

KARNATAKA POWER TRANSMISSION CORPORATION LIMITED

TECHNICAL SPECIFICATION

SECTION -LIGHTING SYSTEM

TECHNICAL SPECIFICATION

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SECTION : LIGHTING SYSTEM

1.0 LIGHTING SYSTEM:

1.1 **General:**

The scope of work comprises of design, engineering , Supply installation, testing & commissioning of various lighting fixtures complete with lamps, supports & accessories, ceiling fans complete with electronic regulators and accessories, lighting poles complete with distribution boxes, galvanized rigid steel conduits, lighting wires, G.I Earth wire , receptacles, switchboards, switches, junction boxes , pull out boxes complete with accessories both in control room & outdoor yard. The bidder has to quote for ceiling quantities for various type of luminaries based on the area and level of illumination required.

The entire control room building lighting (except GIS building) shall be done by LED based low power consumption luminaires to achieve desired lux level specified. The bidder shall quote on lump sum basis on the basis of design criteria specified for control room building. Street lighting shall also be done by LED based low power consumption luminaires to achieve desired lux level specified.

1.2 **System Description:**

1.2.1 **AC Normal Lighting:**

AC lights will be connected to AC lighting panels. All the lights connected to the AC lighting system in different areas will be connected to the main lighting distribution boards.

1.2.2 **AC Emergency Lighting**

This system will be available in control room building, GIS Hall, DG set building & switchyard. AC lighting load will be connected to this system which will be normally 'ON'. The lighting panels of this system will be connected to the emergency lighting board which is fed from diesel generator during the emergency. 50% of lighting fixtures shall be connected on AC emergency lighting.

1.2.3 **D.C. Emergency lighting.**

A few DC emergency lighting fixtures operated on the DC system will be provided in the strategic locations including staircase, corridors, electrical rooms, Battery charger room, LT switchgear

room in control room building and DG set building and GIS building so that the operating personnel can safely find their way even during emergency of a total AC failure. These lights will be normally 'OFF' and will be switched 'ON' automatically when under voltage occurs in the AC main lighting distribution board. GLS Lamp down lighters in false ceiling area and Bulkhead fixtures in non false ceiling are to be used.

1.2.4 Portable fixtures

Three numbers of battery operated, portable fixtures will be provided in the GIS building and control room building and one number shall be provided in DG set building.

These fixtures will be provided at important locations in the above mentioned areas.

1.3 The minimum lux levels to be maintained in the different areas shall be as per following

Sl No	Area	Average level	Remark
1	Control room	350	At floor level
2	PLCC Room	300	At floor level
3	LT Room	150	At floor level
4	Battery Room	100	
5	Corridor & Landing	150	
6	DG Set Room	150	At floor level
7	Tool Room	150	At floor level
8	Toilet	50	At floor level
9	Switchyard layout	50	50 lux on main equipments (power Tr., GIS modules consisting of , isolators, circuit breakers, CT, VTs, surge Arrestors etc) at first level (equipment connection level), 20 lux on balance areas of switchyard ground level.
10	GIS Building	200 lux	At equipment level
11	Street / road	20 lux	At ground level

For achieving the specific lux levels in the switchyard, the contractor can provide luminaries of 1x400W / 1x250W and 2x400W / 2x250 W flood light as per requirement. For GIS building, 250W metal halide fixtures

along with surface mounted 1x60W GLS down lighters for emergency areas shall be provided. The street/road lighting shall be with LED based low power consumption luminaires to achieve desired lux level specified.

Bidder shall submit detailed calculation for reaching the above LUX levels. The contractor shall confirm the lux levels at different locations by measurement after execution of work. (2 locations in 220 KV/110 KV / 66KV switchyard & one in each of above place. Strategic location near equipment which shall be kept normally OFF and these shall be switched ON in case of maintenance work).

The minimum lux level to average lux level ratio should not be less than 0.3 and the maintenance factor shall be 0.65 for outdoor illumination.

1.4 Scope of Work:

The equipment to be furnished & erected as covered in this volume shall be designed, engineered, manufactured, type tested, supplied received at site, unloaded , stored & erected , tested & commissioned as per requirement specified here under.

1.5 VOID

1.6 Supply, Storage & Installation of :

- i) AC & DC Lighting panels
- ii) Lighting fixtures complete with lamps & accessories.
- ii) Receptacles & switchboards
- iii) Galvanized iron conduits for lighting system wiring & fixture supports, complete with all accessories including junction boxes & pull out boxes associated civil works.
- iv) Lighting cables & wires for wiring of all lighting fixtures, ceiling fan points, receptacles etc, from lighting panels/ switch boards.
- v) Lighting poles including associated civil works.
- vi) Earth wires / rods / falls for all lighting fixtures, ceiling fan points, receptacles & GI conduit installation.
- vii) Battery operated portable fluorescent lamps & fixtures.
- viii) 1400 mm sweep A.C.230 volts ceiling fan shall be provided in D.G.set room, Control room, LTAC Panel room etc.

1.7 Supply of aluminum ladders for the maintenance of lighting system.

1.8 The following specific areas are included in the scope of lighting.

- i) 220KV / 110KV/ & 66KV switchyard Area/ GIS building.
- ii) Switchyard Control Room building.

- iii) DG Set room.
- iv) Street lighting inside substation premises
- v) Any other area like 11KV switchyard, approach road etc intimated to vendor during detailed engineering.

- 1.9 The detailed drawing showing the lighting layout of these areas shall be prepared by the bidder & submitted for approval. The above layout drawings shall include disposition & location of lighting fixtures, receptacles, switchboards, ceiling fan points etc-, The conduit layout for substation buildings, cable schedule for sub-station yard etc., for wiring of these equipment shall also be prepared by the contractor & shall be submitted for approval.
- 1.10 Associated minor civil works like fixing of anchor bolts, breaking of floors/walls for fixing conduits / pipes / earth conductors. Sealing of floor/ wall openings after conduits, pipes, earth conductors have been put shall be carried out by the contractor. Further, Civil works associated with erection of lighting poles. Lighting panels etc, are also included in the scope of the contractor. Hardware's, in addition to conduit required, for fixing arrangement for various lighting fixtures are also included in the contractor's scope.
- 1.11 The supply & erection of double compression glands & lugs required for termination of cables in receptacles & junction boxes, lighting panels, sub-lighting panels, street lighting, junction boxes & any other area are in contractor's scope.
- 1.12 Power cables shall be laid through the available cable trenches to the maximum extent possible. Where cable trench is not available, the cable shall be laid buried under ground. The contractor shall quote the unit price of cable laying & termination in the RCC trench & buried cable trench separately.
- 1.13 Each cable & conduit run shall be tagged with number that appears in the cable conduit schedules. Cables & Conduits shall be tagged at their entrance and/or exit from any piece of equipment, junction or pull box floor opening etc.,
- 1.14 The tag shall be made-up of aluminum with the number punched on it & securely attached to the cable by not less than two turns of G.I. wire. cable tags shall be rectangular in shape for power cables & circular shape for control cables.
- 1.15 Location of cables laid directly under ground shall be indicated clearly by cable marker made of galvanized iron plate embedded in concrete block.

- 1.16 The location of under ground cable joints if any, shall be indicated clearly with cable marker with an additional inscription "Cable joint.
- 1.17 The marker, which is a concrete block, shall project 150mm. above ground & shall be spaced at an interval of 30 meters & at every change of direction. It shall also be located on both sides of the road or drain crossing.
- 1.18 The contractor shall furnish & install all tags & markers stated above. The rates for supply & erection of these tags & markers have to be included in the erection rates quoted for cable laying & termination.
- 1.19 Any material, wire, conduits, accessories etc., not specially mentioned or specified but required for Installation of lighting fixtures are included in the scope of contractor.
- 1.20 The successful bidder shall furnish a computer print out for illumination levels at intervals of every 10 metres in the sub-stations area and also within the buildings. Also after the installations the illumination at various points of switchyard will have to be checked by suitable instrument for the illumination levels as per specifications.

