
  - Treble Control - -8/+8dB at 10 kHz
  - Dynamic range - 100dB

- Mic input - 4x

- Sensitivity - 1mV
- Impedence: >1kohm
- S/N (flat at max volume) - 63dB
- Headroom: >25dB
- Speech filter: -3dB at 315 Hz, high –pass,6dB/oct
- Phantom power supply - 16V via 1.2kohm
- VOX input

- Loudspeaker Output (70/100V)
- Connector - Screw, Floating
- Power - 360/240W (Max/rated)

2.4 ENVIRONMENTAL SPECIFICATIONS:

A. Temperature:

1) Operating: 0°C to +40°C.
2) Storage: 0°C to +70°C.

B. Humidity: <95% relative condensing.

2.4.1 REGULATIONS

CE, EN / Any international standard

2.5 CEILING SPEAKERS

This product shall be manufactured by a firm whose quality system is in compliance with the ISO 9001, QUALITY SYSTEM.

This will mainly be installed at Floors lobby of both Tower A and Tower B

2.5.1 General Requirements

6 Watts false ceiling speaker
15Watts Horn type wall mounted speaker

A. Easy to install with spring-loaded mounting clamps
B. Power handling capacity-6 watts/4 watts

2.5.2 Technical Specifications

- Power Handling Capacity - 6 watts
- Sound pressure level - 93dB
- Effective Frequency Range - 300-15kHz
- Rated Input Voltage - 100 Volts
- Color - IFB White
- Weight - 600Grams
- Mounting - Clamps

2.5.3 **ENVIRONMENTAL SPECIFICATIONS:**

a) Temperature:

1) Operating: 0°C to +50°C.
2) Storage: 0°C to +60°C.

b) Humidity: 5% to 93% relative condensing.

2.5.4 **REGULATIONS**

CE, EN, EVAC

3.0 HORN TYPE SPEAKERS .

This product shall be manufactured by a firm whose quality system is in compliance with the ISO 9001, QUALITY SYSTEM.

This will mainly be installed at Basement parking Area.

3.1 General Requirements

High efficiency horn loudspeaker with excellent speech reproduction and sound distribution for a wide range of outdoor application

a) It should be circular or rectangular horn loudspeaker with 100V line input, made up of ABS.

b) It should include 100V transformer with taps on the primary winding to allow different power settings. Nominal full-power, half power or quarter power radiation) i.e. in 3dB steps) can easily be selected by connection the amplifier output to the appropriate tap.

c) The horn loudspeaker should have sturdy adjustable mounting brackets, allowing the sound beam to be accurately directed.

d) It should be designed to withstand operating at their power for 100hrs in accordance with IEC 268-5 Power handling capacity standards.

3.2 Technical Specifications

a) Max Power - 22.5 W
b) Rated power - 15 W
c) Sound pressure level at rated power (1W/1m) - 103 dB
d) Effective frequency range (-10dB) - 500Hz to 5kHz
e) Opening angle (at 1kHz/4kHz,-6dB)
   Horizontal - 130deg/50deg
   Vertical - 130deg/50deg
f) Rated Voltage - 100V
g) Rated Impedance - 667 ohm

h) Connection - 4 wire cable

3.3 ENVIRONMENTAL SPECIFICATIONS:

a) Temperature:

1) Operating: 0°C to +55°C.
2) Storage: 0°C to +70°C.

b) Design rating: IP65

3.4 REGULATIONS

CE, EN OR ANY OTHER INTERNATIONAL STANDARD

4.0 TABLETOP CALL STATION

This product shall be manufactured by a firm whose quality system is in compliance with the ISO 9001, QUALITY SYSTEM.

This will mainly be installed at Control room of whole establishment

4.1 General Requirements

The tabletop microphone should be a stylish, high-quality tabletop unidirectional condenser microphone, intended for making calls in a public address system. It should have heavy metal base and rubber feet ensure stability on any flat surface.

This PTT should not only switch on the microphone, but also provides priority contacts, that are compatible with the amplifiers. The switching characteristic of the PTT-key should be configured internally for PTT-mode (on as long as pressed) or toggle mode (press to switch on, press again to switch off). If the priority contact is not required, the microphone can be connected to amplifiers with 3‑ pin Euro style connector. A green LED indicates when the microphone is active.

Technical Specifications

- Phantom Power Supply
- Voltage range 12 to 48Vvvv
- Current Consumption <8mA

Performance

- Sensitivity 0.7mV@85dB SPL
- Max input Sound level 110dB SPL
- Distortion <0.6%
- Input Noise level 28dB
- Frequency response 100Hz to 16 kHz
- Outdoor impedance 200 ohms

4.2 ENVIRONMENTAL SPECIFICATIONS:

A. Temperature:

1) Operating: 0°C to +45°C.
2) Storage: 0°C to +70°C.

