BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-360-316-015	Rev no.-00	Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	SK	SKS	RS
TITLE		SIGN			21/02/15
SPECIFICATION FOR ILLUMINATION SYSTEM		DATE	21.02.15		
		GROUP	TBEM	W.O. No	83001
CUSTOMER/ CONSULTANT	Rajasthan Rajya Vidyut Utpadan Nigam Ltd. , Jaipur / Tata consulting Engineer Ltd. , Bangalore				
PROJECT	2X660MW Super –Critical Thermal Power Station, Stage –V, Unit 7 & 8-400kV Switchyard at Suratgarh				

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SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE:

1.0.0 This technical specification covers the requirements of design, manufacture, testing at works, packing, dispatch, unloading at site, storage, erection, testing & commissioning of complete Illumination and associated electrical auxiliary system, complete with accessories. No deviation from the requirements specified in various clauses of this specification shall be allowed.

1.0.1 **The Contract shall be on Bill of Quantity basis for the package. In case of change in scope after award of the contract, the additions/ deletions to the scope shall be as per the breakup unit rates for all the equipment and services furnished by the bidder in his offer. The Contractor shall be responsible for the design and verification of the Illumination system, demonstration of lux levels and other criteria at site.**

1.0.2 The term "Owner' appearing in this specification shall refer to ultimate customer, the term 'Purchaser" shall refer to BHEL and the term 'Contractor" shall refer to the successful Bidder.

Name of customer : Rajasthan Rajya Vidyut Utpadan Nigam Ltd. , Jaipur.
Name of Consultant : Tata consulting Engineer Ltd. , Bangalore
Name of the project : 2X660MW Super –Critical Thermal Power Station, Stage –V, Unit 7 & 8-400kV Switchyard at Suratgarh

The specification comprise of following sections:

Section-1: Scope, specific technical requirements & Bill of Quantities.
Section-2: Equipment specification under scope of supplies.
Section-3: General technical requirements for all equipments under the project.
Section-4: Equipment Data Sheet

In case of any conflict between various sections, order of precedence shall be in the same order as listed above.

1.1 ILLUMINATION & SMALL POWER SYSTEM REQUIREMENT FOR VARIOUS AREAS:

The illumination system shall be provided for the following areas.

i) Switchyard control building of Unit 7 & 8
ii) Outdoor switchyard area of unit 7 & 8
iii) Outdoor extension switchyard area of unit -6 under present scope
iv) 11kV Switchyard at unit 7 & 8 power plant side
v) 11kV switchyard at river water pump side

The lighting system of transformer yard area of unit 7 & 8 will not covered under BHEL TBG scope.

1.2 DESIGN CRITERIA FOR ILLUMINATION SYSTEM:

As per design philosophy of switchyard lighting system – Refer attached **Annexure-1** of section-1 of this specification.

1.3 LIGHTING SYSTEM DESCRIPTION:

As per design philosophy of switchyard lighting system – Refer attached **Annexure-1** of section-1 of this specification.

It may be noted that only ceiling fan(for location refer cl. No. 3.10.3 of Annexure-1 of section -1) and exhaust fan in store, toilet pantry shall be in illumination supplier scope , other supply air fan and exhaust fan used in switchyard building shall be in BHEL scope.

Split AC of switchyard building shall be in BHEL scope.

1.4 SCOPE OF SUPPLIES & SERVICES:

1.4.1 SCOPE OF SUPPLY MATERIAL & ERECTION MATERIAL

a) The main items to be furnished for Substation under this contract are detailed in Bill of Quantity **(Annexure-2)** and shall be read in conjunction with other clauses of this specification.

b) All associated items, though not specifically mentioned but required for safe and satisfactory operation of equipment/ system will also be treated as included and the same shall be supplied at NO EXTRA COST to Purchaser.

c) Further, in case any type of luminaire/ panels etc not included below but are required meeting the technical specification shall be specifically brought out in the offer/shall be supplied.

d) 415V MLDB(Main lighting distribution board), NELDB(Normal emergency lighting distribution board) and WDB(Welding distribution board)are being supplied and erected by the purchaser.

e) 30 m height high masts civil foundation work shall be in BHEL scope. 30 m height high masts foundation design shall be in illumination supplier scope High masts foundation bolt shall be in illumination supplier scope. It may be noted that erection of high masts shall be in illumination supplier scope.

f) The cable laying and termination of MLDB,NELDB, WDB, Lighting panels, 63A welding receptacles, split Air conditioner panel , high mast feeder pillar and JB shall be in BHEL scope.

g) The cable termination between JB of street lighting pole and fitting along with **necessary lugs and glands** shall be in Illumination supplier scope.

