



diameter of the aluminium wire will be as per the table for the dimensions of the galvanized steel wire armour given in the relevant standard.

4.6 Outer sheath

FRLS extruded black PVC serving as per IS: 1554 otherwise will be applied over the armouring with suitable additives to prevent attack by rodent and termites. All serving must be given anti-termite treatment.

4.7 Packing

- Cables will be supplied in non-returnable drums. Drum lengths will be such so that cable joints are totally avoided. The drums will be of heavy construction. All wooden parts will be manufactured from seasoned wood. All ferrous parts used will be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drum will be treated by immersing in copper-nitrate solution.
- The ends of each cable length will be sealed before shipment. Heat shrinkable cable cap will be used for this purpose.
- A label will be securely attached to each end of the reel indicating the Purchaser's order number, Owner's identification mark i.e. "NNTPS ", length, type, voltage grade, conductor size and number of cores of the cable. A tag containing the same information will be attached to the leadings end of the cable inside. An arrow and necessary instructions will be marked on the drum indicating the direction in which it should be rolled. Drum numbers are to be indicated on the cable drums.

4.8 Spare Core

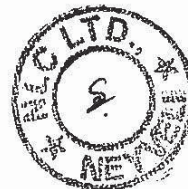
Multi-core control cables will have 20% spare core, minimum one spare.

Separate cables for each type of following services / functions as applicable will be used for each feeder. Same multi-core cable using different services will not be acceptable.

- a) Power.
- b) Control, interlock and indication.
- c) Metering and measuring.
- d) Alarm and annunciation.
- e) C.T. Cables.
- f) V.T. Cables.

4.9 Constructional Requirements

- a) Cable will have suitable filters laid up with the conductors to provide a substantially circular cross section before the sheath is applied. Fillers will be suitable for the operating temperature of the cable and compatible with the insulating material. All materials will be new, unused and of finest quality.
- b) Workmanship will be neat, clean and of the highest grade.
- c) LT Power cables will be 1.1kV grade, heavy duty, stranded aluminium conductor, XLPE Insulated galvanized steel wire/strip armoured, flame retardant low smoke (FRLS) extruded PVC type outer sheathed.





- d) Control cables will be 1.1kV grade, heavy duty, stranded copper conductor, PVC Type-A insulated, galvanized steel wire armoured, flame retardent low smoke (FRLS) extruded PVC of Type - ST1 outer sheathed.
- e) Special Properties:
All the above cables will be conforming to the relevant Indian/IEC standard in general, with the following special properties:
- Oxygen Index of the outer sheath will not be less than 29, when tested as per ASTM-D-2863.
 - Temperature Index of the outer sheath will not be less than 250 C, when tested as per ASTM-D-2863.
 - Halogen acid contents in outer sheath will not be more than 20%, when tested as per IEC-60754.
 - The maximum smoke density in percent light absorption should not exceed 60% in case of PVC compound and 20% in case of fire survival cables, when tested as per ASTM-D-2843.
 - Swedish chimney test as per SS-4241475 class F3 and ladder test for flammability as per IEEE-383.

4.10 Joints and Terminations

Materials of construction for a joint/termination will perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts will incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations will have the same qualities as that of the cable outer sheath in terms of ambient/operating temperature withstand capability and resistance to hazardous environments and corrosive elements. No joints will be allowed unless the cable drawn length is exceeded.

4.11 Cable Identification

Cable identification will be provided by embossing the following on the outer sheath:

- Manufacturer's name or trade mark
- Voltage grade
- Year of manufacture
- Type of insulation.
- Type of outer sheath e.g. "FRLS" etc.
- ISI marks
- Nominal cross sectional area of the conductor & no of cores
- Sequential marking
- Owner's identification mark "NNTPS"





5 TESTS

5.1 Type Test

Cables will be type tested quality. For each type and rating of cables reports on all type tests as per relevant standards, and carried out with in last five years from the date of bid opening will be submitted.

These reports will be for the tests conducted on the similar type of cables proposed to be supplied under this contract. These tests should have been conducted at an independent laboratory. If type test certificate are not available the same will be conducted in the presence of the purchaser.

5.2 Shop Tests

The Cables will be tested in accordance with relevant IS/IEC standards at manufacturers' works in the presence of consultant /purchaser or his representative as given below:

- Routine tests on each drum of cables.
- Acceptance tests on drums chosen at random for acceptance of the lot will be conducted in the presence of Consultant / purchaser or his representative.

5.3 Additional Tests

Following additional acceptance tests will also be performed on each type of cables having outer sheath with improved fire performance (Category C1, Type FR/ Category C2, Type FRLS):

- a) Oxygen index test (for both C1 & C2) – The oxygen index test will be carried out as per ASTM D2863. The Oxygen index will not be less than 29. All the additional tests will be conducted in the presence of the purchaser.
- b) Temperature Index Test (for both C1 & C2) - The measured value of temperature index will be 21 at a temperature of 250°C.
- c) Flame retardance test on single cable and on bunched cables (for both C1 & C2) - After the test, there should be no visible damages on the test specimen within 300mm from its upper end. After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the bottom edge of the burner, measured at the front and rear of the cable assembly.
- d) Halogen acid gas evolution test (for category C2) – This test will be as per IEC-754-1. The level of HCL evolved will not exceed 20 per cent by weight.
- e) Smoke density test (for category C2) – Smoke generation by outer sheath under fire as per ASTM D 2843. The cables will meet the requirements of light transmission of minimum 40% after the test.
- f) Test for rodent & termite repulsion property.





6 FIRE PROOF SEALING SYSTEM

Fire proof sealing system will consist of Fire-stops/fire-seals for sealing of cable/cable tray and conduit/pipe penetrations, both horizontal and vertical, through brick or RCC walls/floors, to prevent the spread of fire from one area, which is separated from others by fire-resistant barriers.

'Fire-breaks' provided on long runs of cable racks/trays to prevent the propagation of fire along the cable rack, within a single fire-area or fire-zone.

The FPS system will also include all the necessary accessories and equipment required for supporting, holding in position, fixing and installation of the fire-stop/fire-break.