2.0 SCHEDULE OF QUANTITIES:
The contractor shall supply & install the following equipment accessories in accordance with the specification.

2.1 VOID

2.2 VOID

2.3 LIGHTING FIXTURES & RECEPTACLES:
The lighting fixtures shall be of standard make only. The typical types are indicated infra.

Sub item	Type	Description
	FC	2 x 36 W fluorescent lamp in corrosion proof fixture consisting of a canopy made of fibre glass reinforced polyester (FRP) with gasket a gear tray made of sheet steel & a reeded acrylic cover fixed by toggle clips, similar to Philips Cat. No. TDC-10/240 or equivalent/bajaj Cat No.BJI-240 FG or equivalent/Crompton Greaves.

	SC	150 W SON-T Tubular Sodium – Vapour lamp in street lighting luminary. A special optical reflector clear acrylic cover, a single piece die cast aluminum housing made out of LM6 & corrosion resistance proof similar to Philips Cat No. SRX-51 or equivalent / bajaj Cat No. BJMSPT/150 or equivalent / Crompton Greaves cat no. SSG23151H or equivalent.
	F1	2 x 36W fluorescent lamps in industrial reflector type fixture, complete with accessories & suitable for pendent Mounting, similar to Philips Cat TKC 24/236 or equivalent / Bajaj cat No. BJIV – 236 or equivalent/ Crompton Greaves. IVE:1224HSB or equivalent
	IF	Incandescent GLS lamp in recessed down light having high purity aluminium reflector electromechanically brightened and anodized. Stainless steel leaf springs and pressure die cast ceiling similar to Philip cat no. DN 622 or equivalent / Crompton Greaves cat no. DDLV103C or equivalent.
	SF1	Weather Proof integral Floor lighting with housing made of corrosion resistant die cast aluminum painted black. Grey powder coated outside suitable for 150 W SON-T lamp for termination with conduits/flexible Cat. No. F69045 or equivalent /Bajaj Cat No.BGEMF-150W similar to SV Philip cat no. SWF230/150 or equivalent/ Crompton Greaves cat no. FAD 11151H or equivalent.
	SF2	2x400 W / 2 x 250 W, HP Sodium vapour lamps in high Flood lighting fixture suitable for outdoor mounting with aluminum enclosure: similar to Philipps Cat. No. SNT001 or equivalent / Bajaj Cat. No. BJEFT-22CA or equivalent/Crompton Greaves cat no. FHP 1324 or equivalent.
	SF3	1x250 W/ 1x400 W HP Sodium vapour lamps in high flood lighting fixtures suitable for outdoor mounting with Aluminium enclosure and integral control gear similar similar to Philip cat no. SWF 330 or equivalent/ Crompton Greaves Cat no. FAP 1114 or equivalent/ Bajaj cat no. BJEFT14 CA or equivalent.
	PF	1x11 CFL lamp emergency light with battery operated portable fixture with builtin battery & battery charger suitable for a lighting period to six hours similar to alpha Deluxe of M/s.DELTA FLASH LITE/MICRO LITE of M/s. MICRO/ BPL make.
	FB	9W CFL lamp in bulkhead fixtures with cast Aluminum alloy body, suitable for column, wall & ceiling mounting finished stove enameled silver gray outside white inside,

		to be supplied complete (with front glass, wire guard, tropicalised, gasket & E.S. Procelain, lamp holder taped $\frac{3}{4}$ E.T. for conduit entry) similar to Philips Cat.No. FXC 101 or equivalent/Bajaj Cat. No. BJBE-19 or equivalent/Crompton Greaves.
	FF	2x36 fluorescent lamp with mirror optics in recseed mounting type decorative fluorescent fitting consisting of whitestove enameled sheet steel housing with accessories & reflector of aluminum sheet steel duty of aluminum sheet duty electro-chemically brightened & anodized fitted with aluminum lamellae white. Similar to Philips Cat No. TBS-285/236 or equivalent/ Bajaj Cat. No. 236 or equivalent/Crompton Greaves cat no. CRFA2411SB or equivalent.
	MP	125 W MV Lamp, in weather proof post top latern with case aluminum canopy, mounting piece, opal acrylic cover tripod gasket & all other accessories for mounting on pole top similar to Philips Cat.No. HPC-101 or equivalent/Crompton Greaves cat no. MPT 12H or equivalent/Bajaj.
	FL	2x36W fluorescent lamps in decorative lighting fixture with widespread mirror optics suitable for pendent mounting with twin tube complete with all accessories: similar to Philips cat no. TCS-306/236 or equivalent/ Bajaj cat no. BJSM-236 or equivalent/ Crompton Greaves cat no. CSB W 1124 HSB or equivalent.
	IB	60/100W GLS lamp in bulkhead fixtures with cast aluminium alloy body, suitable for column, wall and ceiling mounting finished stove enameled silver grey outside white inside, to be supplied complete (with front glass, wire guard, tropicalised, gasket and E.S>Porcelain, lamp holder taped $\frac{3}{4}$ " E.T. for conduit entry) similar to Philips cat no. NXC 101 or equivalent/ Compton Greaves IBH1110/BC or equivalent
	BL	2x9 or 1x18 W CFL bollard light for landscape lighting having FRP/LLDPE housing similar to Philips FGC202 or equivalent/ Crompton Greaves cat no. CFBL1129 or equivalent
	DLR	2x18 W CFL down light for recess mounting lighting having similar to Philips FBH225/2x18 or equivalent/Crompton Greaves cat no. DDLH218TG or equivalent
	DSM	1x13 W surface mounted CFL similar to Art Light make cat no. RL 3146 or equivalent
	HL	2x18 CFL decorative hanging down light similar to cat

		no. Art light RL 3166/HL or equivalent			
	CL	1x18 WATT decorative ceiling mounted luminaire similar to Philips Dixie Cat FL 343/118 or equivalent			
	LED LUMINAIRES		Philips	CG	
a)	I-LED1		QUADRA	INSTA	
		2x2, luminaires with high efficacy and low power consumption suitable for general office lighting, conference room and cabins applications.	LED BCS705 20xLXML/NWPSU-E-220-240V BBS705 20xLXML/NW PSU-E-220-240V BBS805 2xLLM1800/8 40 PSU-E-220-240V	PRISMA 45W/OME GA 45W	
b)	I-LED2	19W, Recessed type LED luminaires with high efficacy and low power consumption for passages, corridor and toilet areas	LUX SPACE BBS480 1xDLED-4000 PSU-E 220-40V WH	INSTA DL 12W-6SH	
c)	S-LED	Street lighting luminaires	BETA Power BRP320 1x24LED-HP/CW PSU GR	VERSAT-2-48	

LED LUMINAIRES:

Indicative models of LED luminaires are indicated above. The offered luminaires shall have minimum 50 lumens/watt capacity (ie., ratio of total output lumens & input power) including driver. The quantity of these luminaires shall be decided on the basis of design criteria specified and lux level required at various rooms/locations. The bidder shall submit complete type test certificates & photometry reports of offered luminaires duly certified/conducted at accredited laboratory for owner's acceptance. The luminaires/drivers should generally comply with following relevant standards.