1.4.2 FREE ISSUE ITEMS FROM PURCHASER:

Power Cables: Following are the various cable sizes that may be used for project execution. Bidder shall estimate the cables required for successful completion of the full scope of works and furnish the break up of quantity. The following size of cable quantity shall be free issued to the successful bidder .

1) WDB to 63A receptacles- 3.5 core x 70 sq.mm Al/XLPE
2) MLDB/NELDB to lighting panels - 3.5 core x 70 sq.mm Al/XLPE
3) MLDB to Split air conditioner panels - 3.5 core x 70 sq.mm Al/XLPE
4) Outdoor lighting panel to High mast feeder pillar -4Cx16 sq mm Al/XLPE
5) Feeder pillar to feeder provided in High mast -4Cx16 sq mm Al/XLPE
6) Outdoor lighting panel to junction box of street lighting pole- 2 core x 2.5 sq. mm Cu/PVC

Earthing material : Galvanised 50X 10 mm GI earthing Flat and 40 mm dia MS rod shall be available with the purchaser. Bidder shall estimate the GI Flats and MS rod for successful completion of the full scope of works and furnish the quantity. The quantity of the GI Flat and 40 mm dia MS rod shall be free issued to the successful bidder. No variation shall be admissible to the Contractor so far the input remains unchanged.

1.4.3 SCOPE OF SERVICES:

The bidder shall quote for ETC which include civil works, cable termination & earthing against each item as applicable. The list is attached as Annexure-2 (BOQ).

1.4.3.1 ERECTION COMMISSIONING AND TESTING:

a) The Contractor shall give the offer for Erection, Testing and Commissioning of the Illumination Equipment at Site.
b) The scope of ETC shall include receipt of material at site, unloading at site , safe storage of material, handling of equipment/ material at site, erection of equipment / material at site including fabrication, equipment and system testing, commissioning of the entire system. **Store for Illumination material shall be provided by BHEL.**
c) Conducting lux level measurement as per approved designs to the satisfaction of owner / purchaser.
d) All material and consumables required for erection work shall be in Contractor's scope. Erection material shall cover, but not limited to, Clamps etc for Luminaries(both indoor and outdoor) , Connections between Junction Boxes and Luminaries in outdoor area, All cable glands, lugs and ferrules require for cabling/ wiring. Any other material required for erection shall deemed to be in Contractor's scope.
e) Earthing of all electrical equipment as per requirements.

f) Contractor shall arrange all machinery tools & tackles, instruments and consumables required for erection, commissioning and testing of the system.

g) Contractor shall ensure that sufficient quantity of commissioning spares is made available for timely completion of commissioning of the system. The contractor shall furnish a list of Commissioning spares that will be brought by him. The unused commissioning spares shall be returnable to the Bidder.

1.4.3.2 Civil Works:

Civil works such as foundation for outdoor lighting panels and feeder pillar of high mast shall be done by the contractor. The rates for these civil works shall be included in the erection rates of respective items.

1.4.3.3 EARTHING: As per specification requirement is to be followed wherever applicable.

1.5 TYPE TESTS:

Bidder shall submit valid type test reports (as per relevant IEC/IS standard) for the tests carried out within last five years **from the date of opening of the tender** (i.e. 03.12.2012). The reports should have been conducted on identical or similar equipment/components to those offered. In case type test reports are more than 5 years old (from the date of opening of the tender) or the reports of type tests are found to be technically unacceptable , the type test shall be conducted by the vendor without cost and delivery implication to BHEL. The type test if conducted shall be witnessed by BHEL/Customer.

1.6 INSPECTION & TESTING:

Before being fitted on the equipment, all components shall be subjected to routine tests at the Contractors factory, as per the relevant IEC/IS standards. A detailed test report proving the successful passing of such tests shall be provided.

Prior to dispatch, the routine & acceptance tests shall be carried out on equipment in accordance with the applicable IEC /IS and the material shall be offered for final inspection to BHEL and RRVUNL in accordance with agreed quality plan with 3 weeks advance information.

1.7 QUALITY PLAN:

The contractor shall carry out contract works in accordance with sound quality management principles which shall include such as controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirement shall apply to all activities during design, procurement, manufacturing, inspection,

testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Contractor shall submit detailed Quality Plan for BHEL / customer's approval within 1 week of P.O. placement.