The FPS system will comply in all respects with the requirements of the codes and standards listed below

IEEE-634 ASTM-E-814

ANSI-IEEE-383 IEC-331 IEC-332

Fire stop/ seal

The FPS system adopted for cables or cable trays penetrating through walls and floor constitute a openings, or cables passing through embedded conduits / pipes / pipe-sleeves, fire stop / seal', which is meant to prevent spreading of fire between areas separated by fire-resistant barriers.

Fire Break

The fire proofing system, other than fire-stops, adopted to retard flame propagation long runs of horizontal or vertical cable trays in the same fire zone or area, in an event of a fire, will constitute a 'fire-break' and will be provided by applying a suitable fire-resistance coating on cables and cable trays for the required length, with or without a fire resistant panel, at the point of the fire break to obtain the fire-rating specified.

Application of fire proof sealing system

Fire stops will be provided for cable penetration openings listed below

The passage of cables/cable trays pipe sleeves/embedded conduits through walls / floors.

Vertical raceways, which carry cables between successive floors, through openings provided in the RCC floor slab, will be sealed by fire stops at each floor level.

Cable entry through openings in floor slabs below HT/LT switchgear, MCCs, various Control and relay panels and other bottom entry panels, will be effectively sealed by fire stop

Location of fire breaks

Firebreaks will be provided on both cable rack and trenches at all cable tray intersections and tee-offs.

On linear runs of cable trays between fire stops or fire breaks, fire breaks will be provided at intervals of 15 metres on horizontal cable runs and 5 m on vertical cable runs.





Fire breaks in linear runs of cable trenches between intersections and tee-offs will be provided at intervals of 30 metres.

Contractor will furnish the test certificates for the fire stops and fire breaks after award of contract for Owner/Owner's Representative review. If the certificates are not satisfactory all the tests will be conducted free of cost. The offered system i.e. fire stops and fire breaks will be identical (or better) with the system which is successfully type tested for the specified rating i.e. the composition density of the material, thickness of coating in case of fire breaks and any other properties of the material / system offered will be identical or better than the tested system and will be subject to Owner / Owner's Representative.

Test on fire stops

The fire stops will be subjected to the following type tests:

Fire Rating Test

Hose Stream Test

Type tests will be conducted on different fire stop test specimens described above as per IEEE-634. The sizes of the fire stop test specimens, will be similar to the largest of the sizes being used in the plant.

Preconditioning of fire stop test specimens before conducting the fire rating and hose stream tests, each test specimen will be preconditioned for thermal ageing, water immersion and vibration.

Test on Fire Stops

During the fire rating test, the transmission of heat through the cable penetration fire stop will not raise the temperature on its unexposed surface above the self ignition temperature of the outer cable covering, the cable penetration fire stop material, or material in contact with the cable penetration fire stop, with a maximum temperature limit on the unexposed surface of 200oC.

Tests on fire breaks

Firebreaks will undergo the following tests as per ANSI-IEEE-383:

Ampacity test

Flame test

7 DRAWINGS, DATA AND MANUALS TO BE FURNISHED FOR APPROVAL

- Cable datasheets
- Cable sizing
- QAPs & Test Reports
- Relevant catalogues





8 RATINGS AND REQUIREMENTS

8.1 L.V. Power cables 1100 V grade

1100 V grade, power cable conforming to following requirement and in line with IS-1554, IS-5831, IS-8130 & IS-3975.

Conductor : Stranded and compacted plain aluminium of grade H2 and class 2/stranded, high conductivity annealed plain copper as per Annexure, generally conforming to IS:8130

Insulation : Extruded cross linked polyethylene (XLPE).

Inner Sheath : Extruded FRLS PVC compound conforming to type ST2 of IS:5831 for multicore cable.

Armour : Galvanised single round/ strip steel wire armour for twin and multicore cables.

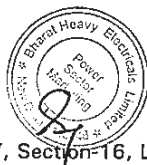
Non-magnetic hard drawn aluminium single round wire conforming to H4 grade for single core cables.

Overall Sheath : Extruded FRLS PVC compound conforming to type ST2 of IS:5831.

8.2 Control Cables 1100 V Grade

1100 V grade, 700 C rating, PVC Control cable conforming to following requirement and in line with IS-1554, IS-8130, IS-5831 & IS-3975.

Conductor : Stranded, non-compacted & circular, high conductivity annealed plain copper,





generally conforming to IS:8130.

Insulation	:	Extruded PVC compound conforming to type A of IS:5831.
Inner sheath	:	Extruded FRLS PVC compound conforming to type ST1 of IS:5831 for multicore cables. Single core cables will have no inner sheath
Armour	:	Galvanised single round steel wire for twin and multicore cables.
Overall sheath	:	Extruded FRLS PVC compound conforming to type ST1 of IS:5831

8.3 Trailing Cables (Power & Control)

Trailing cable, 1.1kV grade with highly flexible stranded tinned copper conductor, insulation of EPR (Ethylene-propylene Rubber) each individual core protected and covered and overall outer cover of poly-chloroprene rubber cable will conform to IS 9968 part-1.





VOLUME- IV
SECTION-17,
ILLUMINATION



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1. GENERAL

This specification is intended to cover the design, engineering, manufacture, assembly, testing at manufacturer's works, supply & delivery, properly packed for transport to site of Illumination System complete with luminaires and all accessories for efficient and trouble-free operation of 2 x 500 MW Neyveli New Thermal Power Plant at Neyveli, Tamilnadu for Neyveli Lignite Corporation Limited.

2. CODES AND STANDARDS

All equipment and materials will be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification.

IS 3646 (Part I to III)	:	Code of Practice For Interior Illumination
CBIP Manual	:	Substation Equipment, Illumination and Layouts
IES (Illuminating Engineering Society of North America)	:	Application and Reference Volume
IEC 60598	:	Luminaires
IEC 60081	:	Double Capped Fluorescent Lamps
IEC 60920 & 60921	:	Ballast for Tubular Fluorescent Lamps
IEC 60400	:	Lampholder for Tubular Fluorescent Lamps & Starter Holder
IEC 60064	:	Tungsten Filament Lamp for Domestic And Similar General Purpose
IEC 60188	:	High Pressure Mercury Vapor Lamps





Indian Electricity Rule (IE) 1956 as amended up to date.

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted subject to approval of the Owner. In such case, copies of the English version of the standards adopted will have to be submitted along with the bid.

The electrical installation will meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Codes of Practice. In addition, other rules and regulations applicable to the work will be followed.

