1.0 DEFINITIONS

The following abbreviations used in the bill of quantities specifications and drawings represent:

- **ISS**: Indian Standard Specification
- **IER**: Indian Electricity Rules, 1956
- **B**: British Standard (Wherever specifically called for)
- **HRC**: High Rupturing Capacity
- **GI**: Galvanized Iron
- **MS**: Mild steel
- **C.I.**: Cast Iron
- **PVC**: Polyvinyl Chloride
- **HT**: High Tension
- **LT**: Low Tension
- **A-Amp**: Ampere
- **KV**: Kilo Volts
- **PT**: Potential Transformers
- **CT**: Current Transformers
- **OCB**: Oil Circuit Breakers
- **ACB**: Air Circuit Breakers
- **SFU**: Switch Fuse Unit
- **MCCB**: Moulded Case Circuit Breaker
- **MCB**: Miniature circuit Breaker
- **IC**: Iron Clad
- **DB**: Distribution Board
- **KVA**: Kilo Volts Ampere
- **KVAR**: Kilo Volts Ampere—Reactive
- **PCC**: Power Control Center
- **MCC**: Motor Control Center
- **NC**: Normally closed
- **NO**: Normally open
- **SWG**: Standard Wire Gauge
- **CL/RL**: Ceiling Light
- **DL**: Drop Light

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REGULATION & STANDARDS

The installation shall conform in all respects to Indian Standard Code of Practice for Electrical Wiring Installation IS - 732, CPWD specifications and 'National Electric Code'. It shall also be in conformity with the current I.E. Rules and Regulations and requirements of the local Electric Supply Authority and Fire Insurance regulations in-so-far-as these become applicable to the installation.

Electrical work in general shall be carried out as per following CPWD Specifications with up-to-date amendments:

- General Specifications for Electrical Works. (Part IV - Sub-station) - 1982.

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

In general, the materials equipment and workmanship not covered by the above, shall conform to the Indian Standards (latest edition) unless otherwise called for.

Following is a list for guidance only of the contractor & this is not an exhaustive nor a complete list of applicable latest edition of IS:

1. Switchgear:
   a. Requirements of AC Circuit Breakers IS 2516 (Part I) Sec 1, 2 & Moulded case circuit breakers & 3 (Part II) IS 4710
   b. Switches & Switch isolators above 1000v but not exceeding 11 kV IS 375
   c. Markings & arrangements for Switchgear Switchgear bus bars, main connection and Auxiliary wiring IS 4237
   d. General requirements for switchgear and controlgear for voltages not exceeding 1000 V IS 8828
   e. Specifications for miniature circuit breakers IS 2675
   f. Specification for enclosed distribution, fuse boards and cut outs for voltage not exceeding 1000 volts IS 2208
   g. HRC Cartridge fuse links 650 volts

2. Cables:
   a. Specification for PVC insulated (Heavy Duty) electric cables part I for voltage upto 1100 volts IS 1554 (part I)
   b. Specification for XLP E insulated cables (for voltage above 1100 V) with Aluminium conductors IS 7098 (part II)
   c. Specification for XLP E insulated cables (for voltage Upto 1100 V) with Aluminium conductors IS 7098 (part I)

3. a. Specifications for rigid non metallic conduits for electrical installation IS 9537
   b. Specifications for accessories rigid non metallic conduits IS 3837 for electrical installation

4. Box for the enclosure of electrical accessories steel IS 5133 (part -I)
   and C.I. boxes.

5. 3 Pin plugs and socket outlets IS 1293
   Ceiling Rose IS 371

6. Adhesive insulating tapes for electrical purposes IS - 2448 (part I & II)

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General & safety requirements for electrical light fittings. IS 1913
1. Watertight electric light fittings IS 3553
2. Flood Lights IS 1947
3. Ceiling fans and regulators IS 374
4. Propeller type / G Ventilating fans IS 2312
5. Code of Practice for earthing IS 3043
6. Glossary of terms for electrical cable and conductors IS 1885
7. Code of Practice for buildings (General) electrical installation IS 1646
8. Protection of buildings and allied structures against lightning IS 2309
9. Current Transformers IS 2705 (Part I to III)
10. Voltage Transformers IS 3156 (Part I to III)
11. Power Transformers IS 2026 (Part I to IV)
12. Shunt capacitor for power systems IS 2834
13. Direct acting electrical indicating instruments IS 1248
14. Factory assembled switchgear IS 8623
15. Degrees of protection provided by enclosures for low voltage switchgear and controlgear IS 2147
16. Installation & maintenance of switchgear IS 3072 (Part I)
17. Control switches and Push Buttons IS 6875
18. Fuse switch & switch fuse units IS 4064
19. Relays IS 3231
20. Integrating instruments IS 722
21. Auxiliary contactors IS 2959

2.6 DELETED

2.7 INSPECTION OF MATERIALS
2.7.1 All materials used or unused or procured can be checked by Engineer-in-charge for quality & if found not as per specifications / standards or otherwise of poor quality, it shall not be used & shall be replaced.

2.8 DRAWINGS
2.8.1 The work shall be executed as per latest working drawings duly approved by the Engineer-in-charge & subject to any minor changes. The Drawings & data provided is for guidance to the contractor. The exact dimensions, location, distance & levels etc shall be governed by the space conditions.
2.8.2 The contractor shall examine all architectural, structural, plumbing, sanitary & air conditioning drawings before starting any work & reports to the engineer-in-charge any discrepancy or defect which in his opinion appear on them & get the same rectified / omitted in electrical drawings.
2.8.3 After completion of work, the contractor shall submit to the engineer-in-charge, layout drawing indicating complete wiring installed & single line diagrams of the installation.
2.8.4 In case of concealed wiring system, the contractor shall submit the routing drawings (based on Engineer-in-charge lighting layout drawings) showing location of embedded conduits / JBs / Inspection boxes for final record & maintenance.
2.8.5 The contractor shall prepare and submit to the engineer-in-charge for approval detailed shop drawings of all switch boards, panels, Distribution boards, cabinets, Bus trunking, etc. as required within 30 days of signing of the contract.

2.9 ENGINEER/ FOREMAN

[Signature of tenderer(s)]
Page 219
2.9.1 The Contractor shall employ a competent, licensed, qualified full time electrical engineer/foreman/supervisor to direct the work of electrical installations in accordance with the drawings & specifications. The engineer/foreman/supervisor shall be available at site at all times to receive instructions from the Engineer-in-charge in any day to day activities throughout the duration of the contract. The engineer/foreman/supervisor shall correlate the progress of work in conjunction with all relevant requirements of the supply authority. The skilled workers employed for the work should have requisite qualifications and should possess competency certificate from the Electrical Inspectorate of Local Administration.

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Date:-

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SECTION II

(EQUIPMENT SPECIFICATIONS)

1.0 MAIN SWITCH BOARDS & SUB-SWITCH BOARDS.

1.1 GENERAL

1.1.1 The panels shall be extensible type with provision of extension of Bus on either side. Medium voltage power & motor control centers shall be in sheet steel cubical type enclosure, floor mounted, freestanding type, totally enclosed & compartmentalised design.

1.2 CONSTRUCTION

1.2.1 The Panels shall be free standing type, with sheet steel enclosure having following features.

1.2.2 The panels shall be made out of minimum 2.0-mm thick CRCA sheet steel. The internal frame shall be made of structural steel angles / channels. The panels shall be dust & vermin proof duly powder coated in approved colour, by seven-tank process. The degree of protection shall not less than IP52 as per relevant IS code. The sheet steel shroud & partitions shall be of min. 1.6-mm thickness. All sheet steelwork forming the exterior of the panels shall be smoothly finished, leveled, having rounded corners & free from any flaws. All doors to be fixed with dust-excluding neoprene gasket with fasteners designed to ensure proper compression of the gaskets. Where ever covers are provided instead of doors, sufficient and generous overlap shall be ensured between sheet steel surface with gaskets & closely placed fasteners to preclude the entry of dust.