1.8 UTILITIES AVAILABLE:

Construction water and 415V power shall be available at one point at each substation. Bidder shall be required to make own arrangement for taking supplies from there.

Annexure-1 Project -400kV Substation
Design philosophy of switchyard lighting system

1.0 SCOPE :

The document covers various types of lighting system, lighting system design, illumination levels for various areas, luminaries type and low voltage power services for following areas.

i) Switchyard control building of Unit 7 & 8
ii) Outdoor switchyard area of unit 7 & 8
iii) Outdoor extension switchyard area of unit -6 under present scope
iv) 11kV Switchyard at unit 7 & 8 power plant side
v) 11kV switchyard at river water pump side

The lighting system of transformer yard area of unit 7 & 8 and power plant area will be under the scope of power plant package.

2.0 TYPES OF LIGHTING SYSTEM :

2.1 Lighting system will be provided with AC Normal, AC Emergency and DC Emergency lighting as listed below.

i) Outdoor switchyard of unit 7 & 8 - AC Normal, AC Emergency

ii) Outdoor extension switchyard of unit -6 - AC Normal **(It may be noted that in existing switchyard only normal lighting system is available**).

iii) Switchyard control building of unit 7 & 8 - AC Normal, AC Emergency, Portable type Ni-Cd battery operated emergency lighting units and 220V DC Emergency lighting.

iv) 11kV Switchyard at unit 7 & 8 power plant side - AC Normal, AC Emergency

v) 11kV Switchyard at river water side - **AC Normal (It may be noted that DG emergency supply is not available at river water pump side).**

2.2 The sources of power supply are as below:

i) 415V AC Normal (ACN) Supply from ACDBs.

ii) 415V AC Normal cum Emergency (ACE) Supply from ACDB/ DG emergency Board of power plant.

iii) 220V DC Emergency Supply from 220V DC Distribution Board.

iv) Maintenance 24V AC lighting system-Not envisaged for switchyard and associated Control room building .

Luminaries distribution for Indoor area- For switchyard building normally all AC luminaries (80% on ACN and 20% on ACE) will be in service and DC luminaries will be dark. Upon failure of AC normal supply, DC luminaries will be automatically switched 'ON'. On restoration of AC Emergency supply through DG, DC luminaries will be put-off automatically after a time gap of three minutes following the restoration of supply to

normal AC or emergency AC lighting system. In addition to automatic control, provision to switch-off DC lamps after restoration of AC supply could be done manually by DCELP.

Luminaries distribution for Outdoor area- For outdoor switchyard area normally all AC luminaries (80% on ACN and 20% on ACE) will be in service. Upon failure of AC normal supply, 20% AC emergency luminaries will be in service.

2.3 A.C Normal Lighting System:

2.3.1 AC Normal lighting fixtures are fed through a number of conveniently located AC Lighting Panels (ACLPs) which are fed from main Lighting Distribution Boards (MLDBs).

2.3.2 The Lighting transformer shall be encapsulated epoxy cast resin dry type air cooled with off circuit taps +/-5% in steps of 2.5%. Also the Main Lighting distribution shall be fed from 415/415 V Lighting transformers. The MLDB will consist of incoming MCCB and required number of outgoing triple pole and neutral SFUs (Refer drawing no. TB-0-360-316-004 for detailed SLD of MLDB) .

2.3.3 The ACLPs will be provided with 3-phase incomer controlled by MCB + ELCB and Miniature Circuit Breakers (MCBs) for outgoing feeders. MCBs will be provided with adequate rating for the expected short circuit current in the circuit. The fault level at LP will be restricted to **3kA.**

2.3.4 **Indoor lighting panels LP-1 :** 415V AC indoor lighting panel with 415V, 3 phase ,4 wire bus & one 63A, TPN MCB with ELCB(Earth leakage circuit breaker with 30 mA sensitivity) as incomer and 18 nos. 20A , 240V SPN MCBs as outgoing feeders. Lighting fixtures in indoor areas shall be controlled from the respective Switches. Provision of manual control shall be provided in indoor lighting panel.

2.3.5 **Outdoor lighting panel LP-2:** 415V AC lighting panels, 63A, 3 phase 4 wire bus with 63 A TPN MCB as incomer and 6 nos. 20A single pole MCB and 4 nos. 32A triple pole MCB as outgoing feeder. The timer or photocell for automatic ON and OFF shall be provided in outdoor lighting panel. Provision of manual control shall be provided in outdoor lighting panel .