Areas to be covered in TG package are entire Power House Building including BMCC room, Transformer Yard, Adjoining roads, DG Plant Building, Service Building, ACW Pump House, Switchgear/MCC rooms, piping gallery, CPU Regeneration plant, cable gallery, all roads within battery limit and area illumination of the above premises.

Any other area/premises not specifically mentioned here, but which fall under the battery limit of this package are included in the scope.

The following equipment and materials are broadly covered under this scope.

Lighting Transformers, Main lighting boards, Emergency lighting boards, Emergency DC lighting panels, Lighting panels/boards, Street lighting panels etc.

Lighting fixtures with lamps and accessories.

Street light poles and High Mast towers.

Ceiling fans, receptacles, switches, switchboards, portable emergency lights, portable 24V supply module including handset maintenance equipment and required extension cable etc.

Cable trays and supporting structures

Cables, wires, splicing/termination/connection accessories.

Conduit and accessories, junction and pull boxes, terminal blocks.

Grounding materials and connections.

All fittings, supports, brackets, anchors, clamps and connections.

Steel for field fabrication of supports and brackets

Welding sockets with Welding DB

3. DESIGN CRITERIA

The illumination system will provide lighting supply to all plant areas. In addition, it will also provide emergency lighting to selected areas during plant emergency conditions, as described below.

The entire illumination system will be installed in an adverse industrial environment. Fixtures / Accessories in some areas will be subject to vibration, coal dust, oil/water vapors as prevalent in a Thermal Power Plant.

The design will be such so to ensure the minimum lighting levels as specified for different areas.

The illumination system will comprise of following sub-systems:



Normal A.C. Lighting

This will be provided by A.C. lighting fixtures distributed throughout the plant. These lights will be ON as long as the station A.C. supply is available. A.C. lighting fixtures will be fed from respective area A.C. Lighting Panels, which in turn will be connected to Main Lighting Distribution Boards (MLDB). The Main Lighting Distribution Boards will be fed from through 415V/433V Lighting transformers.

In CPU regeneration Plant area, MLDB will be fed from respective LT switchgear/MCC.

Emergency A. C. Lighting

On failure of normal AC supply, emergency AC lighting will be provided in selected areas of the Powerhouse, TG area and some other areas close to the powerhouse for general visibility, safe movements & operation of major equipment and auxiliaries. Emergency AC lighting fixtures will be fed from respective Emergency AC Lighting Panels. These panels will be fed from the Emergency AC Lighting Distribution Board (ELDB). The Emergency Lighting Distribution Board (ELDB) will be fed from 415V Emergency switchgear having D.G system backup through 415V/433V lighting transformers.

20% of the total fittings will be fed from Emergency lighting for areas such as TG Area, control rooms etc. AC emergency lights will operate during normal conditions also.

Two nos 415 V feeders will be made available from the 415 V Emergency (N/E) switchgear.

Emergency D.C. Lighting

The Emergency DC Lighting System will be located strategically in critical operating areas and at emergency exits. Emergency DC lighting will also be provided in the Control rooms, Switchgear/ MCC rooms and other strategically important areas. These fixtures will be fed from respective Emergency DC Lighting Panels. The Emergency DC Lighting Boards (DCELDB) will be fed from 220V DC Distribution Boards (DCDB). 10% of the total fittings will be fed from Emergency D.C. Lighting, for areas such as TG area, area and Control rooms etc.

These lights will remain normally OFF but on failure of AC supply these lights will be automatically ON. Tube lights with Electronic choke suitable for 230 V, AC / DC operation or other Energy Efficient Lamps may be used for DC emergency lighting.

24 V Maintenance Sockets with necessary step-down Transformer will be provided at Strategic locations such as TG Hall areas and Switchgear rooms etc.,

Emergency Lighting with self contained batteries

This system will be provided by portable self-contained battery / automatic charger / inverter fed compact fluorescent lamps in isolated buildings / areas where station D.C. supply is not available. These portable emergency light units will be switched on automatically on loss of normal AC supply. Battery packs for portable emergency lights will be rated for minimum two and half hour duty.



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Watch Tower / Street Lighting /Area Lighting

Time-switch with inbuilt battery backup and/or photocell will be used for controlling street lights/area lights with provision for manual over-ride.

Illumination Calculation

Standard Lumen method will be adopted for interior and exterior lighting in order to determine the number of lighting fixtures for obtaining the desired average level of illumination.

The coefficient of utilization will be considered to take care of Lumen loss due to:

- a) Effect of room dimensions.
- b) Absorption of light in luminaries.
- c) Absorption of light at various room surfaces i.e. ceiling wall etc.
- d) Floor cavity, ceiling cavity.
- e) Mounting height.

Moreover a maintenance factor will also be considered to account for the fall of illumination due to aging, pollution like dust deposits etc.

Voltage drop at the fixture terminals from the MLDB bus will not exceed 3%. Circuit loading of each lighting Panel will be done in such a way that almost balanced loading in all the phases i.e. R, Y and B is achieved. At least two sub circuits will be used for illumination of a particular area. Sub circuit loading of each lighting panel will be restricted to 2000 Watts.

Design of lighting system will be such that the average lux level specified is achieved. These lights will remain normally off, but on failure of AC supply these lights will be automatically on. Maintenance light (24 Volt) would be used for maintenance purpose.

Hand lamps

10 nos. 24 V halogen lamps with reflector along with 1100 V, twin core PVC sheathed, 2.5 mm² stranded copper wire of 20 m lengths as handset will be supplied loose.

ILLUMINATION LEVELS AND CHOICE OF LIGHTING FIXTURES

The area-wise average illumination levels and type of luminaries will be as indicated below:

S No.	Location	Lighting Fixture Type	Lux Level
1	Control Rooms	Energy Efficient FTL in Decorative fittings with wide angle mirror optic antiglare reflector. Decorative Compact fluorescent tube (CFL) fitting with internal mirror reflector with mounting bracket suitable for 1x18W/ 1 x 22W/ 1x25W lamps.	400
2	Testing Laboratories	Energy Efficient FTL in Decorative fittings with wide angle mirror optic antiglare reflector.	