1.2.3 The following minimum clearances have to be maintained after taking into consideration connecting clamps & bolts etc.:  
   i) Between Phases - 32 mm.  
   ii) Between Phases & Neutral - 26 mm.  
   iii) Between Phases & Earth - 26 mm.  
   iv) Between Neutral & Earth - 26 mm.

1.2.4 All functional units such as MCCB shall be arranged in multi tier formation, & each such unit shall be fully compartmentalised. A vertical cable alley of at least 300 mm width shall be provided to serve one / two vertical sections of feeders. Cable alley shall have hinged doors & suitable cable clamping arrangement with slotted angles shall be provided in the cable alley. Similarly, vertical bus bars shall be housed in between two feeder compartments in a separate bus chamber. The openings between the bus chambers & feeder compartments shall be covered with Bakelite / brylam sheet of minimum 2.0 mm thickness. The vertical bus bar chambers shall be provided with removable bolted covers on the front and the back. All the interconnecting links to the feeders shall be shrouded so as to avoid accidental contact, by means of phenolic barriers. Each compartment shall have its own individual door with concealed hinges & the door shall have interlocking facility with the feeder unit, also arrangement for by-passing this facility shall be provided.

1.2.5 All insulating materials used in the construction of the panels shall be of non-hygrosopic materials, duly treated to withstand the effect of high humidity & high temperatures

1.3 BUSBARS

1.3.1 The busbars shall be of 31 MVA rupturing capacity, suitable for 3 phase, 4 wire, 415 Volts, 50 Hz AC supply. The bus bars shall be made of high conductivity & high strength aluminium confirming to the requirement of E91E of IS 5082. The busbars shall have uniform cross section throughout out the length & shall be designed for carrying rated current continuously throughout the length. The cross-section of the neutral busbar shall be same as
that of the phase busbar for busbars of capacity up to 200 Amp; for higher capacities, the
neutral busbar shall not be less than half (50%) the cross-section of that of the phase busbars.
The busbars & links shall be designed for a maximum temperature of 75 deg. C.

3.2 The maximum current density shall be taken as 1 Amp per sq.mm of cross-sectional area.
Busbars shall be supported on suitable non-hygrosopic, non-combustible, material such as
DMC / SMC at sufficiently close intervals to prevent busbar sag. Ridges shall be provided on
these supports to prevent tracking between adjacent busbars. Large clearances & creepage
distances shall be provided on the busbar system to minimise the possibility of fault. All
busbar joints shall be provided with high tensile steel bolts (electroplated with Nickel /
Cadmium), spring washers & nuts so as to ensure good contact. The joints shall be formed
with fishplates on either side of the busbars to provide adequate contact area. Bus supports
shall be provided on either sides of the joints (max. unsupported distance from the joint shall
be 400 mm).

1.3 Power shall be distributed to feeders in dual section by a set of vertical busbars (phase &
neutral). Individual module shall be connected to this vertical busbar through sleeved
connections. All busbars shall be insulated with PVC tapes / tubes (heat shrink type) with
colour coding (Red/ Blue/ Yellow/ Black).

1.4 The busbars & the connections to the functional circuits from the busbars & their supports
shall be able to withstand thermal & dynamic stresses without any damage or deformation,
due to the system short circuits. The neutral and the earthbar should also be capable of
withstanding the above level.

1.5 The contractor shall furnish calculations along with his drawings establishing the adequacy of
busbars both for continuous duty & short circuit rating. The panel manufacturer should have
CPRI test certificate for IP52 & short circuit rating.

1.4 MOULDED CASE CIRCUIT BEAKERS(MCCB)

1.4.1 Moulded Case Circuit Breakers shall be incorporated in the Panels where ever specified.
MCCB's shall conform to IS13947-2, EC-947-2-1989 in all respects. MCCB's shall be
suitable for three phase 415 Volts.

1.4.2 The MCCB cover and case shall be made of high strength heat treatment and flame retardant
thermo-setting insulating material. Operating handle shall be quick make/quick break, trip-
free type and shall have suitable ON, OFF & TRIP indicators. MCCB's shall have common
operating handle for simultaneous operation and tripping of all poles.

1.4.3 Suitable extinguishing device shall be provided for each contact. Tripping unit shall be of
thermal-magnetic type provided in each pole and connected by a common trip bar such that
tripping of any one pole operates all the poles to open simultaneously. The thermal-magnetic
device shall have IDMT characteristics for sustained over loads and short circuits.

1.4.4 Contact tips shall be made of suitable arc resistant, sintered alloy for long electrical life.
Terminals shall be of liberal design with adequate clearances.

1.4.5 The MCCBS shall have a Breaking capacity of not less than 25kA RMS at 415 volts.

1.4.6 Original test certificates of all MCCB's as per IEC and IS shall be furnished.
1.5.1 GENERAL

1.5.1.1 Direct reading electrical instruments shall be in conformity to IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instruments glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

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

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

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

1.5.2 AMMETERS

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

1.5.3 VOLTMETERS

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

1.5.4 CURRENT TRANSFORMERS

1.5.4.1 Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1kv. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However the rated secondary current shall be 5 A unless otherwise specified. The acceptable minimum class of various applications shall be as given below:

<table>
<thead>
<tr>
<th>Measuring</th>
<th>Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>Class 5 P10</td>
</tr>
</tbody>
</table>

1.5.4.2 Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50KA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate

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CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

5.4.3 Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for C.T.'s shall be copper conductor, FR1S insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

5.4.4 The current transformers to be selected for this panel will have at least 20% extra VA capacity available over the normal capacity based on the following details:

- For ammeters: 3VA
- For current coils of KW & KWH: 5VA
- For current coils of PF, meters: 1.5VA
- For all recorders: 5VA
- For all normal wiring: 2VA
- For current coil of protection relays: 10VA

5.4.5 Under no circumstances the VA rating of the C.T's will be less than 15 VA.

1.6 MISCELLANEOUS

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

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

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

1.7 CABLE TERMINATIONS

1.7.1 Cable entries and terminals shall be provided in the switch board to suit the number, type and size of aluminium conductor power cables and copper conductor control cable specified.

1.7.2 Provision shall be made for top or bottom entry of cables as required through separate removable gland plates. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated.

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

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

1.8 CONTROL WIRING

1.8.1 All control wiring shall be carried out with 100/660v grade single core PVC cable conforming to IS 694/IS 8130 having stranded copper conductors of minimum 1.5sq.mm for potential circuits and 2.5sq.mm for current transformer circuits. Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wiring
shall be identified by numbering ferrules at each end. All control fuses shall be mounted in front of the panel and shall be easily accessible.

1.9 TERMINAL BLOCKS

1.9.1 Terminal blocks shall be 500 Volts grade of the stud type. Insulating barriers shall be provided between adjacent terminals. Terminal blocks shall have a minimum current rating of 10amps and shall be shrouded. Provisions shall be made for label inscriptions.

1.10 LABELS

1.10.1 Labels shall be of anodized aluminium, with white engraving on black background. They shall be properly secured with fasteners.

1.11 TESTS AT MANUFACTURES WORK

1.11.1 All routine tests specified in IS: 8623-1993 shall be carried out and test certificates submitted to the Engineer in-charge.

1.12 TESTING AND COMMISSIONING

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

a) Operation checks and lubrication of all moving parts.
b) Interlocking function check.
c) Insulation test: When measured with 500V megger, the insulation resistance shall not be less than 100 mega ohms.
d) Insulation test of oil: When tested as per IS: 6792-1972, the oil shall withstand a voltage of 40 KV for a minute with out break down.
e) Trip tests & protection gear test.

2. DISTRIBUTION BOARDS

2.1 GENERAL

2.1.1 Distribution boards for power and light circuit distribution shall be factory built and shall be suitable for 415 volts, 3 phase or 230 volts single phase supply as specified in BOQ. The distribution boards shall conform to IS 8623 (for factory built assemblies).