- 1) CISPR – 15/EN 55015 (for RFI/EMI)
- 2) IEC 61347 -2- 13 (for safety)
- 3) IEC 62384 (for performance of controlgear)
- 4) IEC 61547 (for EMC immunity requirements)
- 5) IEC 61000 -3- 2 (for harmonics)

RECEPTACLES

RO	15 A, 240V, Outdoor Receptacle.
RI	5/15A, 240V, Indoor Receptacle.
RP	63A, 415V, Interlocked switch Socket , Outdoor Receptacle.

SWITCH BOARDS

SWD1	Decorative type switch-board with Nos.-5A switches & No-5A receptacle.
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SWD2	Decorative type switch-board with Nos.-5A switches & No-5A receptacle.
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CONDUITS & ACCESSORIES

Galvanised Rigid Steel Conduits:

Sub – Item	Description
	19 mm
	25 mm
	32 mm
	40 mm

JUNCTION BOXES

Sub – Item	Description
	Qty. in Nos.
	Junction Box with 5 Nos. terminal blocks

LIGHTING POLES

Sub – Item	Description
	Qty. in Nos.
	Type A1 poles
	Type E1 poles

LIGHTING WIRES

Sub – Item	Description
	Qty. in Nos.
	2.5 Sq. mm Cu
	4.0 Sq. mm Al/Cu
	6.0 Sq. mm Al/Cu

10.0 Sq. mm Al

Sub – Item	Description	Qty in metres
	15 SWG GI wire 50x6 thick M.s. Rod 20mm Dia M.S. Rod.	
Ceiling fans (Nos.)	1400 mm Sweep with Electronic regulator	
MAINTENANCE EQUIPMENT (Nos.): (a) A type aluminium ladder of 3 mtr vertical height (b) Cart wheel mounted aluminum Ladder vertical height 7.5 mtrs when extended.		
CABLE LAYING IN RCC CABLE TRENCHES & TERMINATION (Kms) 415V – 4C x 70 Sqmm. Al. PVC 415V – 4C x 16 Sqmm. Cu. PVC 415V – 2C x 6 Sqmm. Al. PVC Armoured cable		
CABLE LAYING IN BURRIED CABLE TRENCHES & TERMINATION (Kms) 415V – 4C x 70 Sqmm. Al. PVC 415V – 4C x 16 Sqmm. Cu. PVC 415V – 2C x 6 Sqmm. Al. PVC Armoured cable		

3.0 CODES AND STANDARDS

- 3.1 The design, manufacture, performance of equipment shall comply with all currently applicable standards, regulations & safety codes in the locality where applicable, will be installed. Nothing in this specification shall be constructed to relieve the Bidder of these responsibilities.

3.2 Unless other-wise specified equipment offered shall confirm to latest applicable Indian & IEC standards. Equipment complying, with any other authoritative standards such as 7-3r-1tish, U.S.A, VDE etc., will also be considered if it ensures performance equivalent be installed. Nothing in this application shall be construed to relieve the bidder of these responsibilities.

A. LIGHTING FIXTURES & ACCESSORIES

- i) IS: 19 13 General & safety requirements for electric lighting fittings.
- ii) IS:3528 Waterproof electric lighting fittings.
- iii) IS:4012 Dust proof electric lighting fittings.
- iv) IS:4013 Dust tight electric lighting fittings.
- v) IS: 10322 Industrial' lighting fittings with metal reflectors.
- vi) IS:2206 Well glass lighting fittings for use under ground in mines(non-flame proof type)
- vii) IS: 10322 Specification for flood lights.
- viii) IS: 10322 Specification for decorative lighting outfits.
- ix) IS: 10322 Luminaries for street lighting .
- x) IS:2418 Tubular fluorescent lamps.
- xi) IS:9900 High pressure mercury vapour lamps.
- xii) IS: 1258 Specification for Bayonet lamp fluorescent lamps.
- xjii) IS:3323 Bi-pin lamp holder tubular fluorescent lamps.
- xiv) IS: 1534 Ballasts for use in fluorescent lighting (Part-1) lamps.
- xv) IS: 1569 Capacitors for use in fluorescent lighting lamps.
- xvi) IS:2215 Starters for fluorescent lamps.

- xvii) IS:33324 Holders for starters for tubular fluorescent lamps.
- xviii) IS:418 GLS lamps.
- xix) IS:3553 Water tight electric fittings.
- xx) IS:2713 Tubular steel poles.
- xxi) IS:280 MS Wire for general engg. Purposes.

B CONDUITS, ACCESSORIES & JUNCTION BOXES

- i) IS:9537 Rigid steel conduits for electric wiring
- ii) IS:3480 Flexible steel conduits for electric wiring.
- iii) IS:2667 Fittings for rigid steel conduits for electric wiring.
- iv) IS:3837 Accessories for rigid steel conduits for electric wiring
- v) IS:4649 Adapters for flexible steel conduits.
- vi) IS:5133 Steel & Cast Iron boxes.
- vii) IS:2629 Hot dip galvanizing of Iron & Steel.

C LIGHTING PANELS:

- I) IS:13947 LV Switchgear & Control gear (Part-I to 5)
- ii) IS: 8828 CB's for over current protection for house hold & similar installations.
- iii) IS: 5 Ready mix paints
- iv) IS:2551 Danger notice plates.
- v) IS:2705 Current Transformers.
- vi) IS:9224 HRC Catridre fuse links for voltage

- vii) IS:5082 Wrought aluminum & Al. Alloys, bars. Rods, tubes & sections for electrical purposes.
- viii) IS:8623 Factory built Assemblies of Switchgear & Control gear for voltages upto, & including 1000V AC & 1200V DC.
- ix) IS: 1248 Direct Acting indicating instruments.

D

CABLES:

- IS: 694 PVC insulated cables for working voltages upto & excluding 1100 volts.
- IS: 1293 3 Pin plug.
- IS: 371 Ceiling roses.
- IS:3854 Switches for domestic & similar purposes.
- IS:5216 Guide for safety procedures & practices in electrical work.
- IS:732 Code of practice for- electrical vdring installation (System voltage not exceeding 650v.
- IS:3043 Code of practice for earthing
- IS:3646 Code of practice of interior aluminum part 11 & 111.
- IS: 1944 Code of practice for lighting of public through fares.
- IS:5571 Guide for select-ion of electrical equipment for hazardous areas.
- IS:800 Code of practice for use of structural steel in general building, construction.
- IS:2633 Methods of Testing uniformly of coating on zinc coated articles.

IS:6005 Code of practice for phosphate Iron Steel

E. **INDIAN ELECTRICITY GRID CODE (IEGC)**

INDIAN ELECTRICITY ACT (2003).

4.0 LIGHTING PANELS:

a) OUTDOOR

415 AC lighting panel with 415V, 63A, 3 phase 4 wire bus and one number 63A, TP, MCB with neutral unit as incomer and 20A, SP MCB as outgoing feeders, the details are as follows:

The type & quantity needs to be revised as per the Lighting masts quantity.

Type of Panel	Description	Details of Outgoing Feeders
ACP 2	Outdoor	6 Nos. 20A single pole MCB and 3 Nos. of 32A Triple pole MCB with Neutral and suitable timer and contactor for automatic switching.
ACP 3	Outdoor street lighting panel	3 Nos. 32A Triple pole MCB with Neutral with suitable timer and contactor for automatic switching. All timer-based Lighting Distribution panels should have an Auto-manual selection also built in scheme for maintenance purposes.

Note: The number of outgoing feeders indicated above are the minimum.

b) INDOOR

415V indoor AC lighting panel 63A 3 phase 4 wire bus and one number 63amp TP MCB with 300mA, 63A TP RCCB. Flush mounted with per phase isolation and LED indication lamps. The DB will be flush mounted and double door type.