B. Humidity: <95%

4.3 REGULATIONS

A. CE, EN

END OF SECTION – XVI

SECTION – XVII

C.C.T.V. SYSTEM

1. SCOPE

This section covers the design, supply, installing, testing and commissioning of Closed Circuit Television system comprising CCD Cameras, DVR and Monitors.

2. CCD FIXED INDOOR CAMERAS (DOME TYPE)

The CCD Cameras shall have the following features:-

i. It shall be general purpose colour video cameras.

ii. It shall have standard resolution with excellent sensitivity for fine performance at low light levels.

iii. It shall have signal to noise ratio of more than 48 dB.

iv. It shall be provided with linear shutter and back light compensation.

v. The linear electronic shutter shall be capable of automatically selecting integration period appropriate for the illumination level. The range of speeds shall be 1/50-1/100,000 seconds.

vi. **Video Characteristics**

a.	Image Device	:	1/3-inch interline transfer CCD
b.	Sensitivity	:	0.1 to .002 lux Scene illumination. Conditions: usable video (50 IRE) output
c.	Resolution	:	EIA: 510 lines horizontal.
vii.	Electronic Shutter	:	EIA speed range: 1/50 sec to 1/100,000 sec.

viii. **Backlight**

a.	Compensation	:	Switch selectable, on-off.
b.	Geometric Distortion	:	0%
ix.	Signal-to-Noise Ratio (SNR)	:	Greater than 48 dB
x.	Video Signal Output	:	1.0 v p-p (140 IRE) composite video, consisting of 714 mV (100 IRE) of luminance and of negative-going sync signal of 286 mV (40 IRE)

xi.	White Balance	:	ATW or AWB
xii.	Synchronization	:	Line locking with vertical phase adjustment.
xiii.	Automatic Gain Control	:	Required.

3. COLOUR MONITOR

The colour Closed circuit Video monitor shall be suitable for providing high 450 TV lines horizontal, resolution, high contrast picture on a 21 inch diagonal screen. The monitor shall have solid state circuitry. It shall be include video loop through connectors with a switchable high-2 Nos. 75-ohm out put (one for extension) termination on the rear panel. The monitor shall be suitable for 240 V, 50 Hz. The monitor shall be housed in an enameled steel cabinet with a recessed plastic carrying handle. The monitor shall be provided with controls for brightness, contrast, vertical hold, horizontal hold and power on/off. These shall be located at the front of the unit. The monitor shall comply with UL standard 1410. It should have SVHS input / output.

4. DIGITAL VIDEO RECORDER

a) The system will combine the functions of a multiplexer, VCR and telemetry switcher for system versatility and functional use a with large system. It shall offer full triplex operation.

b) It shall use the latest high performance Wavelets ™ compression technology, and record pictures up to a resolution upto SVHS standard.

c) It shall use the built-in hard disk drive or external archive medium to both record to, and play back from these media.

d) The unit will support connection to Ethernet networks/IP Connectivity. Software will permit view of either live pictures or playback from the Hard Disks Recorder, while simultaneously recording.

e) It will have Ethernet compatibility, 10/100 MBPS Base-T network interface card on Ethernet units

f) It will permit video transmission via Ethernet.

g) It will have 2 selectable record levels: VHS & S-VHS.

h) It will have user-friendly Windows™ style menus, SCSI port for VAIDe, AIT1, AIT2 and CD-RW arching devices

i) It will have capability of VMD and activity detection

5. PTZ INDOOR CAMERAS

a) It shall be colour integrated speed dome camera.

b) It shall be remotely configurable with integrated telemetry receiver.

c) It shall have 360^0 continuous pan and 180^0 continuous tilt..

d) It shall have minimum 50 pre-set positions.

e) It shall have auto tour facility for automatic operation.

f) It shall have sector tilting / camera tilting.

g) It shall have auto IRIS / auto focus.

h) It shall have minimum 450 TV lines.

i) Sensitivity shall be 1-lux, usable video.

6. OUTDOOR P/T/Z WEATHER PROOF DAY / NIGHT DOME CAMERA

a) It shall be colour integrated weather proof IP-65 outdoor.

b) It should be suitable to operate both in day / night mode with low lux sensitivity. Day mode shall be 2-lux and Night mode shall be 0.016 lux.

c) It shall have optical zoom 18x and digital zoom 10x.

d) It shall have 360^0 continuous pan and 180^0 continuous tilt..

e) It shall have auto IRIS / auto focus.

f) It shall have minimum 450 TV lines.

g) It shall have auto tour facility for automatic operation.

END OF SECTION – XVII

SECTION – XVIII

MODE OF MEASUREMENTS

1.0 Wiring light points, fan points, exhaust fan points, call bell points, socket outlets, telephone / TV outlets shall be measured and paid on point basis as per BOQ, and as elaborated below unless stated otherwise.