2.2 TYPE

2.2.1 Distribution Board shall be double door type suitable for flush installation. The boards shall be of cabinet design, totally enclosed and shall provide protection against ingress to IP 42 of IS 2147. However, if none of the types available from the approved makes meets the above requirement, alternative makes can be offered with technical literature and copy of test certificate with the approval of the Engineer-in-Charge.

2.3 COMPONENTS

2.3.1 Distribution boards shall generally be provided with the following major components:

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Page 225
Distribution board shall be provided with MCB and or earth leakage circuit breaker as mentioned in drawing and BOQ. Earth leakage circuit breaker shall be current operated type and of 30mA sensitivity unless otherwise stated. ELCB shall be mounted within distribution board box. Distribution board box, MCBs, ELCBs used shall be of one same manufacturer. Standard size manufactured by approved manufacturer shall be used. In case size specified in BOQ is not standard size of manufacturer, in that case next higher standard size distribution board box shall be used with incoming & outgoing MCB as specified in BOQ. Additional cutout/space for outgoing MCB shall be plugged with blank plates. No extra cost shall be paid for using bigger/higer size distribution board box and blank plates.

MINIATURE CIRCUIT BREAKERS

24.1 Miniature Circuit Breakers for lighting circuits shall be of “B” curve where as the circuits feeding discharge lamps (HPSV / MH / HPMV) halogen lamps, all power outlet points, equipment/machinery shall be of “C” Curve (Motor circuit) types. All miniature circuit breakers shall be of 10 KA rated rupturing capacity unless otherwise stated. MCBs shall generally conform to IS 8828. The miniature circuit breakers shall be suitable for snap fixing on a standard DIN rail. The MCBs shall be suitable for operating under full load under ambient temperature condition (i.e. 10°C to 55°C in India). MCBs shall have terminals suitable for receiving.

24.2 Aluminium cables of adequate cross-section (upto 32 Amp rating 16 sq. mm. and 40,50,63 Ampere 35 sq. mm. cable). Three phase MCBs shall have common trip bar so that all the poles make and break simultaneously. Miniature circuit breakers shall be quick make & quick break type with trip free mechanism. MCB shall have thermal & magnetic short circuit protection.

EARTH LEAKAGE CIRCUIT BREAKERS:

25.1 Earth leakage circuit breakers shall be used as incomers in distribution boards wherever specially called for in BOQ. ELCB shall be suitable for incorporation in standard DB manufactured by the approved manufactures. ELCBs shall be of core balance type and shall not cause nuisance tripping the ELCB shall be rated for 30mA / 100mA fault circuit tripping. ELCB shall be provided with test push button to test the healthiness of the circuit.

BUS BARS

26.1 The bus bars shall be copper and duly tinned or plated. The bus bar rating shall be at least 200 ampere.

26.1.1 Three phase DBs shall have single piece bus bar and coupling link avoiding drilling and bolting of bus bars.

26.1.2 However, if the above 'unique bus bars' system is not available from the approved manufacturers alternative makes can be offered with full technical particulars.

26.1.3 Neutral busbars shall be provided with the same number of terminals as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. Phase barrier shall be fitted and all live parts shall be screened from the front.

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The DB cabinet shall be made of at least 1.6mm thick sheet steel duly stove enameled or powder coated (as per standards manufacturing product). The cabinet shall be suitable for either recess mounting or surface mounting. The cabinet shall be provided with conduit / cable entry knockouts at top and bottom or plates shall be of detachable construction. the cabinet shall be dust and vermin proof with proper gaskets for the front door.

The DB cabinet and internal mounting arrangement shall be such that the entire bus and MCB assembly can be easily detachable from the cabinet.

Distribution Board shall be double door type and suitable for flush installation. All distribution boards shall be of three phase (415 Volts) [Three row 24/30/42 Module, 4 Pole modular I/C] or single phase (240 volts) [One row 8/10/14 Module] type with incoming MCB and/or ELCB as in Schedule of quantities. Three phase DBs shall have 4Pole MCB as incomer (this MCB shall not be accommodated in the three rows) and each row shall have one 2Pole ELCB and balance MCBs or Blanking plates. e.g. A 3 row, 24 module DB shall have 1 No. 4Pole MCB as incomer, 3 No. 2Pole ELCBs (one for each phase) and 18 No. SP MCBs or Blanking Plates. (Six for each phase). Similarly a single phase DB shall have a 2Pole MCB as incomer and 2Pole ELCB and balance MCBs or Blanking plates.

Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. All distribution board enclosures shall have an etched zinc base stave painted followed by synthetic stave enameling, colour light grey. A circuit identification card in clear plastic cover shall be provided for each distribution board.

Distribution boards shall be provided with a write and protect directory indicating the area of loads served by each circuit breakers, the rating of breakers, size of conductors etc. The directory shall be in front of the cabinet.

Distribution boards shall be surface mounted or recessed mounted as required. DBs shall be mounted at the locations as shown on the approved execution drawings.

Surface boards shall be fixed with suitable angle iron clamps and bolts. All the cables/conduits shall be properly terminated using glands/ check nuts etc. Wiring shall be properly terminated using crimping lugs/sockets and PVC identification ferrules. Distribution boards shall be bonded to the earth at least at two points using brass bolts and lugs. Suitable name plate and danger plate indicating the voltage shall be fixed to the front cover.

Distribution boards shall be tested at factory as per I.S. 8623 and original test certificate shall be furnished.

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Date:-

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SECTION-III

(INTERNAL WIRING)

GENERAL

Medium voltage distribution system shall be applicable for wiring 3 phase, 4 wire 415 volts, 50 Hz, AC supply and single phase, 2 wire 230 volts, 50 Hz, AC supply.

This section covers the general technical requirements & measurement of the various components in internal electrical installation works.

REGULATION & STANDARDS

1. The system shall be governed by the requirements of IS : 732 and I.E. Rules and N.I.C. IS Standards and Codes applicable for medium voltage distribution is also listed in specification.

2. The definitions of terms shall be in accordance with IS:732-1989 (Indian Standard Code of Practice for Electrical Wiring), except for the definitions of point, circuit, & sub-main wiring which are defined in clauses hereunder.

3. The conventional signs & symbols for technical work shall be as shown in drawing.

POINT WIRING

3.2 A point (other than socket outlet point) shall include all work necessary in complete wiring to the following outlets from the controlling switch or MCB. The scope of wiring for a point shall however, include the wiring work necessary in tapping from another point in the same distribution circuit.

a) Ceiling rose or connector (in the case of points for ceiling / exhaust fan points, prewired light and call bells).

b) Ceiling rose (in case of pendants except stiff pendants).

c) Back plate (in case of stiff pendants).

d) Lamp holder (in case of goose neck type wall brackets, batten holders and fittings which are not prewired).

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

3.3 Following shall be deemed to be included in point wiring.

a) Conduit, conduit accessories for the same and wiring cables between the switch box and the point outlet. See also (g) below.

b) All fixing accessories such as clips, nails, screws, phil plug etc. as required.

c) Metal switch boxes for control switches, regulators, sockets etc. recessed or surface type and
   i) phenolic laminated sheet covers over the same for piano type switches.
   ii) modular covers over the same for modular type switches and MCBs.

d) Outlet boxes, junction boxes, pull through boxes etc. but excluding metal boxes if any, provided with switch boards for loose wires / conduit terminations.

e) Control switch piano type, modular type, MCB as specified in the boq.

f) Three pin or six pin socket, ceiling rose or connector as required (2 pin & 5 pin socket outlet shall not be permitted).

g) Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.

h) Interconnecting wiring between points in the same circuit, in the same switch box or from another.

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i) Protective (loop earthing) conductor from one metallic switch box to another in the distribution circuits, & for socket outlets, the length of protective conductor run along the circuits, / sub-mains is excluded from the scope of points.

j) Bushed conduit / porcelain tubing where wiring cables pass through wall etc.