Type of Panel	Description	Details of Outgoing Feeders
ACP 1	Indoor	18 Nos. outgoing, 16 Amps SP MCB

Note: The number of outgoing feeders indicated above are the minimum. The bidder to design and decide the number of feeders as per requirements.

220V DC indoor type change over board and 220V Dc 32A two wire bus and one 32A contactor backed up by 32A double pole MCB as incomer. The panel shall have local push button controls. Following are the various types of panels required with control timer.

Type of Panel	Description	Details of Outgoing Feeders
DCP	Indoor	6 Nos. outgoing, 16 Amps DP MCB

Note: The number of outgoing feeders indicated above are the minimum. The bidder to design and decide the number of feeders as per requirements.

c) Sub-Lighting Panels

Type of Panel	Description	Details of Outgoing Feeders
SLP	Outdoor	6 Nos. 20A single pole MCB and 3 Nos. of 32A Triple pole MCB with Neutral and suitable timer and contactor for automatic switching with LILO facility using 8 Nos. terminal blocks suitable for cable upto 16 Sq.mm cable Enclosure shall be suitable for outdoor use with IP-55 degree of protection as per IS: 13947 (part-1).

Type test reports for following tests on all lighting panels shall be submitted for approval

- Wiring continuity test
- High voltage (2.5kV for 1 minute) and insulation test
- Operational test
- Degree of protection [(not less than IP-55 test on outdoor Lighting Panels and IP-52 test on indoor Lighting Panels as per IS 13947 (part I)]
- Heat run test

5.0 LIGHTING FIXTURES & ACCESSORIES.

5.1 General:

All lighting fixtures & accessories shall be designed for continuous operation under atmospheric conditions existing at site, without reduction in the Life or without any deterioration of materials, internal wiring,

5.2 Temperature Rise:

All lighting fixtures & accessories shall be designed to have a low temperature rise according to the relevant Indian Standards. The design ambient temperature shall be taken as 50 degree C.

5.3 **Supply Voltage**

5.3.1 Lighting fixtures & accessories meant for 240V A.C. operation shall be suitable for operation on 240V A.C. 50 Hz, supply With specified voltage & frequency variation between 168 to 264 volts

5.3.2 Lighting fixtures & accessories meant for 220V D.C. operation shall be suitable for operation on 220V D.C. with variation between 190 to 240 Volts.

5.4 Lighting Fixture

The Lighting fixtures & accessories shall be Phillips or Bajaj or Crompton greaves make only except for fixture type DSM & H I which make has been specified elsewhere in this section. . The different types of lighting fixtures are also indicated elsewhere in this section.

5.4.1 All fixtures shall be designed for minimum glare. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection.

5.4.2 All Lighting fixtures shall be complete with fluorescent tubes/ incandescent lamps/mercury vapour / sodiumvapour lamps as specified & shall be suitably wired up.

5.4.3 All mercury vapour & sodium vapour lamp fixtures shall be complete with accessories like ballasts, ignitrons, power factor improvement capacitors etc., These shall be mounted as far as possible in the fitting assembly only. If these cannot be accommodated inside , then a separate metal enclosed box shall be included to accommodate the accessories in addition with a fuse & terminal block suitable for loop-in , loop-out connections . Outdoor type fixtures shall be provided with outdoor type weather-proof box. The Bidder shall indicate starting time of these lamps to

attain full light output. Curves for starting, characteristics with varying supply voltage etc., are to be furnished by the contractor.

- 5.4.4 All fluorescent lamps fixture shall be complete with all accessories like ballasts. power factor improvement capacitors, lamps, starters, Holders etc.,
- 5.4.5 High beam fixtures shall be suitable for pendant Mounting & the floodlights shall have suitable base Plate / frame for mixing on structural steel member. Hook mounted High bay fixtures are not acceptable.
- 5.4.6 Each fixture (other than bulk head fixtures) shall have Terminal blocks suitable for 2.5 sq mm stranded copper conductor. The internal wiring should be completed by the manufacturer & terminated on the above terminal blocks. The bidder shall specifically furnish details of internal size of wires, type of installation including other technical particulars & indigenous availability. In certain cases the fluorescent fixtures, which are located adjacent to each other, shall require adequate terminals to facilitate loop in - loop out connections of 2.5sqmm. Stranded copper conductor The above shall be ascertained by the tenderer at the time of erection. The terminal blocks shall be as specified in clause no. 9 of this section.
- 5.4.7 Each lighting, fixture shall be provided with an earthing terminal suitable for connection to 16 SWG GI earthing conductors.
- 5.4.8 All metal or metal enclosed parts of the housing shall be suitably constructed so as to ensure satisfactory earthing continuity throughout the fixture upto the earthing terminal
- 5.4.9 The mounting facility & conduit knock-outs for the fixtures shall be as specified & shall be suitable for minimum 20-conduit entry.
- 5.4.10 On completion of manufacture, all surfaces of the fixtures shall be thoroughly cleaned & degreased. The fixtures shall be free from scale, rust, sharp edges & burrs.
- 5.4.11 All enamel finishing shall have a minimum thickness of 2 mils for outside surface & 1.5 mils for inside surface. The finish shall be non-porous & free from blemishes, blisters & fading,
- 5.4.12 The housing shall be stove -enameled or vitreous enameled or anodized aluminum as indicated in the specification of the

relevant

fixture.

- 5.4.13 The surface shall be scratch resistant & shall show no sign to cracking or flaking when bent through 90 degree over 1/2 inch diameter mandrel.
- 5.4.14 The light reflecting surfaces shall have optimum light reflecting, coefficient such as to ensure the overall light output as specified by the manufacturer.
- 5.4.15 The diffusing levels used in the fluorescent fixtures specified (as applicable) shall be made of height compact.. Polystyrene sheet & shall have no yellowing property over prolonged use.
- 5.4.16 For certain areas the fixtures offered shall be suitable for provision of vibration dampers, if required during installation to enable the lamps to perform the full lamp life. Bidder shall indicate the cost of such dampers separately.
- 5.4.17 The different types of lighting fixtures required are as indicated in clause 2 above.

5.5 **Accessories**

5.5.1 **Reflectors**

The reflectors shall be manufactured from sheet steel aluminum as applicable of not less than 22 SWG thickness. They shall be securely fixed to the captive type.

5.5.2 **Lamp holders & starter holders**

- 5.5.3 a) Lamp holders & starter holders for florescent tubes shall be of the spring loaded, low contact resistance, begin rotor type, resistant to wear & suitable for operation at the specified temperature, with out deterioration in the insulation value, contact resistance or retention of the lamp/starter. They shall hold the lamp/starter in position under normal shock & variation.

(b) Lamp holders /starter for incandescent lamps &HPMV/HPSV lamps shall be of screwed, manufactured in accordance with relevant standard &designed to give long & satisfactory service.

5.5.4 **BALLASTS:**

- a) The Ballasts shall be designed, manufactured & supplied in accordance with relevant standard & function satisfactorily under site condition specified. The ballasts shall be designed to have a long service life & low power loss.
- b) Ballasts shall be mounted using self-locking anti-vibration fixing & shall be easy to remove without dismantling the fixtures. They shall be totally enclosed units.
- c) The Ballasts shall be of the inductive, heavy duty filled with thermosetting insulating moisture polyester compound filled under pressure or vacuuming. The ballast wiring shall be of copper wire. They shall be free from hum. Ballasts which produce humming sound shall be replaced free of cost by the contractor -Ballasts for high pressure mercury vapour/HPSV lamps shall be provided with suitable tapplings to set the voltage within the range specified. End connections & taps shall be brought out in a suitable terminal block, rigidly fixed to the ballast enclosure.
- d) Separate ballast for each lamp shall be provided in case of multi-lamp fixtures.
- e) High frequency electronic ballasts shall be capable of satisfactory performance in adverse environment like that of EHV substation. Ballasts shall consist of AC/DC converter, high frequency power oscillator and low pass filter. The ballasts shall be suitable for use of nominal voltage of 240V +/- 10%, 50 Hz supply. The filter circuit shall suppress the feedback of high frequency signals to the mains. The ballast shall be rated for 36/40W fluorescent fixtures. The ballasts shall conform to IEC 68-2-6FC, IEC 929 for performance, IEC 928 for safety and EN 55015, EN 55022A for RFI and EN 61003.
- f) The successful Bidder has to submit G.A. & wiring diagram with all terminal details for owner's approval.