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S No.	Location	Lighting Fixture Type	Lux Level
		Decorative Compact fluorescent tube (CFL) fitting with internal mirror reflector with mounting bracket suitable for 1x18W/ 1 x 22W/ 1x25W lamps.	400
3	Turbine Hall	400W HV SV high beam flame proof well glass fixture	200
4	Compressor Plant	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish (pendant / bracket mounting)	200
5	DG Room	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish (pendant / bracket mounting)	200
6	Pump House	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish (pendant / bracket mounting)	200
7	Battery Room	Energy efficient 2X40 W FTL industrial type corrosion proof with vitreous enamel finish (pendant / bracket mounting)	250
8	Air Conditioning Plant Room	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish (pendant / bracket mounting)	200
9	AHU Room	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish (pendant / bracket mounting)	200
10	Switchgear/MCC/Electrical & Electronic equipment Rooms	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish (pendant / bracket mounting)	250
11	Elevator M/C Room	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish (pendant / bracket mounting)	200
12	Office room	Decorative recessed type energy efficient 2 x 40 FTL with mirror reflector Decorative Compact fluorescent tube (CFL) fitting with internal mirror reflector with mounting bracket suitable for 1x18W/ 1 x 22W/ 1x25W lamps. For rooms without false ceiling, surface mounted fixtures will be used.	300
13	Cable spreader Area	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish	100
14	Oil Room and indoor hazardous areas	1 x 70 W HPMV Flame proof well glass fixture	150
15	Passage, Indoor Stair	Energy efficient 2x40 W FTL industrial	100





S No.	Location	Lighting Fixture Type	Lux Level
	case , Toilet etc	type with vitreous enamel finish	
16	Outdoor/Semi outdoor stairs/ Transformer Yard	Dust & weather proof 70 W HPSV well glass fitting with reflector and integral mounted control gear.	70
17	Street & periphery lighting	150W HPSV street light fittings	20
18 (a)	Control Room	DC emergency lighting Energy efficient 2x40W FTL industrial type of vitreous enamel finish and with electronic choke suitable for 220V DC operation.	400
18 (b)	Other areas	Energy efficient 2x40 W FTL industrial type with vitreous enamel finish and with electronic choke suitable for 220V DC operation.	

4. SPECIFIC REQUIREMENTS

4.1 Equipment and Material

- Equipment and material will comply with description, rating, type and size as detailed in this specification.
- Equipment and materials furnished will be complete and operative in all details.
- All accessories, control devices, internal wiring, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment will have to be furnished.
- All parts will be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment will be inter-changeable.

4.2 Lighting Fixtures and Lamps

- Fluorescent fixtures with electronic ballast will be generally provided for a room height upto 5m. Type of fixture will be industrial type with gasket, clear acrylic cover and enamelled reflector or decorative type to suit the aesthetics. For areas with false ceiling , recessed mounted decorative fixtures with mirror optic louvres will be used. In control room / computer rooms, decorative mirror optic fluorescent light fittings with antiglare features will be provided. The surface finish will be smooth, unobtrusive and scratch resistant.
- Reflector will be of sheet steel or aluminium, minimum 20 SWG thick and securely fixed by fastening device of captive type.



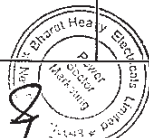


- Fixture will be suitable for 19 mm conduit entry and 16 SWG GI earth wire connection.
- Fixture will be furnished complete with lamps and integrally mounted accessories. These will include holders, ballast, capacitor, starter, ignitors (separate type) etc.
- For corrosive areas, corrosion proof lighting fixture will be provided. For hazardous areas, light fittings, conduits, junction boxes etc. will have to meet the corresponding area classification requirement.
- Medium bay or high bay type of lighting fixtures with HPMV/HPSV lamps will be used depending on the mounting heights for indoor areas having room height more than 5m. Medium/ High bay fixtures will be provided with vibration damper wherever required.
- For areas like boiler and outdoor areas such as roads, street, transformer areas and open yards, weatherproof HPSV flood/ street lighting fixtures will be used. For areas like boiler platforms, weatherproof well glass type HPSV fixtures with wire guards will be used.
- All type of fluorescent lamps including Compact Fluorescent Lamp (CFL) will be bi-pin rotary type and either cool daylight or white.
- Mercury / Sodium vapour lamp will be colour corrected type with screwed cap.
- Lamps will be suitable for use in position and capable of withstanding small vibrations.
- Ballasts will be of heavy duty, low loss and polyester-filled type with copper winding.
- Ballasts for Mercury / Sodium vapour lamps will be provided with suitable tappings to set the voltage within range specified.
- Ballasts will be free from hum. Ballasts which produce humming sound will be replaced, free of cost.
- In multi-lamp fixture, each lamp will be provided with individual ballast.

4.3 Receptacles

- Receptacles will be heavy duty, complete with individual plug and switch as described below:

Sl.No.	Type	Description
1.	RA	5A, 230V, 2 Pole, 3 Pin with third pin earthed - Suitable for flush mounting in office areas and control room. The switch will also be flush mounting piano type.
2.	RB	15A, 230V, 2 Pole, 3 Pin with third pin earthed - Wall/ column mounted, metal clad gasketed construction, suitable for 19 mm conduit entry, screwed metal cover tied with metal chain, weatherproof construction suitable for indoor/outdoor installation. This will be provided at an interval of 30m, or minimum one in each room.



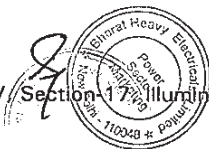


Sl.No.	Type	Description
3.	RC	63A, 415V, 3 Phase, 5 pin interlocked plug and switch with fifth pin earthed. Wall/column mounted, metal clad gasketed construction weather proof, suitable for loop in/ loop out connection of 4 Core 35 sq.mm AYWY cable. These receptacles will be provided at an interval of 50m throughout the Plant Area.
4.	RD	100A, 415V, 3 phase, 5 Pin interlocked plug and switch with fifth pin earthed Wall/column mounted metal clad gasketed construction weather proof, suitable for loop in/ loop out connection of 3.5 Core, 95 sq.mm AYWY cable.

- The conduit box of the receptacle will be provided with earthing screws with washer and nuts welded on the surface for grounding with 16 SWG GI wire. Arrangement will be provided inside the conduit box for grounding of third pin.
- Shrouded type plug will be provided with corresponding matching arrangement at sockets to prevent accidental contact with finger during plug insertion.
- Lighting Distribution Boards and Lighting Panels will be so constructed as to permit free access to the terminal connections and easy replacement of parts. Front access doors will have padlocking arrangements.