**MEASUREMENTS**

1. Point wiring (other than socket outlet point)
   i) Unless otherwise specified there shall be no linear measurement for point wiring, light points, fan points, ex fan point & call bell points. These shall be measured on unit bases by counting, and classified as laid down in 3.3.2.

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

2. Classification
   Points measured under 3.3.1 on unit basis shall be classified as under according to the type of building.
   i) Residential Buildings:
      a) Group ‘A’, for point wiring for type I, type II, type III and residential quarters and hostels.
      b) Group ‘B’, for point wiring for type IV and above type of residential quarters and barracks.

   ii) Non Residential Buildings:
      Group ‘C’ for all types of non residential buildings such as Airport Terminal Building, Offices, hospitals, laboratories, Educational Institutions, libraries, Sub-station Buildings, Pump Houses, Air conditioning Plant room, community centers, M.T. Garages, Fire station etc.

   iii) For any other type of building for which the points have to be classified shall be decided by the Engineer-in-charge.

3. Point wiring for socket outlet points:
   i) The light plug 5A / 6A & power plug 15A / 16A points wiring shall be measured on linear basis from the respective tapping point of live cable viz switch box, another socket outlet point, or the sub distribution board as the case may be up to the socket outlet.

   ii) The metal box with cover, switch / MCB, socket outlet & other accessories shall be measured and paid as a separate item.

   iii) The power point outlet may be 15A / 5A or 16A / 6A six pin socket outlet, where so specified in the tender documents.

1. Group Control / Loop Points wiring.
   i) In the case of points with more than one point controlled by the same switch, the same point shall be measured in parts i.e. (a) from the switch to the first point outlet as one point and classified according to 3.3.2 and (b) for the subsequent points, shall be treated as separate point(s), and classified according to 3.3.2.

   ii) No recovery shall be made for non provision of more than one switch / MCB. In such cases.

3.5 Twin control light points wiring.
   i) A light point controlled by 2 Nos. of two way switches shall be measured as two separate points from the fitting to switches on either side and classified according to 3.3.2.

   ii) No recovery shall be made for non provision of more than one ceiling rose or connector in such cases.

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Multiple controlled call bell points,

i) In the case of call bell with a single call bell outlet, controlled from more than one place, the points shall be measured in parts i.e. (a) from the call bell outlet to the nearest ceiling rose meant for connection to bell push treated as one point and classified according to 3.3.2 and (b) form that ceiling rose to the subsequent points, shall be treated as separate point(s), and classified according to 3.3.2.

ii) No recovery shall be made for non provision of more than one ceiling rose or connector for connection to call bell in such cases.

CIRCUIT AND SUB-MAIN WIRING

Circuit wiring
Circuit wiring shall mean the wiring from the distribution board up to the tapping to the nearest first point of the distribution circuit viz., up to the nearest switch box.

Sub-main wiring
Sub-main wiring shall mean wiring from one main/distribution switch board to another.

Measurement of Circuit & Sub-main wiring,

i) Circuit & Sub-main wiring shall be measured on linear basis along the run of the wiring. The measurement shall include all lengths from end to end of conduit or PVC casing capping as the case may be, exclusive of interconnection inside switch board etc. The increase on account of diversion or slackness shall not be included in the measurement.

ii) The length of circuit wiring with two wires shall be measured from the distribution board to the first nearest switch box in the circuit irrespective of weather the neutral conductor is taken to the switch box or not.

iii) When wires of different circuits are grouped in a single conduit, the same shall be measured to the nearest switch box in the circuit irrespective of weather the neutral conductor is taken to the switch box or not.

iv) When circuit wires and wires of point wiring are run in the same conduit, circuit wiring shall be measured on linear basis depending on the actual number of sizes of wires run in the existing conduit.

v) Protective (loop earthing) conductors which are run along the circuit wiring and the sub-main wiring shall be measured on linear basis and paid for separately.

OUTLET BOXES

3.3 The switch box shall be made of metal on all side except on the front. In the case of cast iron boxes, wall thickness shall be at least 3mm and in case of welded mild steel / G.I. boxes the wall thickness shall not be less than 16 gauge for boxes up to a size of 20x30cm and above this size 14 gauge M.S. boxes shall be used. Clear depth of the box shall not be less than 50mm and this shall be increased suitable to accommodate mounting of fan regulators in flush pattern. All fitting shall be fitted in flush pattern. Outlet boxes shall be suitable for light & power accessories as specified elsewhere. Cost of outlet boxes, modular cover plates (for modular switches / sockets & MCB points) & phenolic laminated sheets (for piano type switch / sockets) shall deemed to be included in the rate of point wiring. In case of piano type switches 3mm thick phenolic laminated sheet shall be fixed on the front with brass screws.

6 & 16 Amp Switch Socket Outlet- modular range.

6.1 Switch socket outlet on lighting circuit shall be of 5 pin 6 Amp outlet and shall have safety shutters. The switch shall be of rocker mechanism type with silver safety contact. Switch and socket outlet shall be separate unit in modular range and shall be plate type and of white finish. Switch shall be indicator type.

6.2 Switch socket outlet on power circuit shall be of 6 pin 16/6Amp outlet and shall have safety shutters. The switch shall be of rocker mechanism type with silver contact. Switch and
socket outlet shall be separate unit in modular range and shall be plate type and of white finish. 16Amp switches shall be indicator type.

All switch for control of metal halide lights shall be MCBs of 6Amp unless otherwise stated. The MCBs shall be of rocker mechanism type. Light control MCBs shall be 6A rating, for control of upto eight points & 10A rating for more than eight points.

**Telephone Outlets:**

Each telephone outlet shall be provided RJ-11 type. The telephone outlet plate shall be in white finish.

**Industrial Type Sockets:**

Industrial type sockets shall be provided wherever specifically called for Industrial sockets shall be totally metal clad with porcelain base incorporating the pins. Socket shall have 3 pins for single phase applications and 4 pins and scraping earth for 3 phase applications. The sockets shall be provided with suitable metal clad plug top with suitable cable entry. Sockets shall have metal covers with chain. Industrial type sockets shall be provided with a suitable sheet steel housing made of 16 gauge with socket mounted in flush with cover of the housing.

For window type Air Conditioning units, water coolers, Hand dryers etc. 20 Amp 2 pin with earth metal clad socket outlet with plug shall be provided near the A.C. unit. Single pole miniature circuit breaker of suitable rating in M.S. box shall be provided separately to control the supply.

**Welding Socket Outlets**

The Panel of the Welding Socket shall be made of 2 mm thick CRCA sheet steel with the facility to house 63A, 415 V MCB with 35 kA rupturing capacity. The panel shall be suitable for indoor installation at Internal Protection of IP:54 with two coats of epoxy paints. The Panel shall be having the inlet and outlet for the cables. The panel shall be grouted with the existing slab with the help of suitable channel and angle for its firm standing.

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Signature of Tenderer(s)

Date:-
SECTION IV

LIGHT FIXTURES

(LIGHT FIXTURES & FANS)

Luminaire shall be supplied as per the design specified in the Schedule of Quantities. Luminaire shall be complete in all respects with basic mounting channel, lamp holders, starter with holder, copper / electronic ballast, connector block, internal wiring and decorative attachments, if any.

The light fixtures and fans shall be assembled and installed in position complete and ready for service in accordance with the detailed drawings, manufacturer’s instructions and to the satisfaction of the Engineer-In-Charge.

Light fixtures in general shall be recessed type in false ceiling or surface mounted on soffit of slab or wall with rawl plugs. Luminaire shall be installed as specified on the drawings. Wherever luminaries are fixed on the false ceiling, suitable supporting and fixing arrangements independent of the frame, work of false ceiling shall be provided.