5.5.5 Starter:

Starters shall have bimetal electrodes & high mechanical strength. Starters shall be replaceable without disturbing the reflector or lamps & without the use of any tool. Starters shall have brass contacts & radio interference suppressing capacitor.

5.5.6 CAPACITORS:

a) The capacitors shall have a constant value of capacitance & shall be connected across the supply of individual lamp circuits.

b) The capacitors shall be suitable for operations at supply voltage as specified & shall have a value of capacitance so as to correct the power factors of its corresponding lampcircuit to the extent of 0.98 lag.

c) The capacitors shall be hermetically, sealed in a metal enclosure.

5.6 Lamps:

5.6.1 General Lighting Services (GLS) lamps shall be provided with screwed caps shall be of 'clear' type unless otherwise specified.

5.6.2 The fluorescent lamps shall be 'Day-light-colour' type unless otherwise specified & shall also be provided, features to avoid blackening of lamp ends. The bidder should clearly state these, features in the bid.

5.6.3 Mercury vapour lamps, sodium vapour lamps shall be colour corrected type, with screwed caps.

5.6.4 The lamps shall be suitable for use in any position. Restrictions, if any, shall be clearly stated in the bid.

5.6.5 The lamps shall be capable of withstanding small vibrations & the connections at lead-in-wires & filaments / electrodes shall not break under such circumstances.

5.6.6 The constructional features of gas discharge lamps for special applications shall be included in the bid.

5.6.7 The contractor shall supply and install all the above type of lamps. The cost of the lamps shall be included in that of the lighting fixtures as specified.

5.7 The bidder shall furnish typical wiring diagram for fluorescent. HPMVHPSV fitting including all accessories. The diagram shall include technical details of accessories ie., starters, chokes, capacitors etc.,

5.8 Flexible conduits if required, for any fixture shall be redeemed to be included in the contractor's scope.

6.0 RECEPTACLES

- a) All receptacles shall be of cast steel/aluminum, heavy duty type, suitable for fixing on wall/column & complete with individual switch.
- b) In general the receptacles to be installed are of the following types
 - i) TYPE RO- 15A, 240V, 2 pole, 3 pin type with third pin grounded, metal clad with gasket having cable gland entry suitable for 2C x 6 sq mm. PVC armoured cable & a metallic cover tied to it with a metallic chain & suitable for installation in most location indoor/outdoor. The switch shall be of rotary type. Receptacles shall be housed in an enclosure made out of 2mm thick G1 - sheet with hinged door quality padlocking arrangements. Door shall be lined with good quality gasketing and shall conform to IP-55.
 - ii) Type RI - Combination of 5A & 15 A, 240V, 3 pin type with third pin grounded, suitable for flush mounting.
The switch shall be of piano key type & shall be flush mounted.
 - iii) Type RP-63A, 415%!, 3 phase, 4 pin interlocked plug & switch with contacts. Other requirements shall be same as type RO The receptacle shall be suitable for 3.5Cx.25/3.5x70sqmm, Aluminum conductor cables entry & shall also be suitable for loop-in & loop-out connection of cables' of identical size. Receptacle shall be suitable for outdoor application. Receptacles shall be housed in a box made out of 2mm thick G.I.sheet, with hinged door with pad locking arrangement. Door shall be lined with good quality gasketing. They shall conform to IP-55.

7.0 SWITCH & SWITCH BOARDS

- a) All switch boards/boxes~ shall be of bent steel construction, fabrication of 16 SWG sheet with 6mm thick Bakelite or 3mm thick Perspex sheet cover.
- b) Switch board/boxes 5/15 Amps Receptable and electronic fan regulators located in office building areas shall be

modular flush mounted type or brick wall with only the switch knob projecting outside.

- c) Switch board/boxes shall have conduit knock outs on all the sides. Adequate provision shall be made for ventilation of these boxes.
- d) Flush type receptacles provided shall be so located that only the plug projects outside.
- e) Switches shall be of piano key type having quick make & quick-break mechanism complete with position indicator & shall conform to relevant standard.
- f) Regulator for fans wherever present shall be mounted on a separate board.
- g) All the components housed in the switchboard shall be used to an outgoing terminal block by 2.5sqmm. stranded copper wire (as specified in clause 15 of this section). The terminal block shall be adequately rated & shall be as specified in Clause No. 9 of this section, suitable for termination of sizes up to 2 nos. 10mm stranded Aluminum conductor:- on the outgoing side.
- h) The exact number of switch including regulator for fans and layout of the same in the switchboard shall be to the requirement during installation.
- i) The maximum no. of luminaries controlled by one no. 6 Amp switch would be 4 nos. For D.C. fixtures there will be no switch and same shall be directly controlled from DCLP
- j) The luminaries shall be wired in such a fashion that luminaries on each phase are evenly distributed all over the room.

8.0 CONDUITS & CONDUIT ACCESSORIES:

- 8.1 The contractor shall supply & install] all rigid steel/PVC, heavy duty conduits all accessories required like associated couplers, pull out boxes, elbows, tees, reducers, junction boxes, steel wire for cable/wire pulling, GI saddles, screws, bolts, nuts required. The size of conduits to be used shall be as required.
- 8.2 All steel conduits shall be seamed by welding, shall be of heavy gauge & shall be hot dip galvanized.

- 8.3 The conduits shall conform to IS: 9537. The minimum size of conduit shall be 20mm.
- 8.4 Each of conduits shall be straight, free from blister & other defects & furnished in standard length of 3.0 Mts. threaded at both ends. The manufacturer's name shall be stamped on each piece.
- 8.5 Flexible conduits wherever required shall be made with bright, cold rolled annealed & electro-galvanized mild steel strips or PVC/plastic.
- 8.6 Concealed conduits shall be PVC and exposed conduits shall be of steel.
- 8.7 All conduits accessories shall conform to relevant IS & shall be hot dip galvanized or high quality virgin PVC and shall be ISI marked.
- 9.0 JUNCTION BOXES:
- 9.1 The contractors shall supply & install the junction boxes.
- 9.2 The junction boxes shall be concealed type for indoor lighting and suitable for mounting on columns, lighting poles, structures etc. for outdoor. The supply & erection of brackets, bolts, nuts & screws required for the erection shall be included in the installation rates.
- 9.3 Junction boxes shall be of square /rectangular type of 1.6mm sheet steel with minimum 6mm thick pressure die cast aluminum material LM-6 & shall have bolted cover with good quality gasket lining.
- 9.4 The junction box & cover shall be hot dip galvanic.
- 9.5 The junction boxes shall be complete with conduit knockouts/ thread nuts & provided with terminal strips which shall be as specified under clause No. 9 of this section. The junction boxes shall be suitable for termination of conduit/glands of dia. 20mm, 25mm, 32mm, and 40mm on all sides. The junction boxes shall be provided with 4 way terminals suitable for two numbers 10 sq.mm. wire and for street Earthing / switchyard lighting suitable for 2 No. 4Cx16 sq mm Aluminum cable.