2.3.6 For lighting system of an area, alternative rows of lighting fixtures shall be fed from different circuits to take care of complete lighting failure.

2.4 AC Emergency Lighting System:

2.4.1 AC Emergency lighting fixtures shall be fed through suitable numbers of conveniently located AC Emergency Lighting Panel (ACELPs) which are fed from AC Emergency Lighting Distribution Board (ACELDB).

2.4.2 Constructional details & technical particulars of ACELP shall be **same** as ACLP's as described above (Refer drawing no. TB-0-360-316-004 for detailed SLD of AC ELDB).

Annexure-1 Project -400kV Substation
Design philosophy of switchyard lighting system

2.5 220V D.C Emergency Lighting System:

2.5.1 DC Emergency lighting fixtures will be fed through suitable numbers of conveniently located DC Emergency Lighting Panel (DCELPs) which are fed through 220V DC Distribution Board (DCDB).

2.5.2 Indoor **220V DC Lighting Panels type DCP:** 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 panels shall have local push button controls. Lighting panels shall have 6 nos. 16A DP MCB unit of outgoing feeder. The panels shall have under voltage relay .

2.6 For safe personnel movement during non-availability of normal AC illumination, self-contained Ni-Cd battery operated emergency lighting units (ELU) with 4 hours duration will be provided in following areas.

(i) Switchyard control room =1no.

(ii) Shift Incharge room =1no.

(iii) LT switchgear room =1 no.

(iv) Maintenance staff room =1 no.

(v) Battery room =1 no.

(vi) Passage in each floor= 1 no.

(vii) Maintenance room =1 no.

(viii) Relay room =1 no.

(ix) Cable vault =1 no.

Each battery will have battery charger and 2X10W fluorescent lamp(CFL).

2.7 OUTDOOR SWITCHYARD LIGHTING:

2.7.1 30 m height **high mast (telescopic type)** will be used for 400kV switchyard unit 7 & 8 , extension of 400kV switchyard unit -6, 11kV switchyard at unit 7 & 8 power plant side and switchyard road lighting. Separate lighting through lighting poles shall generally not provided for road i.e. Road inside 400kV switchyard fence shall be illuminated by 30 m high masts flood light fixture.

2.7.2 **9.5 m high lighting pole will** be used for lighting of 11kV switchyard at river water pump side. The poles will be as per IS-2713.

2.3.7 Area lighting shall be with lighting mast of 30 meter height with its accessories. Mast shall be in two sections, hot dip galvanised and suitable for wind velocity as per IS 875

part 3. It shall also include all accessories for high mast including head frame, steel wire rope 6 mm dia, trailing cable, double drum winch, galvanised lantern carriage arrangement suitable for 8/16 nos. Luminaries and its control gear boxes. Lighting mast shall have motorised lantern carriage arrangement. The mast shall have an integral power tool installed inside the base compartment for its operation. The mast shall be supplied complete with foundation bolts manufactured from special steel along with nuts, washers and anchor plates. Suitable control panel housing control circuit for operation and control for power tool motor shall be provided with mast. Lighting mast shall be supplied along with 1x400W/ 2x400W/ 1x250W/ 2x250W fixtures and one no. twin dome aviation obstruction light with lamp. The mast with control panel shall be fenced with locking arrangement. Lighting mast shall be provided with lightning protection.

3.0 LIGHTING SYSTEM DESIGN BASIS:

3.1 Lighting system will be designed to ensure adequate visual performance, safety & reliability and will be free from excessive glare and flicker from discharge lamps. In switchyard Control Room, particular attention will be given to ensure proper and aesthetic illumination so as to prevent any glare/ luminous patch on control surfaces when viewed from an angle.

3.2 Energy Efficient **FTL-T5 type Fluorescent fixtures with electronic ballasts** will be used wherever required.

3.3 Fixtures mounted outdoor and in dusty areas will be weatherproof type with DOP of minimum IP-55.

3.4 Average lux levels and type of fixtures envisaged for the various areas, as applicable in the switchyard, are as follows.