Suspended type fluorescent light fixture shall be fixed to circular junction box with a metallic ball and socket arrangement and comprising of suspension pipes etc. for installing the luminaries.

Fixtures shall be suspended true to alignment plumb level and capable of resisting all lateral and vertical forces and shall be fixed as required. It is the duty of the Contractor to make these provisions at the appropriate stage & locations shown on the drawings.

All the materials used in the construction of luminaires shall be of such quality, design and construction that will provide adequate protection in normal use, against mechanical, electrical failure/faults and exposure to the risk of injury or electric shock & shall withstand the effect of exposure to atmosphere.

A suitable capacitor to improve the power factor of luminaire to at least 0.9 lag shall be provided. Capacitors shall be hermetically sealed.

Erection of fixtures shall include assembling of all components of the fixtures such as chokes, condensers, starters, ignitor, decorative attachments, etc.

Bulkhead fittings shall be of cast iron/cast aluminium body suitably painted white inside and grey outside complete with heat resistant glass cover, lamp holder and wire guard suitable for 100 watts incandescent lamp.

External and road light fittings shall be weather proof fittings of approved design so as to effectively prevent the admission of moisture. An insulating distance piece of moisture proof material shall be inserted between the lamp holder nipple and the fitting. Flexible cord conductors and cord grip lamp holders must not be used where exposed to weather.

1.2 LAMPS

1.2.1 Fluorescent lamps shall conform to IS in all respects. Fluorescent lamps shall be of bi-pin pattern. The colour of the light shall be white or cool day light, as required. Unless otherwise specified, the lamps shall be of 36 W or 18 W and 1200 / 600 mm long.

1.2.2 All fluorescent lamps shall be of at least 3250 lumens output for 36 W & 1300 lumens output for 18 W lamps.

Signature of tenderer(s)
LAMP HOLDERS, CEILING ROSES ETC.

Accessories for light outlets such as lamp holders, ceiling roses etc. shall be in conformity with requirements of relevant IS Specifications. Only approved make of accessories shall be supplied.

BALLASTS

All ballast in general shall be copper wound and shall be silent in operation. Ballast shall have a long life and shall be highly reliable.

For fluorescent lamp fixtures electronic ballasts shall be used unless otherwise stated.

Ballasts shall be suitable for 240V, 50 Hz AC supply.

CEILING FANS

Ceiling fans shall conform to IS: 374 (Latest Edition) all respects. Fan shall be smooth and silent in operation. The fan motor shall be a capacitor type motor with internal starter and external rotor pattern. The blades shall be made of aluminium sheets panted in off white shade. The design and construction of blades shall be such that maximum quantity of air is displaced in smooth manner. The motor and blades shall be statically and dynamically balanced. The fan shall be provided with double ball bearings which are accessible for lubrication. The ceiling fan shall be provided with rubber shackle and a down rod of at least 12" long. The suspension arrangement. Fans shall be provided with bottom cover and a top canopy. A regulator for 5 speed operation and stop shall be provided with every fan. Electronic step regulators shall be provided, if specified.

Ceiling fans shall be suspended from the special hooks or special fan hook boxes. Where hooks are used the wiring to the fan shall from the ceiling rose. Wherever special fan hook boxes are used, the fan wiring shall be terminated in porcelain/ PVC auto-way connectors. Lead-in wires shall have cross-section area of not less than 1.5 mm (copper).

All ceiling fans shall be installed at a height not less than 2.75 mtr above the floor level.

In rooms having fluorescent lamp lighting fixtures and ceiling fans, the fans shall be installed with their blades at least 100 mm above the lighting fixtures or else the distance between light fixture and fan shall be sufficient enough so that light is not obstructed by the movement of fan.

EXHAUST FANS

Propeller type exhaust fan shall conform to IS: 3212 (latest Edition) in all respects. The motor shall be of die-cast aluminium case. The fan motor shall be of squirrel cage induction design. Singly phase motors shall be capacitor-start and run type. Exhaust fans be provided with a special anti-corrosive treatment to withstand normal concentrations of chemical fumes in the environment.

The fans shall be designed to withstand the effects of moisture under normal conditions of use.

The design of motor and its windings shall be such that moisture in surroundings is not absorbed by the windings. Exhaust fans shall be complete with mounting rings, ring arms and realign suspension. The motor and blades shall be statically and dynamically balanced. The blades shall be of mild steel sheets and so designed that they operate smoothly with minimum noise. The fans shall be finished to be a glossy grade shade with approved enamel paint. The fans shall also be provided with gravity louvers for exhaust arrangement or bird screen for inlet arrangement.
Exhaust fans shall be fixed at the locations shown on the drawings. The fans shall be fixed by means of lug bolts grouted in wall. Exhaust fan be connected to the exhaust fan point by means of a flexible cord.

Signature of Tenderer(s)
Date:-

Page 234
SECTION-V

(EARTHING FOR ELECTRICAL WORK)

1.0 GENERAL

1.1 All non-current carrying metal parts of the electrical installation shall be earthed as per IS 3043. All metal conduit, trunkings, cable armour, switchgear, distribution boards, meters, light fixtures, fans and all other metal parts forming part of the work shall be bonded together and connected by two separate and distinct conductors to earth electrodes. Earthing shall also be in conformity with the provisions of Rules 32, 61, 62, 67 and 88 of IER 1956. These specifications apply to both copper and GI earthing systems. The material to be used shall be as per that given in BOQ.

2.0 EARTHING CONDUCTORS

2.1 All earthing conductors shall be of high conductivity copper or GI and shall be protected against mechanical damage and corrosion. The size of earth conductors shall not be less than half that of the largest current carrying conductor. The connection of earth continuity conductors to earth bus and earth electrodes shall be strong and sound and shall be easily accessible. The earth conductors shall be rigidly fixed to the walls / slab / floor, cable trenches, cable trays or conduit and cables, by using suitable clamps made of non-ferrous metal compatible with the earthing conductor.

2.2 The following earthing conductors are required to be used for various sections of the installation.

2.2.1 All fixtures - lighting, fan and switch enclosures, lighting conduits shall be earthed with 16 SWG bare copper wire or 10 sq.mm copper conductor, PVC insulated wires.

2.2.2 3rd pin of power socket outlets upto 20A shall be earthed with 14 SWG bare copper wire or 4.0 sq.mm copper conductor, PVC insulated wire.

2.2.3 All single phase switches and DBs above 20A and upto 30A rating shall be earthed with one run of 10 SWG bare copper wire or GI wire.

2.2.4 All single phase switches and DBs above 30A and upto 63A rating shall be earthed with one run of 8 SWG bare copper wire or GI wire.

2.2.5 All three phase switches / DBs upto 30A rating shall be earthed with 2 runs of 8 SWG bare copper wire / GI wire.

2.2.6 All three phase switches / DBs above 30A and upto 63A rating shall be earthed with 2 runs of 4 SWG copper wires / GI wires.

2.2.7 All three switches / DBs above 63A and upto 100A shall be earthed with 2 runs of 4 SWG copper wire / GI wire.

2.2.8 All three phase switches / DBs above 200A rating and above shall be earthed with 2 runs of 25 x 3mm copper tapes / GI tapes.

2.2.9 All motor frames shall be earthed by two earthing conductors of specified cross section.

Signature of tenderer(s)
Main earth bus shall be taken from the main medium voltage panel to the earth electrodes. The number of electrodes required shall be arrived at taking into consideration the anticipated fault on the medium voltage network and soil resistivity.

All the sub-mains and sub-circuits shall be provided with earth continuity conductors as specified and connected to the main earth bus. Earthing conductors for equipment shall be run from the exposed metal surface of the equipment and connected to a suitable point on the sub-main or main earthing bus. All switches shall be connected through double earthing conductor to the earth bus. Earthing conductors shall be terminated at the equipment using suitable lugs, bolts, washers and nuts.