4.4 Main Lighting Distribution Boards/Lighting Panel / Distribution Boards

- The Main Lighting Distribution board will be fed from Lighting Service Switchgear through 415V/433V lighting transformers with off circuit taps $\pm 5\%$ in steps of 2.5%. The lighting transformer will be encapsulated cast resin dry type and will be housed in a suitable enclosure. The main lighting distribution boards will consist of two incoming MCCB/SFU with a bus coupler and required number of out going feeders consisting of triple pole and neutral SFUs/MCCB. The board will be designed for the required short circuit level of 20 kA. All the distribution boards will be sheet steel metal clad, dust and vermin proof, cubicle type with degree of protection conforming to IP-52. Outdoor panels will be weather proof type with IP-54 protection. The thickness of sheet steel enclosures will be 2 mm minimum for load bearing and 1.6 mm for other members.
- The lighting panels will be rated for 415 V, 3 phase, 4 wire, AC with neutral bus and suitable for either wall/column mounting. Indoor panels will have degree of protection of IP 52 and the outdoor panels will have a degree of protection of minimum IP 55. Additionally, all outdoor panels will be provided with detachable canopy at the top with regular slope towards the rear to prevent accumulation of rain water.
- The panel bus bars will be of electrolytic grade Hard drawn Aluminium, sized for a maximum temperature of 40°C over the ambient temperature,



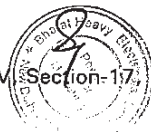
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colour coded for easy identification of phase and neutral bus bars. Minimum size will be 25x6mm

- The cable/conduit entry may be either from the top or bottom (for Indoor Panels) / from bottom only (for Outdoor Panels) with removable cable gland plates and will be terminated in suitable separate terminal blocks. Necessary double compression type brass cable glands, tinned copper cable lugs are to be provided.
- Provision will be made for earthing the panel at two points. A copper earth bus will run along the length of the panel. The front access door of the panels will have padlocking arrangement.
- The incoming to each Normal and Emergency AC Lighting Panel will be provided with a triple pole MCB with neutral isolating facility and one earth leakage circuit breaker. Combined type triple pole MCB and earth leakage circuit breaker (ELCB) are also acceptable for incomers to Lighting Panels.
- Normal and Emergency AC lighting panels will have outgoing MCBs having thermal elements for overload protection and an instantaneous magnetic trip to protect against severe faults. All MCBs provided will be suitable for breaking capacity of 9 kA (minimum) at 230 V AC.
- The Emergency DC Lighting Panels will have Incoming and outgoing feeders with HRC Switch fuse units or MCB units with back up fuse as required.
- The Lighting Panels will be of double door type with the outer enclosure made of sheet steel having a minimum thickness of 2 mm with a hinged door and suitable locking arrangement.
- Each of the MLDBs/ ELDBs will be provided with voltmeter and ammeter along with selector switches, 'SUPPLY ON' indicating lamps, etc.
- The incomers of Main and Emergency AC Lighting Distribution Boards (MLDB & ELDB) will be provided with energy (kWh) meter for measurement of energy consumed by the lighting loads. The energy meters will be 3 phase, 4-wire type suitable for measurement of unbalanced loads.
- Each outgoing MCB will be of 15 A, but load to be limited to 2 kW or maximum 10 nos. fittings to be connected to one MCB.
- Individual control in office buildings will be through single pole flush type switches. In those areas where group controls are required, rotary switches/MCBs will be provided.
- Lighting panels feeding the boiler area will be provided with contactors for control from a remote point. Lighting fixtures of boiler area platforms will be fed from different circuits such that all the lights in the area are not 'On' all the time. The lights connected to a circuit or few circuits will be 'ON' automatically through photocell. Provision will be made for switching 'ON' for rest of the lights. In heat zones, ie; in the areas where ambient temperature is 60 deg C and above, heat resistant control cables will be used in hot dip galvanized rigid steel surface





- Each Lighting Distribution Board will be complete with designation and caution notice plates fixed at front cover and a directory plate fixed inside the front cover. This directory plate will contain details of the lighting panels being fed from the Distribution Board including their designation, location, loading etc. Each Lighting Panel will be complete with designation and caution notice plates fixed on front cover and a circuit directory plate fixed on inside of the front cover. Circuit directory plate will contain details of the points to be controlled by each circuit including the location of the point controlled, rating of the protective units and loading of the circuit. The plates will be of anodised aluminium with inscriptions indelibly etched on it. Each Lighting Distribution Boards will be painted as stated in Clause No. 4.15. For street lighting, 3-phase power from MLDB will be supplied by 3 nos. single pole MCB. The circuit will be looped in and out at each lighting pole through a Junction box and Tee off will be provided with single pole MCB for supply of power to the fixture of that lighting pole.
- Number of outgoing feeders in MLDB's, SLDB's will be provided as per requirement. Feeders for Purchaser's use and 20% spare feeders of each type and rating will be provided in MLDB, LDBs/SLDBs.

4.5 Lighting Transformer

- Lighting transformers will be three phases, delta/star, 415 V/433 V, air cooled, Encapsulated epoxy cast resin insulated dry type. Secondary neutral will be solidly earthed.
- Lighting transformers will be provided with Off load tap switch/link with change of $\pm 5\%$ in step of 2.5% tapping full capacity. Insulation class will be 'F' with temperature rise limited to Class B.
- KVA rating : 100 KVA (min)

Vector Group : Dyn11

Maximum Temperature rise over

50 Deg C ambient in winding by resistance : 90 Deg.C

Neutral : Solidly grounded.

- The secondary neutral of the transformer will be brought out for getting a grounded 4 wire supply. Each transformer will be routine tested in the presence of Purchaser or his representative. Type test conducted for similar type of Transformers will be furnished for approval.
- The transformer will be liable for rejection if the tolerance on the quoted values of losses, impedance, temperature rise, etc. exceeds the specified values of relevant standard.
- The transformer will be mounted inside sheet steel enclosure with IP23 protection.



4.6 Fittings and accessories for lighting Transformers

Each transformer will be equipped with fittings and accessories as listed below
50 mm dia. winding temperature indicator with maximum reading pointer and electrically separate sets of contacts for trip and alarm.