Sl. no.	Location	Average level of illumination (lux)	Type of lighting fixtures	Type of Luminaries
AC Light fittings				
1.	Control/Relay/ PLCC room	500	Decorative recessed with wide angle mirror optic anti-glare type	2X28W energy efficient lamp
2.	Conference ,Engineers, maintenance staff , maintenance, shift incharge, Library cum record room	300	Decorative recessed with wide angle mirror optic anti-glare type	2X28W energy efficient lamp
3.	Electronics test lab	250	Decorative recessed with wide angle mirror optic anti-glare	2X28W energy efficient lamp

Annexure-1 **Project -400kV Substation**

Design philosophy of switchyard lighting system

4.	LT Switchgear, AHU room	250	Industrial type with vitreous enamel reflector	2X28W energy efficient lamp
5.	Cable vault	100	Industrial type FTL	2X28W energy efficient lamp
6.	Battery room	150	Corrosion proof	2X36W energy efficient lamp
7.	Pantry , Toilet	100	Channel mounted box type	2X28W energy efficient lamp
8.	Passage, staircase	100	Industrial type with vitreous enamel reflectors / channel mounted box type	2X28W energy efficient lamp
9.	Store	250	Industrial type with vitreous enamel reflectors / channel mounted box type	2X28W energy efficient lamp
10.	**Switchyard area and roads**(i.e. 400kV switchyard unit 7 & 8 , extension of 400kV switchyard unit -6, 11kV switchyard at unit 7 & 8 power plant side)	20	Flood lighting fixture	1X400W/2X400W /1X250W/2X250W High Pressure Sodium Vapour (HPSV) lamps
11.	11kV switchyard at river water pump side	20	Street lighting fixture	1X150W High Pressure Sodium Vapour (HPSV) lamps
DC light fitting (Location as per note -4)				
12.	Control/Relay/ PLCC /Conference room	-	Decorative recessed type with cylindrical reflector	1 x 100 W Incandescent lamp

13.	Engineers, maintenance staff , maintenance, shift incharge, Library cum record , Electronics test lab , store , cable vault, LT switchgear, battery, AHU and corridor and exit	-	Industrial bulk head or industrial well glass with reflector	1 x 100 W Incandescent lamp

Note-

1- The minimum lux level to average lux level ratio should not be less than 0.7 (i.e. Emin / Eav≥ 0.7) for indoor area.

2- Ratio of minimum lux level to average lux level shall not be less than 0.3 for outdoor switchyard. Ratio of minimum lux level to maximum lux level shall not be less than 0.2 for outdoor switchyard. The maintenance factor for outdoor switchyard shall be 0.6 under average condition.

3 Control, Relay , PLCC and conference room have **false ceiling , all other rooms are without false ceiling.**

4- Following minimum DC light fitting shall be provided in the following areas.
-Control room -1no. , Relay room -1 no. , PLCC rrom-1 no., Electronic test lab-1no., Shift incharge room -1 no., Engineer room -1 no., Maintenance Staff room -1 no., Maintenance room -1 no., Library cum record room -1no., Conference room – 1 no., Store room-1 no., LT switchgear room -2 nos., corridors and exit -6 nos., Battery room – 1 no., AHU room -1 no., Cable vault- 2 nos.

However 10% emergency DC light fitting shall be provided in switchyard control room .

3.6 The lighting fixtures will be group controlled from lighting panel by miniature circuit breakers. The lighting fixtures in office areas, control rooms etc. will be controlled by switches.

3.7 All LP's and LDB's shall be painted with shade 631 of IS -5. Outdoor lighting panels shall have IP: 55 degree of protection and shall be provided with canopy.

3.8 The JBs used in outdoor areas shall be weatherproof type and coated with epoxy paint. All JBs shall be of polycarbonate /FRP/ Di-cast aluminium.

3.9 **ILLUMINATION DESIGN CALCULATION :**

3.9.1 For indoor design -

The Reflection Factor (RF) will be considered as given below:

Ceiling (rc) Wall (rw) Floor (rf)

For air-conditioned area	50	30	10
For non air-conditioning area	30	30	10

Values of Maintenance Factor (MF), which includes the luminaries depreciation factor also as per IS-3646, will be considered as given below:

a) Air conditioned clean interiors like office rooms Laboratories : 0.8

b) Switchgear room : 0.7

c) General indoor area : 0.7

3.9.2 Utilisation factor considering the room index at applicable surface reflection factors. The working plane shall be considered at 0.85 m from the floor level in switchyard control building. Working plane height shall be considered as 0.0m from the floor level for corridors in switchyard control building and outdoor switchyard.

3.9.3 The value of the ratio of spacing (S) to mounting height (H) shall be commensurate with the type of fittings selected and uniformity of illumination. The suspension height for suspended fixtures shall not exceed 1 meter.

3.9.4 Lighting design for both indoor & outdoor areas shall be done through computer program as per standard norms for lighting design to meet the specified lux level.