9.6 The junction boxes shall have the following indelible markings.

- i) Circuit Nos. on the top.
- ii) Circuit Nos. with ferrules (inside) as per drawings.
- iii) DANGER sign in case of 415 volt junction box

9.7 The junction boxes shall be weather proof type with gaskets conforming to IP-55 as per IS:13947 (Part-I). The conduit connections shall also be properly, sealed to prevent entry of water.

10.00 TERMINAL BLOCKS

10.1 Multi way terminal blocks shall be ESSEN/Tosha make, complete with screws, nuts, washers & marking strips. Terminals shall be stud types.

10.2 Each terminal shall be suitable for terminating up to 2 Nos. 10 sq. mm stranded Aluminum conductors without any damage to the conductors or any looseness of connections. Terminal strips provided in street-lighting poles shall be suitable for terminating up to 2 Nos. 4C x 16 sq mm aluminum cables.

11.0 PULL OUT BOXES

11.1 The contractor shall supply & install the pull out boxes.

11.2 The pull out boxes shall be concealed type for indoor and suitable for mounting on walls, column, structures etc. for outdoor. The supply of bolts, nuts screws required for the erection shall be included in the installation.

11.3 The pull out boxes shall be circular of cast iron or 16 SWG sheet steel & shall have cover with good gasket lining.

11.4 The pull out boxes & cover shall be hot dip galvanized.

11.5 The pull out boxes shall be completed with conduit knock outs/threaded hubs & provided at approximately 3 meters intervals in a conduit run.

11.6 The pull out boxes used outdoors shall be weather proof type with gaskets conforming to IP-55 as per IS:13947(part-I).

12.0 Residual Current Circuit Breakers (RCCB)

For indoor panels 63A 4pole 300 ma RCCB conforming IS 12640 will be provided along with incomer.

13.0 Miniature Circuit Breaker (MCB)

- The miniature circuit breakers shall be suitable for manual closing, opening, automatic tripping under overload and short circuit. The MCBs shall also be trip free. MCB of Type C tripping characteristics as per IS 8828 will be used for Switchyard lighting.
- Single pole as well as three pole/ four pole versions shall be furnished as required in the Schedule of Lighting Panels.
- The MCBs and panel MCCB together shall be rated for full fault level. In case the MCB rating is less than the specified fault level the bidder shall co-ordinate these breaker characteristics with the backup MCCB in such a way that if fault current is higher than breaker rating, the MCCB should trip earlier than the MCB. If the fault current is less than MCB breaking capacity, MCB shall operate first and not the incomer MCCB.
- The MCBs shall be suitable for housing in the lighting panels and shall be suitable for connection with stranded copper wire connection at both the incoming and outgoing side by copper lugs or for bus bar connection on the incoming side.
- The terminals of the MCBs and the 'open' 'close' and 'trip' conditions shall be clearly and indelibly marked.
- The tenderer shall check and co-ordinate the ratings of MCBs with respect to starting characteristics of discharge lamps. The vendor has to furnish overload and short circuit curve of MCB as well as starting characteristics curves of lamps for Employer's approval.
- The MCB shall generally conform to IS:8828.

14.0 Contactors

Contactors shall be of the full voltage, direct-on line air break, single throw, electro-magnetic type. They shall be provided with atleast 2-'NC' and 2'NO' auxiliary contacts. Contactor shall be

provided with the three element, positive acting, ambient temperature compensated time lagged, hand reset type thermal overload relay with adjustable settings to suit the rated current. Hand reset button shall be flush with the front of the cabinet and suitable for resetting with starter compartment door closed. The Contactor shall be suitable for switching on Tungsten filament lamp also. The bidder shall check the adequacy of the Contactors rating wire with respect to lighting load.

15.0 Push Buttons

All push buttons shall be of push to actuate type having 2 'NO' and 2 'NC' self reset contacts. They shall be provided with integral escutcheon plates engraved with their functions. Push buttons shall be of reputed make.

16.0 Labels

- The lighting panels shall be provided on the front with panel designation labels on a 3 mm thick plastic plate of approved type. The letter shall be black engraved on white back ground.
- All incoming and outgoing circuits shall be provided with labels. Labels shall be made of non-rusting metal or 3 ply lamicold. Labels shall have white letters on black or dark blue background.

17.0 Earthing Terminals

Panels shall be provided with two separate and distinct earthing terminals suitable to receive the earthing conductors of size 50x6 G.S. Flat.

18.0 EMERGENCY PORTABLE LIGHTING FIXTURES

- 18.1 The contractor shall supply, store & install Emergency Lighting Fixtures.
- 18.2 The portable fixtures shall have a built in battery rated for 6 hours, battery chargers & solid inverters. These shall be of approved make.

- 18.3 The portable fixtures shall be of a single unit, completely tropicalised & suitable for prolonged use with no maintenance.
- 18.4 The portable fixtures shall be supplied & necessary- supporting brackets of galvanized steel suitable for wall/column mounting shall also be supplied.
- 18.5 The portable fixture shall come-up automatically in the event of failure of normal supply.
- 18.6 The contractor shall submit schematic along with all details & GA drawing for owner's approval.

19.0 LIGHTING POLES

- 19.1 The contractor shall supply, store & install the following types of steel tubular lighting poles required for street lighting,
- a) Type A1 Street Lighting Pole - for one fixture.
 - b) Type E1 Post top lantern Pole - for one fixture.
- 19.2 Street/ flood light poles shall conform to the drawings. The complete civil works for erection of the lighting poles shall be included in the scope of work.
- 19.3 Lighting poles shall be complete with fixing brackets & junction boxes. Junction boxes should be mounted one meter above ground level.
- 19.4 The lighting poles shall be coated with bituminous preserving paint on the inside as well as on the embedded outside surface. Exposed outside surface shall be coated with coats of metal primer (comprising) of red oxide & zinc chromate in a synthetic medium).
- 19.5 The galvanized sheet steel junction box for street lighting poles shall be completely weather proof conforming to IP-55 & provided with a lockable door & HRC fuse mounted on a fuse carrier & fuse base assembly. The junction box shall be as specified at Clause No. 8, however, terminals shall be stud type suitable for 6 Nos. 16sqmm cable.
- 19.6 Wiring junction box at the bottom of the pole to the fixture at the top of the pole shall be done through 2.5 sq.mm. wire.

19.7 Distance of center of pole from street edge should be approximately 1000 to 1200 mm.

19.8 Earthing of poles should be connected to the switchyards and main earth mat wherever it is available & the same should be earthed through 3M long, 20mm diameter, earth electrode.

20.0 CEILING & WALL MOUNTED FANS AND REGULATORS.

20.1 The contractor shall supply & install 1400mm sweep ceiling fans complete with electronic regulator & switch, suspension rod, canopy & accessories. The wall mounted fans shall be of 400 mm sweep.

20.2 The contractor shall supply & install the switch, electronic regulator & board for mounting switch & electronic regulator.

20.3 Winding of the fans & regulators shall be insulated with class-E insulating material. Winding shall be of copper.

20.4 Electronic regulator smooth control shall be provided. Precautions shall be taken in manufacture of fans regulators to ensure reasonable degree of silence at, all speeds.

20.5 Type tests, acceptance tests & routine tests for the fans & regulators shall be carried out as per latest relevant standard.

20.6 Fans & electronic regulators shall be of Alstom/ Compton Greaves /Bajaj Electrical /Usha Electrical make.

21.0 LIGHTING WIRES

21.1 The wiring used for lighting shall be standard product of reputed manufacturers.

21.2 The wires shall be of 1100V grade, PVC insulated product of reputed manufacturers.

21.3 The conductor sizes for wires used for point wiring beyond lighting panels shall be single core 4sqmm, 6 sqmm & 10 sq. stranded aluminum wires & 2.5 sqmm, 4 sq.mm, 6 sq.mm & 1.5 sq. mm stranded copper-wire.