Handling and lifting lugs both for enclosure and core-coil assembly.

Jacking pad for core-coil assembly.

Inspection cover for cable end box.

Door handle operated safety limit switch with 1NO + 1NC contact.

Necessary earthing.

Rating and terminal marking plates.

Note: All indication, alarm, trip contacts provided will be rated for 0.5A at 220 V D.C. and 5A at 240 V A.C

4.7 Fans and Regulators

- The fans will have three well balanced blades, double ball bearings and will be reasonably free from noise. Fan motor will be totally enclosed type with copper winding and class-E insulation. Sweep will be given as 1200 /1400 mm.
- Regulators will have minimum five steps. Electronic Regulators with smooth control will be provided.

4.8 Switch and Switchboard

- All switch boards/boxes will be of folded steel sheet construction, fabricated of 14 SWG MS sheet with 6 mm thick Bakelite front cover and brass fixing screws.
- Each Switchboards will be painted in accordance to Clause No. 4.15
- Switchboards/boxes located in control room and office areas will be flush mounted type on brick wall with only the switch knob projecting outside.
- Switch boards/boxes will have conduit knock outs on the sides. Adequate provision will be available for ventilation of these boxes.
- At least one 5/15A flush type receptacle will be provided in each switchboard and so located that only the plug projects outside.
- Switches will have quick-make and quick-break mechanism operated by a suitable external handle complete with position indicator.

4.9 Lighting Poles / Towers

Street Light Poles

Street light poles will be swaged and welded steel pole, complete with fixing brackets, weather-proof junction box and all other accessories.



All poles and hardware will be hot dip galvanised. Galvanisation will be done in accordance to Clause No. 4.17.

5. HIGH MAST TOWERS

5.1 GENERAL

The scope of covers the manufacture, transport, installation, testing and commissioning of the complete lighting system, using Raising and Lowering type of High mast Towers, including the Civil Foundation Works. All items required for the safe and efficient operation and maintenance of the lighting system, including the high mast, whether explicitly stated in the following pages or not, will be included by the Tenderer. However, the minimum height of lighting mast will be 20 meters with six numbers 2X400W HPSV lamps.

Structures

The High mast will be of continuously tapered, polygonal cross section, at least 20 sided, presenting a good and pleasing appearance and will be based on proven In-Tension design conforming to the standards referred to above, to give an assured performance, and reliable service. The structure will be suitable for wind loadings as per IS 875 Part 3 1987.

Construction

The mast will be fabricated from special steel plates, cut and foiled to form a polygonal section and will be telescopically jointed and welded. The procedural weld geometry and the workmanship will be exhaustively tested on the completed welds. Mast can be fabricated in multiple sections. No site welding or bolted joint will be done on the mast. The minimum over lap distance will be 1.5 times the diameter at penetration. The dimensions of the mast will be decided based on proper design and design calculations will be submitted for verification.

The mast will be provided with fully penetrated flange, which will be free from any lamination or incursion. The welded connection of the base flange will be fully developed to the strength of the entire section. The base flange will be provided with supplementary gussets between the bolt holes to ensure elimination of helical stress concentration. For the environmental protection of the mast, the entire fabricated mast will be hot dip galvanized, internally and externally, having a uniform thickness of 85 microns for the bottom section and 65 micron for the middle and top sections.

Door opening:

An adequate door opening will be provided at the base of the mast and the opening will be such that it permits clear access to equipment like winches, cables, plug and socket, etc. and also facilitate easy removal of the winch. The door opening will be complete with a close fitting, vandal resistant,



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weatherproof door, provided with a heavy-duty double internal lock with special paddle key.

The door opening will be carefully designed and reinforced with welded steel section, so that the mast section at the base will be unaffected and undue buckling of the cut portion is prevented. Size of door opening will be strengthened if required to avoid buckling of the mast section under heavy wind conditions.

Dynamic Loading for the Mast:

The mast structure will be suitable to sustain an assumed maximum reaction arising from a wind speed as per IS 875 (three second gust), and will be measured at a height of 10 metres above ground level. The design life of the mast will be a minimum of 25 years.

Lantern Carriage:

Fabrication:

A fabricated Lantern Carriage will be provided for fixing and holding the flood light fittings and control gearboxes. The Lantern Carriage will be of special design and will be of steel tube construction, the tubes acting as conduits for wires, with holes fully protected by grommets. The Lantern Carriage will be so designed and fabricated to hold the 12 numbers of flood light fittings and the control gearboxes, and also have a perfect self-balance.

The Lantern Carriage can be fabricated in two / three segments and joined by bolted flanges with stainless steel bolts and nylon type stainless steel nuts to enable easy installation or removal from the erected mast. The inner lining of the carriage will be provided with suitable protective arrangement, so that no damage is caused to the surface of the mast during the raising and lowering operation of the carriage. The entire Lantern Carriage will be hot dip galvanised after fabrication. The design will provide a perfect balance for the lantern carriage during raising and to lowering also.

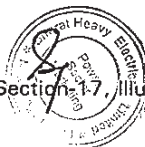
Junction Box

Weather proof junction box, made of Cast Aluminium will be provided on the Carriage Assembly as required, from which the inter-connections to the designed number of the flood light luminaries and associated control gears fixed on the carriage, will be made.

Raising and lowering mechanism:

For installation and maintenance of the luminaries and lamps, it will be necessary to lower and raise the Lantern Carriage Assembly. To enable this, a suitable Winch Arrangement will be provided, with the winch fixed at the base of the mast and the specially designed head frame assembly at the top. Suitable provision/ end limit switches will be provided to trip the winch motor at both top & bottom ends of the designed travel.

Winch:





The winch will be of completely self-sustaining type, without the need for brake shoe, springs or clutches. Each driving spindle of the winch will be positively locked when not in use, gravity activated PAWLS. Individual drum also should be operated for fine adjustment of lantern carriage. The capacity, operating speed, safe working load, recommended lubrication and serial number of the winch will be clearly marked on each winch.

The winch will be self-lubricating type by means of an oil bath and the oil will be readily available grades of reputed producers.