3.10 **LOW VOLTAGE POWER SERVICES:**

3.10.1 240V, 50 Hz, 3 pin Power Receptacles (5A and 15A) shall be provided in switchyard control building. Inside a building, receptacles shall be provided at interval of 30M or part there of for hand tools, water coolers, exhaust fans etc. Inside each cabins at least two receptacles shall be provided and the same shall be indoor/outdoor/flameproof as per the location. **Minimum 2 nos. of 5A and 1 no. of 15A decorative type receptacles shall be provided in each room.**

20/32A, 240V Indoor decorative type Receptacle Single Phase, 3-pin type shall be provided for split AC located in switchyard control building.

3.10.2 Suitable nos. of 63A, 3-phase, 415 V welding receptacles with switch will be provided at following location for welding purposes.

(i) Two nos. in switchyard control building (1 no. located In cable vault and one no. Located in control /relay room).

(ii) One (1) no. for every 60M in switchyard.

(iii) Looping of welding receptacles not allowed.

3.10.3 No ceiling fans shall be provided in packages air conditioned rooms (i.e. Control/Relay/ PLCC /Conference room).

Suitable nos. of 1200 mm sweep ceiling fans with stepped electronic regulator and flush mounted on switchboard shall be provided in following rooms.

Engineers, maintenance staff, maintenance, shift incharge, Library cum record, Electronic test lab and Store.

3.10.4 We have envisaged Split AC in following rooms.

Electronic test lab, Library cum record room , shift in charge room , maintenance staff room, maintenance room and engineer room.

3.10.5 We have envisaged exhaust fan in store , battery , pantry and toilet. Exhaust fans will be provided with their control devices (MCB) & louvers.

3.11 **WIRING / CONDUITS:**

3.11.1 Wiring of lighting system will be done as follows:

i) Wiring installation will be by multi-stranded, PVC insulated, colour coded wires laid in galvanised MS conduits of 20 mm dia minimum size.

ii) Conduits will be medium-duty type hot dip galvanised steel conforming to IS-9537. Conduit accessories will be hot dip galvanised. In corrosive area, conduits will have suitable epoxy coating additionally.

iii) Conduits in control room and conference room i.e. air-conditioned areas will be surface mounted on the roof above false ceiling. Wiring shall be through **concealed** conduit for rooms without false roofing. However vertical drops of conduits will be within column flanges and /or concealed in wall , finally covered for better aesthetics.

iv) Filling area of wires in conduit shall not exceed 40% of the conduit area.

v) Wiring for AC Normal, AC Emergency, and DC Emergency services will be run in separate conduits.

vi) Lighting and receptacles will be fed from separate circuits. No two different phase circuits will be run in the same conduit. However, different circuits of same phase may be laid in the same conduit.

vii) Maximum three number of receptacles will be looped in and looped out in a circuit.

3.11.2 Following sizes of copper conductor wires will be used.

i) 2.5 mm^2, 1100 V grade, PVC insulated, single core, stranded copper conductor for lighting fixtures from switch/JB to lighting fixture.

ii) 2.5/4.0 mm^2, 1100 V grade, PVC insulated, single core, stranded copper conductor from panel to fixture, JBs/switches and circuit wiring depending upon circuit length and voltage drop.

iii) 4.0 mm^2, 1100 V grade, PVC insulated, single core, stranded copper conductor will be used for 5/15 receptacles.

3.11.3 For outdoor area lighting, armoured cables will be used. For loop-in-loop out of cable from high mast to lighting panels, 50/100 mm dia GI Pipes will be used if trench is not available. Hume pipe will be used where cables are crossing roads.

Following size of cables will be used for outdoor.

(i) Outdoor lighting panel to High mast feeder pillar -4Cx16 sq mm Al/XLPE

(ii) Feeder pillar to feeder provided in High mast -4Cx16 sq mm Al/XLPE

(iii) Feeder provided in High mast to lighting fixture -5Cx2.5 sq mm Cu/PVC or 8Cx2.5 sq mm Cu/PVC

3.12 **EARTHING:**

3.12.1 Earthing of lighting system will be done by using of following sizes of GS wire / flat:

i) 12 SWG GS wire for earthing of lighting fixtures, receptacles, conduits, switch boxes.

ii) 8 SWG GS wire for earthing of junction boxes.

iv) 50x10 mm size galvanised MS flat for lighting panels, lighting distribution board and welding sockets.

v) A continuous ground conductor of 12 SWG GS wire will be run all along each conduit run and bonded to it every 600 mm by not less than two turns of the same size of wire. This conductor will be connected to each panel ground bus.