All conduits, cable armouring, raceway, rising mains etc., shall be connected to the earth all along their run by earthing conductors of suitable cross sectional area, sprinkler pipes, LPG pipes, water pipes, steel structural elements, cable trays / racks, lighting conductors shall not be used as a means of earthing an installation. The electrical resistance of earthing conductors shall be low enough to permit the passage of fault current necessary to operate a fuse / protective device a circuit breaker and shall not exceed 2 ohms. As rough guide the following sizes of earthing continuity conductors shall be used for circuit wiring.

<table>
<thead>
<tr>
<th>Size of circuit wires/cables</th>
<th>Size of Copper or GI earth wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 2.5 sq.mm</td>
<td>16 SWG</td>
</tr>
<tr>
<td>b. 4 sq.mm</td>
<td>14 SWG</td>
</tr>
<tr>
<td>c. 6 sq.mm</td>
<td>12 SWG</td>
</tr>
<tr>
<td>d. 10 sq.mm / 16 sq.mm</td>
<td>8 SWG</td>
</tr>
<tr>
<td>e. 25 sq.mm / 35 sq.mm</td>
<td>6 SWG</td>
</tr>
</tbody>
</table>

All single phase wiring shall have one run of earth wire and three phases wiring shall be provided with two runs of earth wires.

LOGIC EARTHING

Separate Earthing pits with 600 x 600 x 3mm copper plate and 19/0.083 insulated copper cable shall be provided for grounding. From this point onwards insulated copper conductors of 1.5 sq.mm. PVC insulated wire shall be provided along-with the entire circuit. For single phase one earth pit should be provided and for 3 phase two earth pits shall be provided. All the joints in the earthing circuit shall be mechanical type with crimped joints. Power and data cable shall be run in separate conduits at a minimum distance of 300mm, however they may cross each other at right angles wherever necessary. Voltage between earth & neutral should be equal to or less than 3 Volts for logic earthing.

PLATE EARTH ELECTRODE

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

i. Copper Plate Electrode : 600mm x 600mm x 3mm

ii. GI Plate Electrode : 600mm x 600mm x 6mm thick.

The electrode shall be buried in ground with its faces vertical and not less than 3 meters below ground level. 20mm dia medium class GI pipe shall be provided on the top of this plate for watering and earth electrode. Earth electrode the auxiliary tunnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300mm deep. A cast iron or MS frame with hinged cover having latching arrangement shall be provided at top of the chamber. The earth electrodes shall be situated not less than 2 meters from the building. Care shall be taken that the excavation for earth electrode may not affect the column footing or foundation of the building. In such cases electrodes may be further away from the building. Distance between any two adjacent earth pits shall not be less than 6 mtrs.
(TESTING OF ELECTRICAL INSTALLATION)

Testing & installation shall be as per IS: 732-1963.

The insulation resistance measured as above shall not be less than 50 divided by the number of points on the circuits provided that the whole installation shall be required to have an insulation resistance greater than one meg-ohm.

Control rheostats, heating and power appliance and electrical signs may, if required, be disconnected from the circuit during the test, but in event the insulation resistance between the case or frame work and all live parts of each rheostat appliance and sign shall not be less than is specified in the relevant Indian Standard Specification or where there is no such specifications shall not be less than half meg-ohm.

The insulation resistance shall also be measured between all conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or the neutral or to the other pole or phase conductors of the supply and its value shall not be less than specified in sub-clause (1.2).

On completion of an electrical installation (or an extension to an installation) a certificate shall be furnished by the contractor or a site engineer signed by the supervisor under whose direct supervision the work has been carried out.

2.1 Testing of Earth Continuity Path

2.2 The earth continuity conductor including metal conduits and metallic enclosures or in all cases shall be tested for electric continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit breaker measured from the connection with the earth electrodes to any point in the earth continuity conductor in the complete installation shall not exceed one meg-ohm.

Before a completed installation or an extension to an existing installation is put into service it shall be tested as per IS: 732. The following tests shall be specifically carried out for all lighting installations:

2.3.1 Insulation Resistance

2.3.2 Testing of earth continuity path.

2.3.3 Testing of polarity of single pole switches.

3.1 Lighting circuits shall be tested in the following manner:

3.2 All switches 'on' and consuming devices in circuit, both polls connected together, to obtain resistance to earth.

3.3 Between polls with lamps and other consuming devices remove and switches 'on' and-

3.4 With lamps and other consuming devices in position but switches 'off'.

4.0 RESISTANCE TO EARTH

4.1 The resistance of earthing system shall not exceed one ohm.

5.0 ARTIFICIAL TREATMENT OF SOIL

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

Signature of Tenderer(s)
Date:

Signature of tenderer(s)
SECTION VII
(CABLES)

GENERAL

1.1 MV cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, specifications and relevant Indian Standards Specifications and cables manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drum.

1.2 The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

MATERIAL

2.1 The MV cables shall be XLPE insulated Aluminium conductor armoured cable conforming to IS:1554 - 1972 (Part-I) laid in trenches, ducts, cable trays or and underground as shown on drawings.

INSPECTION

3.1 All cables shall be inspected 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 utilisation and avoidance of jointing cables. This apportioning shall be got approved by the engineer-in-charge before the cables are cut to lengths. Straight joints shall be avoided and shall need prior approval of the engineer-in-charge in case the joints are unavoidable.

LAYING OF CABLES

5.1 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, & the drums shall be unrolled and cables run over wooden rollers in trenches at intervals not exceeding 2 meters. Cables shall be laid at a depth of 0.75 meters below ground level. A cushion of sand, not less than 80 mm shall be provided both above and below the cable and joint boxes and other accessories. Cables shall not be laid in the same trench or along side a water main. The cable shall first be laid in excavated trench 80 mm layer of sand and shall be spread over the cable. The cable then shall be lifted and placed over the sand bed. The second layer of 80 mm sand shall then be sprayed over the cable. The relative position of the cables, laid in the same trench shall be reserved and the cables shall not cross each other as far as possible. At all changes in directions in horizontal and vertical planes, the cable shall be bent smooth with a radius of bend not less than 8 times the diameter of cable. Minimum 3 meters long loop shall be provided at both sides of every straight joint and 3 meters at each end of cable. Distinguishing marks shall be made on the cable ends for identification. Insulation tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identification.

PROTECTION OF CABLES

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

EXCAVATION & BACK FILL

1. All excavation and back fill including timbering, shoring and pumping required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceed 150 mm. Each layer shall be properly rammed and consolidated before laying the next layer. The Contractor shall restore all surface, road ways, side walks, curbs, walls / slab / floor or other works cut by excavation to their original condition satisfactory to the Engineer-in-charge.

2. On completion of cable laying work, the following test shall be conducted in the presence of the Engineer-in-charge:

TESTING OF CABLES

1. Prior to burying of cables, following tests shall be carried out:

1.1 Insulation test between phases and phase and earth for each length of cable before and after jointing.

1.2 Insulation Resistance Test (Sectional and overall)

1.3 Continuity Resistance Test.

1.4 Sheathing Continuity Test.

1.5 Earth Test.

3. All tests shall be carried out in accordance with relevant Indian Standard Code of Practice and Indian Electricity Rules. The Contractor shall provide necessary instruments, equipment and labour, for conducting the above test and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the engineer-in-charge.

Signature of Tenderer(s)
Date:-
SECTION- VIII

(CABLE TERMINATION)

All cables that will be laid by the contractor shall be connected at both ends to switchgear, panels, equipment, local push buttons, instruments or junction/marshalling boxes terminals as the case may be.

The scope of termination at each end shall include dressing and connection of all the cores of the cables. The following shall be included in the scope of work:

1. Making the requisite holes in the bottom/gland plate of the switchgear for cable boxes/glands.
2. Fixing the cable boxes/glands, terminating the cables in the cable boxes/glands.
3. Earthing the cable armour, crimping the cable lugs on each core (for PILC cables, the bare conductor from cable box shall be taped up to the lug).
4. Neatly clamping the cables inside switchgear/panels’ cable alleys, wiring though and connecting to correct terminals as per the wiring diagrams and cable schedules. The cable and core identifying lugs and ferrules respectively shall be supplied and installed by the CONTRACTOR as part of cable termination work.

