

WIRING

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

INSTALLATION

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

COMMISSIONING & ONSITE TESTING

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

WORKMANSHIP:

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

MODE OF MEASUREMENT:

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



CAPACITOR & APFCR PANEL

SCOPE :

- This specification covers the commissioning of a capacitor bank for continuous duty.

CODES AND STANDARDS :

- The design, manufacture and installation of capacitor banks shall conform to the latest applicable codes in the locality and to the latest applicable standards.

IS : 2834

IS : 9224

- When the above specification is not available, the design shall conform to the latest applicable codes in the locality and to the latest applicable standards.

CONSTRUCTION

CAPACITOR BANK

- Capacitor banks shall be designed to operate at a capacitor unit size of 100 kVAr and 100 kV. Individual elements shall be designed to get the dielectric having a life span restricted to 10 years. The capacitor shall be brought to the site and fabricated top. The capacitor shall be protected against damage caused by traffic.

BUSBARS CHAMBER

- Capacitor bank shall be protected by a vermin proof enclosure with a rubber gasket and shall be mounted on FRP insulation.
- The bus bar chamber shall be of the type cable termination type and shall be protected by a chamber with a door. The door shall be required.

SCOPE :

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

CODES AND STANDARDS :

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

IS : 2834 Shunt capacitors for power system.

IS : 9224 Low voltage fuses.

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

CONSTRUCTION

CAPACITOR BANK

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

BUSBARS CHAMBER :

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



EARTHING:

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

PAINTING:

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

DRAWINGS :

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

TEST & TEST CERTIFICATES:

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

CAPACITOR PANEL:

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

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

MODE OF MEASUREMENT:

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



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

GENERAL DESCRIPTION

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

MATERIAL

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

Technical Requirements:

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

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

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

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

Core Identifications:

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

Black shall always be used for neutral.

Inspection

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

Joints in Cables

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

Jointing Boxes for Cables

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

Jointing of Cables

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

Cable End Terminations

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

Bonding of Cables

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



Cable Installation in Cable Trays and Cable Trenches.

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

Laying of Cables on Cable Trays

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

Laying of Cables in Ground

- Cable trench shall be dug to the minimum depth of 1 mtr and the width shall dependent on the no of cables to be kept with the layer of brick in between two cables.
- **Excavation of trenches** : The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided. Where gradients and changes in depth are unavoidable, these shall be gradual. The excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench. The bottom of the trench shall be levelled and shall be made free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 100 mm in depth. Prior to laying of cables, the cores shall be tested for continuity and insulation resistance. The cable drum shall be properly mounted on jacks, at a suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum and the spindle is horizontal. Cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire drum length shall be laid in one stretch. However, where this is not possible the remainder of the cable shall be removed by 'Flaking' i.e. by making one long loop in the reverse direction. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted off the rollers beginning from one end by helpers standing about 10 meters apart and laid in a reasonably straight line. Cable laid in trenches in a single tier formation shall have a cover of clean, dry sand of not less than 150 mm. above the base cushion of sand before the protective cover is laid. In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 300 mm shall be provided over the initial bed before the second tier is laid. Finally the cables shall be protected by second class bricks before back filling the trench. The buried depth of uppermost layer of cable shall not be less than 750mm.
- **Back Filling** : The trenches shall be back filled with excavated earth free from stones or other sharp edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 300 mm. Unless otherwise specified, a crown of earth not less than 50 mm in the centre and tapering towards the sides of the trench shall be left to allow for subsidence.

Route Marker

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

Cable Trays

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

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

General Requirements

I. Quality of Zinc

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

II. Coating Requirement

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

Testing of Cables

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



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

WORKMANSHIP

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

- Continuity on all phases.
 - Insulation Resistance.
 - between conductors.
 - all conductors and ground.
 - All test readings shall be recorded and shall form part of the completion documentation.
 - Cable joints shall be done as per regular practice and check shall be carried out for loose connections and leakages. Insulation cutting shall be done properly taking care that no area of the conductor remains exposed. Crimping shall be done with the help of hydraulic tool. Proper insulation tape shall be applied at the cable and lug joint.
- Format for cable testing certificate :
- a. Drum no. from which cable is taken :
 - b. Cable from _____ to _____
 - c. Length of run of this cable _____ mtr
 - d. Insulation resistance test
 - between core 1 to earth _____ mega-ohm
 - between core 2 to earth _____ mega-ohm
 - between core 3 to earth _____ mega-ohm
 - between core 1 to core 2 _____ mega-ohm
 - between core 2 to core 3 _____ mega-ohm
 - between core 1 to core 3 _____ mega-ohm
 - duration used:
 - e. High voltage test: Voltage Duration
 - between core and earth
 - between individual cores
- The cable shall be laid side by side in trench with brick covering on all the three sides. The trench shall be such that sharp bends shall be avoided while laying the cable. The bedding of fine sand under the cable shall be not less than 6 mm. The trench shall be terminated in Manholes with specified size of R.C.C. hume pipes as shown in drawing. Cable markers shall be provided through out the route of cable at 10 mtrs distance. The trenches shall be refilled after the cable are laid and the Ground level shall be done as per original after pressing the same. The cables shall be checked for insulation resistance and continuity tests shall be carried out.