3.13 **Maintenance equipments**- The maintenance equipments are not applicable for indoor switchgear control building lighting. It may also be noted that maintenance equipments are not applicable for outdoor switchyard because we are using high masts.

3.14 **Junction Box/Switchboard:**

i) Junction box- The junction box shall be concealed type for indoor lighting.

ii) Switch and Switchboard-All switchboard /boxes shall have required no of 5A switches, one no 5A receptacles located in switchyard building area shall be modular flush mounted type.

ANNEXURE-2(BOQ OF ILLUMINATION SYSTEM)
Project-Suratgarh

Sl. No.	Item Description	Unit	Qty.		Remarks
			Supply	ETC	
A	**Indoor lighting for Switchyard building**				
1	**Lighting panels, split AC Panels and Transformer**				
(a)	200kVA , 415V/415V , air cooled dry type lighting transformer	Nos.	2	2	Used for MLDB supply
(b)	50kVA , 415V/415V , air cooled dry type lighting transformer	No.	1	1	Used for NELDB supply
(c)	100kVA , 415V/415V , air cooled dry type welding isolating transformer	Nos.	2	2	Used for welding distribution board supply
(d)	415V AC Indoor Lighting Panels type-LP-1	Nos.	3	3	
(e)	220V DC Indoor Lighting Panels type DCP	Nos.	2	2	
(f)	415V AC split air conditioner Indoor Panels – LP-3	No.	1	1	Used for split AC supply
2	**Lighting fixtures /exit sign board**				
(a)	Decorative recess mounting luminaire with mirror optics Lighting Fixture, Similar to Philips Cat No. TBS 088 /228W shall be with 2 x 28W FTL or equivalent.	Nos.	220	220	
(b)	Corrosion proof Lighting Fixture, Similar to Philips Cat No. TMX 95 /236W shall be with 2 x 36W FTL or equivalent.	Nos.	10	10	
(c)	Surface mounting luminaire with mirror optics Lighting Fixture, Similar to Philips Cat No. TCS 150/ 228W shall be with 2 x 28W FTL or equivalent.	Nos.	26	26	
(d)	Industrial type Lighting Fixture, Similar to Philips Cat No. TMS 122/228 shall be with 2 x 28 W FTL or equivalent.	Nos.	112	112	
(e)	Recessed mounting Lighting Fixture, Similar to Philips Cat No. DN 622 /GLS 100 W or equivalent.	Nos.	43	43	
(f)	Bulkhead Lighting Fixture (surface mounted) Similar to Philips Cat No. NXC101/GLS 100W or equivalent.	Nos.	43	43	
(g)	Battery operated Portable lighting Fixture.	Nos.	9	9	

ANNEXURE-2(BOQ OF ILLUMINATION SYSTEM)
Project-Suratgarh

(h)	Exit sign board	Nos.	20	20	
3	**Receptacles**				
(a)	5/15 A, 240V Indoor decorative type Receptacle 3-pin type.	Nos.	74	74	
(b)	15A, 240V Indoor Receptacle Single Phase, 3-pin type.	Nos.	35	35	
(c)	32A, 240V Indoor Receptacle Single Phase	Nos.	15	15	Used for split AC
(d)	63A, 415V , 3 phase welding Receptacle .	Nos.	15	15	
(e)	300A,TPN 415V, AC 3 phase 4 wire pin interlocked plug and switch with earthing contacts industrial type Receptacle for oil filtration machine	Nos.	3	3	
4	**Switchboards and Junction Box**				
(a)	Modular switchboard with 4 nos. 5 Amp. Switches and 1 no. 5/15 Amp. Receptacle.	Nos.	25	25	
(b)	Modular switchboard with 6 nos. 5 Amp. Switches	Nos.	16	16	
(c)	Modular switchboard with 2 nos. 5 Amp. Switches	Nos.	9	9	
5	**Fans**				
(a)	Ceiling fan 1200 mm sweep with steeped inbuilt electronic regulator.	Nos.	15	15	
(b)	Exhaust Fan(3000CMH)	No.	1	1	Used in store
(c)	Exhaust Fan(1000CMH)	Nos.	4	4	Used in pantry and toilet
6	**Point wiring for fixtures , receptacles , fans, exit board and switchboard along with wire and conduit**				
(a)	From Lighting panel to switchboard	Nos.	50	50	
(b)	From Lighting panel /switchboard to AC lighting fixtures/exit sign board /fan	Nos.	408	408	
(c)	From Lighting panel to DC lighting fixtures	Nos.	86	86	
(d)	From Lighting panel to receptacles	Nos.	124	124	
B	**Illumination of Outdoor Lighting (Switchyard Lighting)**				
1	**Lighting Panel**				
(a)	Outdoor Lighting Panel for Switchyard Lighting (LP-2).	Nos.	6	6	
2	**Lighting fixtures and pole**				
(a)	Flood light type Lighting Fixture, similar to Philips Cat No. SWF 331 /1x400W or equivalent.	Nos.	11	11	
(b)	Flood light type Lighting Fixture, similar to Philips Cat No. RVP 302/ 2x400W or equivalent.	Nos.	123	123	