2.0 In case of group control light points i.e. more than one light points controlled by switch or MCB, wiring from switch / MCB upto first point shall be primary light point and subsequent points in the group shall be deemed as secondary light points and paid as per item in BOQ. The rate shall include all the items mentioned in the BOQ. Wiring point shall include circuit wiring from DB to 1st tap off point including the earth wire. 6A socket outlet points, power points, fan points, bell points shall be paid on point basis at schedule rates.

3.0 Telephone outlets points shall include wiring from Tag block to 1st tap off point and 1st tap off point to subsequent telephone outlet points. This would include conduit with conduit accessories telephone wire outlet box, with cover plate and telephone jack.

4.0 Wiring for TV outlet shall include wiring from Tap / Splitter box to the 1st outlet and 1st outlet to subsequent outlets. In case DTH connectivity conduit from switcher to various outlets shall be paid on linear measurement basis. The outlet box with cover plate shall be paid separately as per item of BOQ. Wiring shall be drawn by service provider and would not be in the scope of electrical contractor.

5.0 Wiring for fire alarm system shall be measured and paid on linear basis at schedule rates.

6.0 Submain wiring and cables, conduits for various services shall be measured on linear basis and paid as per item of the work.

END OF SECTION – XVIII

SECTION – XIX

1.0 TESTING OF THE INSTALLATION

1.1 Installation Completion Tests

At the completion of the work, the entire installation shall be subject to the following tests:

1. Wiring continuity test
2. Insulation resistance test
3. Earth continuity test
4. Earth resistivity test
5. Polarity test

Besides the above, any other test specified by the local authority shall also be carried out. All tested and calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the contractor at his own cost.

1.2 Insulation Resistance Test

The insulation resistance shall be measured between earth and the whole system conductors, or any section thereof with all protection in place and all switches closed and except in concentric wiring all lamps in position of both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 1100 volts for medium voltage circuits. Where the supply is derived from AC three phase system, the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral. The insulation resistance measured as above shall not be less than 50 mega ohms divided by the number of points provided on the circuit the whole installation shall not have an insulation resistance lower than one mega ohm.

The insulation resistance shall also be measured between all conductors connected to one phase conductor of the supply and shall be carried out after removing all metallic connections between the two poles of the installation and in those circumstances the insulation shall not be less than that specified above.

The insulation resistance between the frame work of housing of power appliances and all live parts of each appliance shall not be less than that specified in the relevant

standard specification or where there is no such specification, shall not be less than half a Megaohm or when PVC insulated cables are used for wiring 12.5 Megaohms divided by the number of outlets. Where a whole installation is being tested a lower value than that given by the above formula subject to a minimum of 1 Megaohms is acceptable.

1.3 Wiring Continuity Test

All wiring systems shall be tested for continuity of circuits, short circuits, and earthing after wiring is completed and before installation is energized.

1.4 Testing Of Earth Continuity Path

The earth continuity conductor including metal conduits and metallic envelopes of cable in all cases shall be tested for electric continuity and the electrical resistance of the same alongwith the earthing lead but excluding any added resistance of earth leakage circuit breaker measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

1.5 Testing Of Polarity Of Non-Linked Single Pole Switches

In a two wire installation a test shall be made to verify that all non-linked single pole switches have been connected to the same conductor throughout, and such conductor shall be labeled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply. In the three of four-wire installation, a test shall be made to verify that every non-linked single pole switch is fitted to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Project Manager as well as the local authorities.

1.6 Earth Resistivity Test

Earth resistivity test shall be carried out in accordance with latest IS Code of Practice for earthing.

1.7 Polarity Test

1.7.1 In two wire installation, a test shall be made to verify that all the switches in every circuit have been fitted in the same conductor throughout, and such conductor shall be labeled or marked for connection to the phase conductor, or to the non-earthed conductors of the supply.

1.7.2 In a three wire or a four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted in a conductor which is labeled, or marked for connection to one of the phase conductors of the supply.

1.7.3 The installation shall be connected to the supply for testing. The terminals of all switches shall be tested by a test lamp, one lead of which is connected to the earth. Glowing of test lamp to its full brilliance, when the switch is in “on” position

irrespective of appliance in position or not, shall indicate that the switch is connected to the right polarity.

1.8 Performance

Should the above tests not comply with the limits and requirements as above the contractor shall rectify the faults until the required results are obtained. The contractor shall be responsible for providing the necessary instruments and subsidiary earths for carrying out the tests. The above tests are to be carried out by the contractor without any extra charge.