MODE OF MEASUREMENT:

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

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

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

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



DISTRIBUTION BOARDS:

GENERAL DESCRIPTION

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

CONSTRUCTION FEATURES

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

Distribution Boards shall comprise of the following:

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



Miniature Circuit Breaker (MCB)

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

Residual Current Circuit Breaker Current Operated Type (RCCB)

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

The RCCB should ensure mainly the following functions:

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

EARTHING

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

PAINTING

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

LABELS

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

TESTING

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

WIRING

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

WORKMANSHIP:

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

MODE OF MEASUREMENT:

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



INTERNAL WIRING

SYSTEM OF WIRING

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

GENERAL DESCRIPTION

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

LIGHTING & POWER WIRING

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



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

TESTING

- The entire installation shall be tested for:

Insulation resistance.
Earth continuity.
Polarity of single pole switches.

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

COMPUTER WIRING :

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

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

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

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

CONDUCTORS

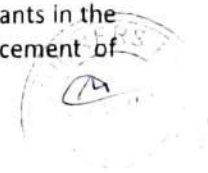
- All PVC insulated copper conductor flexible FRLS wires shall conform in all respects to Standards as listed under sub-head Indian Standards and shall be IS approved and ISI marked.

BUNCHING OF WIRES

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

LOAD BALANCING

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



COLOUR CODE OF CONDUCTORS

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

WORKMANSHIP

Drawing Conductors

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

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

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

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

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

Fish Wire

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

MODE OF MEASUREMENT

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



**LIGHTING FIXTURES &
ACCESSORIES**

GENERAL DESCRIPTION

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

SCOPE

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

WORKMANSHIP:

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

MODE OF MEASUREMENT:

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



PUBLIC ADDRESS SYSTEM

GENERAL :

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

SCOPE OF SUPPLY:

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

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

It shall comprise of :

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

- b) Table stand type microphone.

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

CASSETTE PLAYER :

- The cassette player shall be designed for standard rack mounting and shall have the following characteristics.

- Number of tracks : 2
- Tape speed : 1 7/8 ips (4.76 cm/sec.)
- Wow and flutter 0.3%
- Signal-to-noise ratio 40 dB
- Frequency range : 60 - 10,000 Hz. \pm 3 dB
- Playing time : minimum 12 hours



POWER AMPLIFIERS AND PREAMPLIFIERS :

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

CONTROL PANEL :

The control panel shall be equipped with :

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

MICROPHONE :

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

LOUDSPEAKER FOR PUBLIC ADDRESS SYSTEM :

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

TESTING / INSPECTION :

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

MAINTENANCE :

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



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

SPARES :

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

P A System Wiring

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

WORKMANSHIP:

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

MODE OF MEASUREMENT:

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

CCTV SYSTEM



SYSTEM DESIGN AND ARCHITECTURE

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

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

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

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

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

FULL BODIED CAMERA WITH VARIFOCA LENS AND OUTDOOR ENCLOSURE

GENERAL SPECIFICATIONS:

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

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

TECHNICAL SPECIFICATIONS

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

ELECTRICAL SPECIFICATIONS

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

ENVIRONMENTAL SPECIFICATIONS

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

DIGITAL VIDEO RECORDER

DIGITAL VIDEO RECORDER GENERAL DESCRIPTION

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



NETWORK DIGITAL VIDEO RECORDER SPECIFICATIONS

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

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

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

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

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

NVR should support external storage via e-SATA interface.

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

The NVR shall provide the following two modes of recording:

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

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

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

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

HDMI or YPbPr output at 1920×1080 resolution

Support 32 channels 720P 16 channels 1080P input.

And 8 channels 1080P synchronous playback

Support ID CAMs CDS threshold value setup

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

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

Support keyboard connect.

Well-done lightning protection. No image interference.

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

ELECTRICAL SPECIFICATIONS:

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

ENVIRONMENTAL SPECIFICATIONS:

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

MODE OF MEASUREMENT

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



**TELEPHONE, TELEVISION AND
COMPUTER SYSTEM**

GENERAL DESCRIPTION

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

SCOPE

TELEPHONE CABLES AND WIRES:

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

TELEPHONE TAG BLOCKS:

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

TELEPHONE OUTLET SOCKET:

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



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

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

The Offered IP Communication System must support following configuration:

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

i) **Redundant Power Supply**

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

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

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

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

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

iii) **PC-based system administration**

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

The following data must be administered by the application:

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

- Call charge tariffs/account codes

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

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

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

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

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

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

vi) **IP- payload switching**

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

vii) **IP gateway**

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

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

viii) **IP Networking**

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

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

2.2) System Features and Station Features

b) System features

i) Standard system functions



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

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

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

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

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

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

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

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

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

RNA when free:

 - a call to a free extension should be forwarded to

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

RNA on busy:

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

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

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

(11) **Individual display**

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

(12) **Group ringing**

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

(13) **Group call**

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

(14) **Logical Partitioning**

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

(15) **DECT**

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



c) Features for Stations

i) Standard station function

System software for all stations connected should have following functions:

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

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

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

iii) Team-based call pickup

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

iv) Directed call pickup

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

v) Overriding call forwarding

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

vi) Parking in the system

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

vii) Do not disturb

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

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



xviii) Sending text messages

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

xix) Absent messages

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

xx) Executive - Secretary system function

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

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

d) Applications

i) CTI 1st-party client software

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

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

ii) CTI 3rd-party interface

for operation of telephone functions using CSTA - interface.

← Wall-mountable

COMPUTER WIRES:

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

COMPUTER DATA OUTLET SOCKETS:

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

TELEVISION WIRING & SOCKETS:

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

WORKMANSHIP

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

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

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

MODE OF MEASUREMENT

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



CABLE TRAY & FLOOR RACEWAY

SCOPE

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

CABLE TRAYS :

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

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

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

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

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

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

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

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

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

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