21.4 The. wires used for connection of a lighting fixture from a nearest junction box or for loop-in loop-out connection between two fluorescent fixtures shall be single core copper stranded conductor, 1100V grade flexible PVC insulated cords, unsheathed, conforming

to IS: 694 with nominal conductor cross sectional areas of 2.5 sq. mm.

21.5 The contractor's scope covers the supply & installation of the above wires.

21.6 The wires shall be colour coded as follows:

Red	for	R-Phase
Yellow	for	Y-Phase
Blue	for	B-Phase
Black	for	Neutral
White	for	DC (Positive)
Grey for DC (Negative)		

22.0 PAINTING OF SHOP MADE ITEMS:

22.1 All sheet steel work shall be phosphated in accordance with the following procedure & in accordance with IS:6005 'Code of practice for phosphate Iron & Steel.

22.2 Oil grease & dirt. shall be thoroughly removed by emulsion cleaning.

22.3 Rust & scale shall be removed by pickling with dilute acid followed by washing with water, rinsing with slightly alkaline hot water & drying.

22.4 After phosphating thorough rinsing shall be carried out with clean water, followed by final rinsing with diluted dichromate solution & oven drying.

22.5 The phosphate coating shall be sealed by the application of two coats of ready mixed stoving type metal primer (comprising of red oxide & zinc chromate in a synthetic medium). The first coat may be flash dried 'while the second coat shall be staved.

22.6 After application of the primer, two coats . of finishing synthetic enamel paint shall be applied with each coat followed by stoving. The second finishing coat for external of panels shall be applied after completion of tests.

22.7 Both outside & inside of lighting panel, sheet metal fabricated junction boxes etc., & outside of lighting fixtures shall be finished in light Grey (IS-5 shade 631). Inside of lighting fixtures shall be

finished in white.

22.8 Each coat of primer & finishing paint shall be of slightly different shade so as to enable inspection of the painting.

22.9 The final finished thickness of paint film on steel shall not be less than 100 microns & shall not be more than 150 microns.

22.10 Finished painted appearance on equipment shall not be present and shall have aesthetically pleasing appearance, free of dents, & uneven surfaces.

23.0 TESTS AND TEST REPORTS

23.1 Type tests, acceptance tests & routine test for the lighting fixtures & accessories covered by the specification shall be carried out as per the relevant standard for the respective fixtures & their accessories.

23.2 Manufacturer's type and routine test certificates shall be submitted for the fixtures & accessories. The type test certificates shall be furnished along the bid.

24.0 LIGHTING SYSTEM INSTALLATION WORKS

24.1 General

24.1.1 In accordance with the specified instructions as shown on manufacturer drawings or as directed by owner, Contractor shall unload, erect, install, test & put into commercial use all the electrical equipment included, in the contract. Equipment shall be installed in a neat, workmanship manner so that it is level, plumb square & properly aligned & oriented. Tolerances shall be as established in manufacturer drawings or as stipulated by owner.

24.1.2 All apparatus, connections and cabling shall be designed so as to minimize risk of fire or any damage which will be caused in the event of fire.

24.1.3 Contractor shall furnish all supervision, labour, tools, equipments, rigging materials & incidental materials such as bolts, wedges, anchors, concrete inserts etc., required to complete the installation test & adjust the equipment.

24.1.4 Manufacturer's drawings, instructions & recommendations shall be correctly followed in handling, setting,

testing & commissioning of all equipment & care shall be exercised in handling to avoid distortion to structures, the marring of finish or damaging of delicate instruments or other electrical parts. Adjustment shall be made as necessary to the stationary structures for plumb & level for the sake of appearances or to avoid twisting of frames, bending of hinged members etc.,

- 24.1.5 All apparatus, connections & cabling shall be designed so as to minimize risk of fire or any damage, which will be caused in the event of fire.

24.2 CONDUIT SYSTEM

- 24.2.1 Contractor shall supply, store & install conduits required for the lighting installation as specified. All accessories/ fittings required for making, the complete, 'including but not limited to pull out boxes (as specified in Clause No.. 10) ordinary & tees & elbow, checkouts, male & female bushings (brass or galvanized steel), caps square headed make plugs, nipples, gland sealing fittings, pull boxes, conduits terminal boxes, glands, gaskets & box covers, saddle terminal boxes, & all steel supporting work shall be supplied by the contractor. The conduit fittings shall be of same material as conduits. The Contractor shall also supply 19 mm PVC conduit and accessories for telephone wiring.

- 24.2.2 All un-armoured cables shall run within the conduits from lighting panels to lighting fixtures, receptacles. etc.,

- 24.2.3 Size of conduit shall be selected as required.

- 24.2.4 Exposed conduits shall be run in straight lines parallel to building columns, beams & walls. Unnecessary bends crossings shall be avoided to present a neat appearance.

- 24.2.5 Conduit support shall be provided at an interval of 600mm for horizontal runs & 1000 mm for vertical runs.

- 24.2.6 Conduit supports shall be clamped on the approved type spacer plates or brackets by saddles or U-bolts. The spacer plates or brackets in turn shall be securely fixed to the building steel by welding & to concrete or brickwork by grouting or by nylon raw plugs. Wooden plugs, inserted in the masonry or concrete for conduit support is not acceptable.

- 24.2.7 Embedded conduits shall be securely fixed in position to preclude any movement. In fixing embedded conduit, if welding or brazing is used, extreme care should be taken to avoid any injury to the inner surface of the conduit.
- 24.2.8 Spacing of embedded conduits shall be such as to permit flow of concrete between them & in no case shall be less than 40mm.
- 24.2.9 Where conduits are long, with cable trays they shall be clamped to supporting steel at an interval of 600 mm.
- 24.2.10 For directly embedding in soil, the conduits shall be coated with an asphalt base compound. Concrete pier or anchor shall be provided wherever necessary to support the conduit rigidly & to hold it in place.
- 24.2.11 Conduit shall be installed in such a way as to insure against trouble from tapped condensation.
- 24.2.12 Running threads shall be avoided as far as practicable. Where it is unavoidable, check nuts shall be used.
- 24.2.13 Conduits shall be kept, - wherever possible, at least 30-Omm away from hot pipes, heating devices etc., when it is evident that such property may reduce the service life of cables
- 24.2.14 Slip joints shall be provided when conduits cross structural expansion joints or where long run of exposed conduits are installed, so that temperature change shall cause no distortion due- to expansion or contraction of conduit run.
- 24.2.15 For long conduit run, plug boxes shall be provided at suitable intervals to facilitate wiring.
- 24.2-16 Conduit shall be securely fastened to junction boxes or cabinets, each with a lock nut inside & outside the box.
- 24.2.17 Conduit lengths shall be joined by screwed couplers. Couplers shall be cleanly cut.
- 24.2.18 Conduit joints & connections shall be made through watertight & rust proof by application of a thread compound which insulates the joints. White lead is suitable for application on embedded conduit & lead for exposed conduit.

24.2.19 Field bends shall have a minimum radius of four (4) times the conduit diameter. Bends shall be free of kinks, indentations or flattened surfaces. Heat shall not be applied in making any conduit bend. Separate bends may be used for this purpose.

24.2.20 The entire metallic conduit system, whether embedded or exposed, shall be electrically continuous & thoroughly grounded. Where slip joints are used, suitable binding shall be provided around the joint to ensure a continuous ground circuit.

24.2.21 Conduits & fittings shall be properly protected during construction period against mechanical injury. Conduit ends shall be plugged or capped to prevent entry of foreign material.