1.9 Tests And Test Reports

The Contractor shall furnish test reports and preliminary drawings for the equipment to the Project Manager for approval before commencing supply of the equipment. The Contractor should intimate with the tender the equipment intended to be supplied with its technical particulars. Any test certificates etc., required by the local Inspectors or any other Authorities would be supplied by the Contractor without any extra charge. All test reports shall be approved by the Project Manager prior to energizing of installation.

END OF SECTION – XIX

SECTION –XX

LIST OF APPROVED MAKES OF MATERIAL

S. No.	Item	Approved Make
1)	Rigid PVC Conduit (FRLS only)	Precision Plastic Industries, Nihir, Astral,
2)	Accessories for conduit	Same make as of pipe.
3)	Flexible Copper Wires (FRLS)	Finolex, RR Kable, Havells
4)	Modular Switches	Legrand (Myrius), MK (Blenze), Norisys
5)	Telephone cables Jelly Filled	Finolex, Delton, RR cable
6)	PVC tape	Steel grip, Anchor
7)	Panel Manufacturer	ISO Certified & CPRI approved Panel Builder
8)	MCBs/ELCBs/ELMCBs / Contactor Time Switch (Timer)	Legrand, L&T, Siemens
9)	Distribution boards- TPN & SPN DB (IP 43),	Hensel, Legrand (MDS-DX3), L&T, Siemens
	VTPN DB (IK 43)	Hensel, Legrand (MDS-DX3), L&T,
10)	LT Cables	XLPE armoured cable for 1.1 KV as per ISI 1554. Finolex, Polycab, RR Kable, Hawells.
11)	Glands	Single Compression type, Heavy duty and deep threading
12)	Cable Lugs	Dowells, 3-D, Raychem.
13)	Metal Clad Plugs	Indoor –Legrand, Scame, Hensel. Outdoor - Legrand, Scame, Hensel.
14)	Button holder, Angle holder.	Anchor, CPL
15)	Digital Meter	Rishabh, L &T, Schneider
16)	Cable Tray	i) Ladder/Perforated - Hot deep GI -Indiana, MEM, OBO Better man, Rico steel
17)	CT	AE, Kappa, Rishabh
18)	Telephone tag block	Krone.
19)	TV Cable R G 6 / 11	Finolex, RR Cable, Polycab.
20)	Fire Extinguisher	Should be of ISI approved - Safex,Firex,Safeline
21)	Cat-6 Wire & Fibreoptic Cable and Accessories	Legrand, SYSTIMAX, Panduit, Siemon
22)	UPVC Cable trucking	Legrand, OBO Betterman, MK
23)	RJ 45 Data outlet	Legrand, SYSTIMAX, Panduit, Siemon
24)	Network Switch	HP, Cisco
25)	Rack	Legrand, Rittal, Panduit, Vellrack
26)	Modular Patch Panel	Legrand, SYSTIMAX, Panduit, Siemon
27)	Light Fixture	Phlips, Wipro, Disano, Xal, Regent

28)	Fan(Grey colour, Mat finish / White colour as Required Site).	Crompton, Usha, Havells, Bajaj – Sample to be approved By consultant.
29)	Emergency Signage Light	Legrand, Sigma, Prolight
30)	Exhaust Fan (Should be with louvers)	Usha, Havells, Crompton
31)	Floor Junction Box	OBO, Betterman, Legrand, MK, As per BOQ
32)	Floor Raceway	OBO, Betterman, Legrand, MK, As per BOQ
33)	Addressable Fire Detection System	Honeywell/BOSCH/SIEMENS/UTC/Ravel.
34)	Access Control System	Zk-teco / Honeywell / Seimens
35)	CCTV	Pelco / Honeywell/ AXIS
36)	Monitors Display units	Samsung, LG, Sony
37)	Hard Disk	WD / Seagate
38)	Speakers	Bosch, Yamaha, Honeywell
39)	Amplifier	Bosch, Yamaha, Honeywell
40)	Telephone instrument	BEETEL /BINATONE/PANASONIC
41)	Digital PIR Sensor	Legrand / MK
42)	Display Panel (TV)	SAMSUNG , SONY
43)	HDMI Cable	MX, Kramer, crestron
44)	Projector	EPSON , PANASONIC, SONY
45)	POP-UP BOX	LEGRAND / MK
46)	Video Conferencing Unit	Cisco / Polycom
47)	Flexible Cable / Flexible Shilded Cable	RR / Finolex / Polycab
48)	FIRE SUPPRESSION SYSTEM	Novec or equivalent

NOTE: -

1. Make of any other item left out shall be approved by Client/Consultants before procurement.

2. Make of the accessories for Transformer, HT Panel etc. and any other items shall also be approved by Project Manger.

3. The specifications indicated above are minimum requirement only. The Contractor should supply, erect and commission the equipments/ system according to latest editions of IEC and EI/IS Standards.

Signature of Tenderer

END OF SECTION –XX