All cable terminations shall be solderless crimping type. Proper crimping tools of Dowell or equivalent make shall be used by the CONTRACTOR. The crimping tools used shall be subject to the Site Engineer’s approval.

Signature of Tenderer(s)

Date:-
SECTION IX
(CABLE TRAYS)

Cable trays of ladder and perforated types and the associated accessories such as jointing plates, tees, elbows etc. Shall be fabricated from 2 mm thick galvanised steel sheets, cable tray covers.

If required shall be fabricated from 16 gauge (1.70 mm thick) G.S. sheets.

The cable trays to be supplied standard lengths of 2500 mm and clear inside widths of trays shall be as follows:

a) perforated type trays: 150,200,300,450,600 & 900 mm
b) ladder type trays: 300,450,600,750 & 900 mm

MS Cable trays, accessories and covers shall be mounted with one coat of red oxide zinc chromate primer and two coats of aluminium above paint for indoor use. GS cable trays do not need such treatment unless otherwise called for.

For outdoor use cable trays, accessories and covers shall be either galvanised or made of aluminum as specifically mention in the lay out drawings.

For use in corrosive atmosphere both indoors and outdoors the cable trays, accessories & covers shall be as per note no. 4 above.

The spacing of rungs for ladder type of trays to be 250 mm unless otherwise noted.

All finished cable trays and accessories shall be free from sharp edges and corners, burs and unevenness.

The details of accessories etc. Shown are typical and do not cover the entire range of the same. Fabrication of accessories not covered here shall be done with the help of relevant shop drawings.

INSTALLATION OF CABLE TRAYS

Cable trays shall be installed generally at the elevations shown in respective cable tray layout drawings, if any major modifications in the dwgs are envisaged in the field these should be carried out after getting approval from the consultant. It shall be the responsibility of the electrical contractor to mark up all the field modifications on the latest issues of the dwgs & return two copies of all such as constructed drawings to consultant for updating the relevant tracing/drawings.

Unless otherwise specifically mentioned, all cable tray mounting works shall be carried out as per dwgs.

When cable trays are used in trenches and tunnels, the carrier structure for mounting the trays shall be supplied and installed as per drawings.

The type and size of tray to be used will be as mentioned in the individual layout drawings.

The maximum size of cable tray when used in trenches and tunnels shall be of 600 mm width.

Cable trays shall be bolted to the mounting/carriers structures.

Vertical trays (raceways) and all outdoor cable trays shall be provided with removable 16 gauge painted G.S. sheet covers.

Each continuous laid out length of cable tray shall be earthed at minimum two places by GI flats of minimum size 25x3 m (unless otherwise noted) to the earthing system. The distance between earthing points shall not exceed 10 meters.

The support structure for the erection of cable tray shall be of Galvanised Steel.

Signature of Tenderer(s)
Date:-

Page 241
SECTION-X
(HIGH MAST SPECIFICATION)

SCOPE:
Supply, installation, testing and commissioning of 30.0M Extra Heavy Duty high mast with lowering latern carriage, accessories, luminaries and electrical tool etc. Mast shall be suitable for mounting of up to 18 nos. of 2x400W HPSV flood light luminaries.

CODES & STANDARDS
The masts shall be made with best grade steel in compliance with international/Indian standards having following guaranteed characteristics:

- Minimum yield strength: 355N/sqmm for thickness < 30mm
- Tensile strength ranging from 490 to 630N/sqmm
- Minimum elongation for thickness between 3mm and 30mm: 22%

MAST STRUCTURE
The high mast shall be of continuously tapered, polygonal cross section polygon type (20 sided) of 30 mtrs. In height presenting good visual appearance and shall be based on proven designs to give assured performance, reliability and service. The Mast shall have minimum top diameter appropriate to the selected design of mast for the required rating and bottom diameter of minimum 600 mm. The weight of the Mast shall be such to maintain good elasticity of slender structure. The minimum thickness of the bottom section shall be 6 mm, middle section shall be 5 mm and that of the top section will be 4 mm.

MAST CONSTRUCTION
The Mast shall be fabricated from special steel plates, conforming to IS: 4360, cut and folded to form polygonal section and shall be telescopically painted and fillet welded. The welding shall be in accordance with IS: 5135 the procedural weld geometry and the workmanship shall be exhaustive, tested by the radiography on the completed welds and certificates submitted.

The Mast shall be delivered in only 3 sections at site, which shall be with stressing equipment thus forming the sleeve joint. No site welding or bolted joint will be accepted. The overlap distance shall have full penetration of longitudinal welds, a door opening of 1400mm x 300mm shall be provided at the base of each Mast. The opening shall be such as to permit clear access to equipment like winches, cable, plug, and socket, etc., the opening shall be complete with a close setting vendor resistant, weather-proof door provided with heavy duty double internal lock.

The door opening shall be carefully designed and reinforced with welded steel section, such that the Mast section at the base is unaffected and undue buckling of cut portion is prevented (calculation shall be submitted). The Mast shall be provided with full-operated flange, which shall be free from any lamination or incursions. The welded connection of the base flange shall be fully developed to the strength of the entire section. The base flange shall be provided with supplementary gaskets between the bolt holes to ensure elimination of helical stress concentration for metal protection of the Mast. the entire fabricated Mast shall be hot dip galvanized internally and externally as per BS 729/1971-1986. Thickness of galvanizing shall be 85 microns for base, 65 microns for middle and top section. Welding done on the mast shall have full penetration between plates of all thickness and there should be no fissure, blow holes, porosity, undereutting or detectable angular inclusions.

Signature of Tenderer(s)
ANAMIC LOADING

The Mast structure shall be designed for an assumed maximum reaction arising from the maximum speed (3 second gust), likely to be exceeded only once in 50 Years and measured at a height of 10 metres above ground level. The design life of the Mast shall be 25 years. Wind excited vibration shall be damped by the method of construction and adequate allowance made for the related stresses. The offered high mast shall be rigorously tested under "Wind Tunnel Testing" to ensure safety of the structure after arising of the value of logarithmic decrements and the oscillation and natural frequency based on which dynamic loading on the high mast shall be calculated. The calculation method, the factors taken and norms applied shall be furnished along with the offer.

FOUNDATION

The tenderer shall see the site closely and minutely with regard to the nature of the soil, average depth of decomposed garbage and debris at proposed Mast location and the other site conditions, before working out the type of foundation and specification for the proposed High Mast. The contractor shall carry out the load bearing capacity test of the spoil at all locations of masts.

The tenderer shall be responsible for the design of the foundation and safe erection and installation of the High Mast in mechanically and structurally safe working condition for the design life of the Mast. The holding down of bolts shall be of high tensile strength, and shall be supplied complete with anchor plate of 4 mm thick for casting into the foundation. The precision made steel template with tube holes shall be provided to ensure correct vertically and horizontally alignment of bolt alignment. The tenderer shall furnish the details of the type of foundation along with the offer.

LANTERN CARRIAGE

The fabricated lantern carriage shall be provided for holding the floodlight fitting and control gear provided on each high mast. The lantern carriage shall be of special design and of durable steel tube construction design to act as electric conduit with cable hole fully protected by grimmets. The lantern carriage shall be so designed and fabricated to hold designed number of floodlight fittings, as specified in the tender design along with the control gear boxes and lanterns. It shall be fitted with cast aluminum (IP-54) junction box and mounting plates. The lantern carriage shall be fabricated in 2/3 halves, joined by bolted flanges with S.N. Bolts with plastic nuts to enable easy removal from the erected mast for replacement/maintenance purpose. The lantern carriage assembly shall not touch the lower surface of the Mast. The carriage design and fabrication shall be such that the lantern carriage will suit the lantern and their control gearbox to be used in the work. Lantern Carriage should be made of Square tube of 4mm thickness only.