The winch drums will be grooved to ensure perfect seat for stable and tidy rope lay, with no chances of rope slippage. The rope termination in the winch will be such that distortion or twisting is eliminated and at least 5 to 6 turns of rope remains on the drum even when the lantern carriage is fully lowered and rested on the rest pads. It should be possible to operate the winch manually by a suitable handle and by an external power tool. It will be possible to remove the double drum after dismantling, through the door opening provided at the base of the mast. Also, a winch gearbox for simultaneous and reversible operation of the double drum winch will be provided as part of the contract.

The winch will be type tested in presence of a reputed Institution and the test certificates will be furnished before supply of materials. A test certificate will be furnished by the Tenderer from the original equipment manufacturer, for each winch in support of the maximum load operated by the winch.

Head Frame:

The head frame, which is to be designed as a capping unit of the mast, will be of welded steel construction, galvanised both internally and externally. The top pulley will be of appropriate diameter, large enough to accommodate the stainless steel wire ropes and the multi-core electric cable. The pulley block will be made of non-corrodable material, like die cast Aluminium Alloy (LM-6). Self-lubricating bearings and stainless steel shaft will be provided to facilitate smooth and maintenance free operation for along period. The pulley assembly will be fully protected by a canopy galvanised internally and externally.

Close fitting guides and sleeves will be provided to ensure that the ropes and cables are not dislodged from their respective positions in the grooves. The head frame will be provided with guides and stops with PVC buffer for docking the lantern carriage.

Stainless Steel Wire Ropes:

The suspension system will essentially be without any intermediate joint and will consist of only non-corrodible stainless steel of AISI 316 or better grade.

The stainless steel wire ropes will be of multi strand construction, the central core being of the same material. The overall diameter of the rope will not be less than 6 mm. The breaking load of each rope will have factor of safety of over 5 for the system at full load. The end constructions of ropes to the winch drum will be fitted with talurit.

The thimbles will be secured on ropes by compression splices. Two continuous lengths of stainless steel wire ropes will be used in the system and no intermediate joints are acceptable in view of the required safety. No





intermediate joints / terminations, either bolted or else, will be provided on the wire ropes between winch and lantern carriage.

Electrical System, Cable and Cable Connections:

A suitable terminal box will be provided as part of the contract at the base compartment of the high mast for terminating the incoming cable. The electrical connections from the bottom to the top will be made by special trailing cable. The cable will be EPR insulated and PCP sheathed to get flexibility and endurance, and have copper conductors. The cable will be of reputed make. At the top there will be weatherproof junction box to terminate the trailing cable. Connections from the top junction box to the individual luminaries will be made by using 3 core flexible PVC cables of adequate size. The system will have in-built facilities for testing the luminaries while in lowered position.

Also, suitable provision will be made at the base compartment of the mast to facilitate the operation of externally mounted, electrically operated power tool for raising and lowering of the lantern carriage assembly. The trailing cables of the lantern carriage rings will be terminated by means of specially designed, metal clad, multi pin plug and socket provided in the base compartment to enable easy disconnection when required.

A distribution board with suitably rated 3 phase incomer MCB and separate MCB's controlled feeders for lighting and power tool will also be supplied. The board will incorporate photo electric cell for control of lighting and control circuit for winch operation with all necessary contactors on incoming / outgoing feeders etc. as required. The board will have IP 55 protection with rainwater protections canopy and epoxy powder coated suitable for out door mounting in coastal area. The work will also include necessary foundation cable glands etc. complete as required. The whole board and few O/G feeders (if required) will be able to control from PLC apart from local DB.

Power Tool for the Winch:

A suitable, high-powered, electrically driven, internally mounted power tool, with manual over ride will be supplied for the raising and lowering of the lantern carriage for maintenance purposes. The speed of the power tool will be to suit the system. The power tool will be single speed, provided with a motor of the required rating. The power tool will be supplied complete with push button type remote control switch, together with 6 (six) metres of power cable, so that the operations can be carried out from a safe distance of 5 (five) metres. The capacity and speed of the electric motor used in the power tool will be suitable for the lifting of the design load installed on the lantern carriage.

The power tool mounting will be so designed that it will be not only self supporting but also aligns the power tool perfectly with respect to the winch spindle during the operations. Also, a handle for the manual operation of the winches in case of problems with the electricity operated tool, will be provided and will incorporate a torque limiting device.



There will be a separate torque-limiting device to protect the wire ropes from over stretching. It will be mechanical with suitable load adjusting device. The torque limiter will trip the load when it exceeds the adjusted limits. There will be suitable provision for warning the operator once the load is tripped off. The torque limiter is a requirement as per the relevant standards in view of the over all safety of the system. Each mast will have its own power tool motor.

Lightning Finial:

One number heavy duty hot dip galvanised lightning finial will be provided for each mast. The lightning finial will be minimum 1.2 M in length or as required so that the lantern carriage also comes within the safety zone and will be provided at the center of the head frame. It will be bolted solidly to the head frame to get a direct conducting path to the earth through the mast. The lightning finial will not be provided on the lantern carriage under any circumstances in view of safety of the system.

Aviation Obstruction Lights:

Neon type Aviation Obstruction Lights of reliable design and reputed manufacturer will be provided on top of each mast.

Earthing Terminals:

Suitable earth terminal using 12 mm diameter stainless steel bolts will be provided at a convenient location on the base of the Mast, for lightning and electrical earthing of the mast. The mast will be provided with duplicate earthing including necessary earth pits as per IS.

Foundation for high mast

The scope also includes supplying all materials and casting of RCC foundation along with necessary Anchor bolts etc.

The detailed drawing for the foundation will be submitted and got approved by/owner consultant before starting of the work.

Luminaries

Luminaries will be specially designed with suitable lamp housing and control gears. The luminaries will be tested as per Indian standards and test reports will be submitted for approval. The luminaries will be suitable for installation on high masts. The number and type of light fitting will be as required / Approved BOQ.

5.2 Maintenance Equipment

- One (1) no. of wheel mounted adjustable telescopic aluminium ladder for maintenance of street lights will be provided.
- For the maintenance of lighting fixtures within the power house, four (4) nos. free standing adjustable telescopic aluminium ladder, adjustable from 5m to 10m & two (2) nos. adjustable aluminium ladders, adjustable from 0.5m to 1.5m will be provided.