24.2.22 After installation, the conduits shall be thoroughly cleaned by compressed air before pulling in the wire.

24.2.23 Lighting fixtures shall not be suspended directly from the junction box in the main conduit run.

24.3 **WIRING:**

24.3.1 Wiring shall be generally carried out by PVC wires in conduits. All wires in a conduit shall be drawn simultaneously. No subsequent drawing of wires is permissible.

24.3.2 Wires shall not be pulled through more than two equivalent 90-degree bends in a single conduit run. Where required, suitable junction boxes shall be used.

24.3.3 Wiring shall be spliced only at junction boxes with approved type terminal strip.

24.3.4 For lighting fixtures, connection shall be teed off through suitable round conduit or junction box, so that the connection can be attended without tiling down the fixture.

24.3.5 For vertical run of wires in conduit, wires shall be suitably supported by means of wooden/hard rubber plugs at each pull/junction box.

24.3.6 Maximum two wires can be terminated to each way of terminal connections.

24.3.7 Separate neutral wires are to be provided for each circuit.

24.3.8 AC & DC wires should not run through the same conduit.

24.4 LIGHTING FIXTURES & RECEPTACLES:

24.4.1 Continuous rows of fluorescent tubes shall be mounted on a continuous MS channel for each row of lights.

24.4.2 Floodlights shall be mounted on steel base facing the tentative direction shown on drawings. Fixing hole shall be provided with slot to turn the fixture by about 5 degree on both sides. Bolts shall be finally tightened with spring washer. The contractor shall supply & install the steel base, channels, angles etc., for the floodlights on the flood light towers. Terminal connection to the floodlight shall be through flexible conduits, & these flexible conduits shall be quoted along with the fixture itself.

24.4.3 The installation rate of lighting fixtures shall include the supply of necessary brackets except GI conduits for pendant mounted fixtures.

24.4.4 The drawings showing the mounting details of each fixture shall be furnished to the owner & necessary, approval to be obtained prior to installation.

24.4.5 The receptacles shall be installed in the locations shown in the drawing.

24.5 LIGHTING PANELS VOID

24.5.1 VOID

24.5.2 VOID

24.6 STREET LIGHTING / FLOOD LIGHTING POSTS

24.6.1 Street lighting / flood lighting posts shall be installed at a distance not more than 30 meter. In front of control room & other buildings decorative post lantern (Type El) poles shall be installed.

24.6.2 The steel tubular poles which are specified for the above purpose to be painted with two coats of aluminum paints after completion of installation. Contractor shall erect the poles (including foundation works), mount the assembled fittings & install necessary cabling.

24.7 JUNCTION

BOXES

24.7.1 Junction boxes having volume less than 1600 cc shall be installed without any support other than that resulting from connecting conduits where two or more rigid metallic conduits enter & accuracy position in box.

24.7.2 Junction boxes with volume equal or greater than 1600 cc & small boxes terminating, on less Than two rigid metallic conduits or other reasons not rill-.Idly held shall be adequately supported by auxiliary steel of standard steel shapes or plates to be fabricated & installed.

23.7.3 Necessary holes for conduit / cable entry shall be made during installation depending on the requirement. The holes shall be drilled / punched neatly & shall be dust vermin proof after 'installation of the conduit.

23.7.4 The welds bolt holes, conduit entry holes etc., made during installation as mentioned above shall be wire brushed & touched up with metal primer specified under clause No. 16 of this section.

23.7.5 LIGHTING PANELS (L.P.)

a) Each panel shall be provided with one incoming Four pole MCB and outgoing miniature circuit breakers as per clause 3.0. The panels shall conform to IS-8623.

b) Constructional Features

- i. Panels shall be sheet steel enclosed and shall be dust, weather and vermin proof. Sheet steel used shall be of thickness not less than 2.00 mm (cold rolled) smoothly finished, levelled and free from flaws. Stiffners shall be provided wherever necessary. The indoor lighting panels will be ready made DB of minimum 1.6 mm sheet thickness.
- ii. The panels shall be of single front construction, front hinged and front connected, suitable for either floor mounting on channels, sills or on walls/columns by suitable M.S. brackets. Indoor panels in control room shall be flush mounted.

- iii. Panels shall have a dead front assembly provided with hinged door(s) and out door panels will be with padlocking arrangement with single key supplied in duplicate.
- iv. All out door panels, removable covers, doors and plates shall be gasket all around with neoprene gaskets.
- v. The outdoor panels shall be suitable for cable/conduit entry from the top and bottom. Suitable removable cable gland-plate shall be provided on the top and bottom of panels. Necessary number of double compression cable gland shall be supplied, fitted on to this gland plate. The glands shall be screwed on top and made of tinned brass.
- vi. The panels shall be so constructed as to permit free access to connection of terminals and easy replacement of parts.
- vii. Each panel shall have a caution notice fixed on it.
- viii. Each panel will be provided with directory holder in which printed and laminated as built circuit directory would be kept inside a document holder/pasted at site.
- ix. Each Outdoor lighting panel shall be provided with one no. 'ON' indicating lamp for each phase along with fuses. For indoor lighting panels din mounted phase indication lamps will be provided , mounted along side of the MCB
- x. Main Bus Bars

Bus bars shall be of aluminium alloy conforming to IS:5082 and shall have adequate cross-section to carry the rated continuous and withstand short circuit currents. Maximum operating temperature of the bus bars shall not exceed 85 deg. C. The bus bars shall be able to withstand a fault level of 9 kA for 1 sec. for AC panels and 4 KA for 1 sec. for DC panels. The Indoor lighting panels shall have copper bus bar

23.8 FOUNDATION & CIVIL WORKS:

- 23.8.1** Foundation for street lighting poles / Flood lighting, poles & panel foundation & transformer shall be done by the contractor. The rates for these civil works shall be included 'in the erection rates of respective items.

23.8.2 The contractor shall check these foundation before commencement of erection to ensure their suitability.

23.8.3 All final adjustment of foundation levels, chipping & dressing of foundation surfaces, setting & grouting of anchor bolts, sills, inserts & fastening devices shall be carried out by the contractor including minor modification of civil works as may be required for erection.

23.8.4 Any cutting of masonry / concrete work, which is necessary shall be done by the contractor at his own cost & shall be made good to match the original work. The contractor shall obtain approval of the site Engineer before proceeding with any cutting of masonry concrete work.

23.9 EXCAVATION & BACKFILLING

23.9.1 The contractor shall perform all excavation & backfilling as required for ground connections and for foundations for street lighting poles, panels & transformers.

23.9.2 Excavation shall be performed up to the required depth. Such sheeting & shoring shall be done as may be necessary for protection of the work.

23.9.3 The contractor shall make his own arrangements for pumping out any water that may be accumulated in the excavation.

23.10 **STEEL FABRICATION:**

23.10.1 The steel structures fabricated by the contractor shall be cleaned of rust etc. All fabrications shall be free of sharp edges.

23.10.2 All steel fabrications shall be painted with two coats of metal primer (comprising of red oxide & zinc chromate in a synthetic medium) followed by two coats of aluminum paint.

23.11 **TESTING & COMMISSIONING**

23.11-1 On completion of erection work, the contractor shall request the owner, for Inspection & test with minimum of fourteen- (14) days advance notice.

23.11.2 The owner shall arrange for joint inspection of the installation for completeness & correctness of the work. Any defect

pointed out during such inspection shall be rectified promptly by the contractor.

23.11.3 The installation shall be then tested & commissioned in presence of the engineer.

23.11.4 The contractor shall provide all men, materiel & equipment required to carry out the tests.

23.11.5 All rectification's, repairs or adjustment work found necessary inspection, testing & commissioning, shall be carried out by the contractor, without any extra cost.