The lantern carriage shall be so designed that it does not cause any damage to the surface of the Mast and is provided with protective buffer arrangement. The complete lantern carriage shall be hot dip galvanized after fabrication.

The weather proof cast aluminum junction boxes (IP-54) shall be provided on the lantern carriage assembly from which the interconnection will be made to the designed number of floodlights fittings and lanterns on the carriage.

MECHANICAL ARRANGEMENT

Signature of tenderer(s)
For installation and maintenance purpose, it will become necessary to raise or lower the lantern carriage assembly. To enable this, a suitable winch arrangement shall be provided in the base of the mast, complete with top pulley, winch stainless steel wire ropes of adequate strength (supporting calculation to be furnished) and winch driving power tools.

**WINCH**

The winch shall be of completely self-sustaining type without the need for breakers, springs, springs or clutches, so as to eliminate any requirement of adjustment of possibility of being effected by moisture or lubricant. The gear ratio shall be of the order of 5:3. The winches shall be of self-lubricating type by means of an oil bath and the lubrication shall be recommended quality.

Termination of the ropes of the winch shall be in such a way, that it does not involve distortion or twisting of the rope configuration. At least, 6 turns of rope shall remain in tension on the drum even when the lantern carriage is fully lowered. The winch shall be designed to be installed or removed from the door to ensure mechanically strong, stable and tidy respectively with no chances of rope slipage. Each rope shall be laid directly from the lantern carriage assembly to the winch drum and shall include intermediate connection. The driving spindle of the winch shall be positively locked when not in use by gravity activated pawls. Winch should be double drum & both drums should move together. Separate movement of drums should not be providing to keep the lantern carriage balanced. Each winch shall be provided with a galvanized water proof canopy. The capacity, operating speed and dimensions of the drum length and the recommended lubrication shall be clearly marked on each winch with an indelible ink. The winch shall be capable of operation by hand or by means of external power tool. A test certificate shall be supplied along with each winch in support of the maximum load operated by the winch and for the safety of the operation at the full load rotation. The handle shall also be provided for hand operation of the winches. The readily adjustable and local torque limit mechanism shall also be provided in manual handle. Torque limit shall be precision made, finally adjustable and working on a system of balls and springs and shall be of standard model.

**TOP PULLEY ASSEMBLY**

The top pulley shall be of diameter, appropriately larger enough to accommodate the steel wire ropes and the multicore electric cable. The material of construction of the pulley blocks shall be non-corrosive and made of die cast (LM 6) aluminum alloy. The Pulley Assembly shall be complete with self-lubricating bearings and stainless steel spindle. There should be 8 nos. pulleys two for each steel wire & electric cable.

Suitable arrangement shall be made in pulleys, such that the electric cable and steel wire ropes are separated before passing over their respective pulleys. Close fitting guides shall be provided to ensure that the ropes and cables do not leave their respective positions on the pulley grooves. The pulley shall be housed in a chassis, which has integral sleeves arrangement that slip over the top of the mast. The sleeve pulley arrangement is secured axially and azimuth guides and stops shall be provided for locking the lantern carriage. For 1 point carriage an anchor point shall be securely welded to the assembly to receive the safety maintenance equipment and live load of about 250 kgs. The pulley assembly shall be protected by galvanized canopy. The external divider as stated above, shall be provided on the pulleys to separate the stainless steel wire ropes and cables, so that chances of wrapping together of the ropes and the cable in windy condition or when the lanterns are in the lowered position can be prevented.

**STAINLESS STEEL WIRE ROPE**

Stainless steel wire ropes shall be of 7x19 construction of 8 mm diameter, having a breaking load of not less than 2634 kgs complete with stainless steel thimbles. The end for connection to the winch drum shall be fitted with copper end stop and the thimble shall be secured by copper compression splices.

[Signature of tenderer(s)]
ABLE AND CABLE CONNECTION

The connection shall be made with single 4.0 Sq.mm CU wire flexible anti-twisting flat sheath power cables of appropriate rating as per the requirement with respect to the number of fixtures. The base compartment of the High Mast shall have one terminal box for terminating the incoming cable. The maintenance cable equal to that within the Mast and fitted with multiple water proof plug socket shall be provided to energize lanterns while in lowering position by hooking up at the base compartment socket power supply.

Similarly, the provision shall be made for electric supply at the base compartment to enable operation of the external power tool for lowering or raising of the lantern carriage assembly. The trailing cables of the lantern carriage rings shall be terminated by means of metal capped plug and socket provided in the base compartment to enable flexibility.

WINCH DRIVING POWER TOOL

The external electric driven power tool shall be single speed, (2.0 Mt./min) three phase, 415V, 50Hz, class B insulation, IP-55 protection, hand-operated motor. The power tool shall be complete with very robust remote control. Switch such that the tool can be operated from safe distance of 5 mtrs. There shall be an arrangement for self-alignment of power tool which can be self-supported during operation. Manual Handle shall be provided for hand operation of the winches and shall incorporate the torque limiter. The tenderers shall specify the capacity rating and speed of the electric motor used in the power tool.

BUILT CONTROL PANEL

Control panel shall be equipped for termination of incoming three phase power cable, outgoings MCBs (10kA) for the fixtures for selective switching if required, multi core CU conductor PVC cable and separate cable for power tool operation, emergency stop button, electronic torque control for safety against overloading or overheating of the hoist motor.

FARTHING TERMINAL

Earthing terminal of 12 mm diameter with stainless steel shall be provided on the Mast structure and connected within the base compartment to provide lighting and cable earthing point.

The entire high mast accessories shall be as per relevant BS standard and test certificates shall be provided in proof of the same.

TEST CERTIFICATE

Following test certificates shall be produced by the manufacturer.

1. Dynamic loading Test Certificate
2. Zinc coating Certificate
3. Winch Load taking Capacity Certificate
4. Electric Motor test certificate
5. Structural Stability of Mast
6. Welding Test certificates as per IS 729/ BS

Note: The bidder shall have to produce the design calculation for Lighting System based on the latest software available for approval.

[Signature of tenderer(s)]

Date:
 SECTION-XI

(STEEL TUBULAR POLES/AREA LIGHTING SCHEME)

The steel tubular pole shall conform to IS-2913 with latest amendment up to date. The weight of the
dividual section and its length shall be as per IS. The overhang portion of the pole shall be
cluding the total length as designated in IS. The Pole shall be fitted with Base Plate of
300x300mmx 6 mm thick MS Plate welded to the bottom of the pole. The foundation of the pole
shall be 1/6th. Height of the pole. The Pole junction box shall be fitted with at a height of 480 mm
from Existing Ground Level. The Junction box shall contain fuse link with fuse base along with earth
bus bar for loop in loop out of the cable for the next fitting. The foundation of the Pole shall be
casted in 1:2:4 of the cement concrete. While casting, a 40 mm dia. PVC Pipe shall be embedded to
facilitate the inlet and outlet of the cable.

The basic lighting scheme of the work is to connect 5 Poles in a single ckt. And adopt a single phase
power supply to its reliability. The wiring from pole to fitting shall be in such a way that in the event
of light fixture being fused, the other lamps in ckt. will not hamper.

FEEDER PILLAR

The Feeder Pillar shall be suitable Out door installation as per IP-56 made out of 2 mm thick CRCA
sheet steel. The Feeder Pillar shall be painted with 2 coats of epoxy paints with canopy on the top to
prevent the ingress of moisture in the panel. The panel shall be suitable for 3 Phase 415 V, 50 Hz
power supply. The panel shall consists of Ammeter, Voltmeter etc. in the slot meant for. The panel
shall be grounded to the ground with the help of base channel on 1:2:4 cement concrete foundation.

Signature of Tenderer(s)
Date:-

Signature of tenderer(s)