5.3 Lighting Cables and Wires

- Lighting Cable will be heavy duty, 660/1100 Volt grade, multicore stranded aluminium conductor, XLPE insulated, extruded PVC inner sheath, single round GI wire armoured and overall FRLS PVC sheathed to IS 7098 Part I.
- Lighting wires will be 660/1100 Volt grade, PVC insulated, stranded conductor, inner sheathed, single core cable to IS 694: Minimum size of cable/wires will be 2.5 mm sq. copper.

5.4 Conduits and Accessories

- Conduits will be of rigid steel, hot-dip galvanized, furnished in standard length of 3 meters, threaded at both ends.
- Conduits upto and including 25mm will be of 14 SWG. Minimum size of conduits will be 19 mm.
- Each piece of conduits will be straight, free from blister and other defects and covered with capped bushings at both ends.
- Flexible conduits will be made with bright, cold rolled annealed and electro-galvanized mild steel strips and coated with PVC.

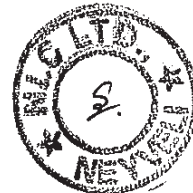
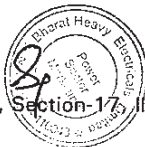
5.5 Lighting Junction Box

- The junction boxes will be of sheet metal, dust and damp proof, generally conforming to IP 55.
- The junction boxes will be complete with gasketed inspection cover, conduit knock out/ threaded hub/ cable entry and terminal blocks.
- Junction boxes for outdoor use will weatherproof IP-55 and those for hazardous location will be flame proof type.
- Junction Boxes will have following indelible markings:
 - a. Circuit nos. on top.
 - b. Circuit nos. with ferrules (inside) as per drawing.
 - c. Danger sign in case of 415V circuit.

5.6 Terminals

- Multiway terminal blocks complete with screws, nuts, washers and marking strips will be furnished for connection of incoming/outgoing wires in the junction boxes.
- Each terminal will be suitable for connection up to two (2) nos. 2.5 mm² copper conductors.

5.7 Name Plate





Name plates will be furnished for identification of devices and circuits. All switches, controls and indications will be permanently and legibly marked in english regarding the functions.

5.8 Painting

All surfaces will be sand blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease and rust.

After cleaning, the surfaces will be given a phosphate coating followed by 2 coats of high quality primer and stoved after each coat.

The equipment will be finished in approved color shade by owner with two coats of epoxy based powder coated paint. The coating will be done electro statically followed by stoving.

Sufficient quantity of touch-up paint will be furnished for application at site.

5.9 Hot Dip Galvanizing

Wherever applicable, the minimum weight of the zinc coating will be 900 gm/sq.m and minimum thickness of coating will be 85 microns for items thicker than 6 mm. For items lower than 6mm thickness requirement of coating thickness will be as per relevant ASTM. For surface, which will be embedded in concrete, the zinc coating will be 900-gm/sq. minimums.

The galvanized surfaces will consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface will be clean and smooth and will be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection will render the material liable to rejection.

After galvanizing no drilling or welding will be performed on the galvanizing parts of the equipment except that nuts may be threaded after galvanizing. Sodium dichromate treatment will be provided to avoid formation of white rust after hot dip galvanization.

The galvanized steel will be subjected to six one-minute dips in copper sulphate solution as per IS-2633. Sharp edges with radii less than 2.5 mm will be able to withstand four immersions of the Standard Preece test. All other coatings will withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site will not be allowed.

5.10 Samples



Owner reserves the right to call for samples if considered necessary and the same will be submitted free and without any obligation.

6. TESTS

6.1. Shop Tests

All equipment will be completely assembled, wired, adjusted and routine tested as per relevant IEC Standards at manufacturer's works.

Tests on Lighting Distribution Boards / Panels will include:

- a) Wiring continuity tests.
- b) High voltage and insulation tests.
- c) Operational tests.

6.2. Test Witness

All tests will be performed in presence of owner's representative, if so desired by the owner.

The Contractor will give an advance notice of shop tests and tests.

6.3. Test Certificates

- Certified copies of all tests carried out at works and at site will be furnished in requisite no. of copies for approval of the Owner.
- The equipment will be dispatched from works only after receipt of Owner's written approval of shop test reports.
- Valid Type test certificate on any equipment (within last 5 years), if so desired by the Owner, will be furnished. Otherwise the equipment will have to be type tested, free of charge, to prove the design.

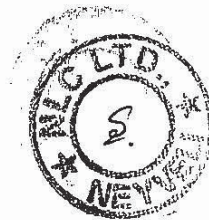
7. DRAWINGS, DATA & MANUALS

Drawings, data and manuals will be submitted in quantities and procedures as specified in the General Condition of Contract and/or elsewhere in this specification for approval and subsequent distribution after the issue of Letter of Intent.

Drawings, Data and Manuals to be submitted for approval

Detail dimensional drawing showing constructional features, cable/ conduit entry, grounding, fixing arrangement etc. of:

- a) Lighting panels & distribution boards.
- b) Receptacles & Junction boxes.





- c) Street light poles & towers.
- d) Lighting fixture complete with lamps and accessories.
- e) Non-integral/separate type control gear box for lighting fixtures, as applicable.
- f) Lux level calculations for each area.
- g) Data sheets for lighting fixture, lamps, accessories with light distribution curves, co-efficient of utilization charts etc. Type and routine test certificates of transformer and cables.
- h) Control schematic and wiring diagram of 415V AC/220V DC lighting panel with automatic changeover from AC to DC and vice-versa, 415V normal AC street/area lighting panel with automatic ON/OFF feature.
- i) Technical leaflets and data sheet on each piece of equipment/ device such as MCB, switch, fuse, receptacle etc. Type and routine test certificates of transformer and cables.
- j) QAP and relevant test certificates
- k) Lighting layouts showing the disposition of fixtures, lighting panels/boards, circuit distributions, conduit & wire routing.
- l) Key Single Line Diagram for lighting distribution, board wise single line diagram with feeder loading, cable schedule and interconnection chart, design calculation for lighting.

Note:

- AS-BUILT lighting layout and erection drawings, properly incorporating the changes/alterations/field modifications, if any, as carried out at field along with circuit distribution schemes of all lighting panels, conduit and cable routing and as acceptable to the Owner.



- Any other relevant drawings, data and manuals necessary for satisfactory installation, operation and maintenance.
- The Contractor may note that the drawings, data and manuals listed are minimum requirement only. The Contractor will ensure that all other necessary write-ups, curves and information required to fully describe the equipment offered are submitted.