ANNEXURE-2(BOQ OF ILLUMINATION SYSTEM)
Project-Suratgarh

(c)	Steel tubular pole-9.5 m height	Nos.	4	4	Used in 11kV switchyard located at river water pump side
(d)	Street Lighting Fixture, similar to Philips Cat No. SGP 401/1X150W or equivalent.	Nos.	8	8	
(e)	Outdoor junction box	Nos.	4	4	
3	30m height high masts complete with all accessories such as junction box , feeder pillar, cabling between JB to fitting , foundation bolt etc.	Nos.	18	18	
C	**Common items(For Indoor /Outdoor area)**				
(a)	2C x 2.5 Sq. mm Cu/PVC cables	m	-	200	
(b)	50X 10 mm GI Flat	m	-	100	
D	**Dismantling and re-erection of existing high mast**	No.	-	1	Located in extension switchyard of unit -6
E	**Mandatory spare of Lighting system**				
(a)	MCBs of each type	Nos.	5		
(b)	ELCB/RCCB of each type	Nos.	5		
(c)	Timers/Photo cells of each type	No.	1		
(d)	Choke of each type	%	5		
(e)	Starter of each type	%	5		
(f)	Fixtures of each type , wattage and make with a minimum of 1 no.	%	10		

Remark 1-Price for supply of all applicable illumination erection hardware material shall be included along with above BOQ in offer. List of erection hardware material for illumination works are mentioned below.

(A) For Indoor works: 3 way,G.I.,circular J.B.(20mm and 25mm),4 way,G.I.,circular J.B.(20mm and 25mm),90deg,G.I.,Inspection Bend(20mm and 25mm),90deg,G.I.,Normal Bend(20mm and 25mm),Heavy duty, Saddle with base(20mm and 25mm),Heavy duty, Saddle without base(20mm and 25mm),M4X25mm, steel screw with nut and washer,G.I. check nut/lock nut(20mm and 25mm),PVC Rawl plug,6mm,Wooden screw,35mm,Earth clip/clamp(20mm and 25mm),Cleat fabrication out of 25x6mm M.S. flat(for hanging conduit in false ceiling areas, Anchor fastner(M10x75mm for cleats,M12x75mm for lighting panels),Rubber bush(20mm and 25mm),20mm,PVC ,flexible conduit,20mm,PVC ,Coupling,Swing out braket,20mm,Heavy duty,ball socket,Machine screw(for fixing surface mounting fixtures on circular J.B.), PVC closure(20mm and 25mm),Reducer (20mm and 25mm). GI conduits & 1.5, 2.5 , 4 , 6 & 10 sq. mm wires, GI wire for earthing.

(B) For Outdoor works: 20x1.5mm Aluminium flat, M12x40mm, G.I. Bolt with nut and washer for fixing outdoor lighting panels,M6x30mm, G.I. Bolt with nut and washer for fixing control gear boxes,M8x30mm, G.I. Bolt with nut and washer for fixing outdoor J.B.s,SLP, M10x35mm, G.I. Bolt with nut and washer for fixing outdoor lighting fixtures,G.I., Earth wire from J.B. to lighting fixtures,Mounting

brackets for lighting fixtures for 1x400W fixtures/2x400W fixtures, GI wire for earthing.

Remark 2: The above quantities (BOQ) are as per preliminary design only. The detail design will be submitted by Vendor and subject to approval by Customer. The BOQ quantities which are finalised after approval has to be supplied. BHEL reserves the right for quantity variation due to any reason upto ± 25% of total value at same unit rate and terms during execution of contract . The quantity of individual items may however vary upto any extent.

Remark 3: 415V AC split air conditioner Indoor Panel –LP-3: 415V AC indoor split air conditioner panel with 415V, 3 phase ,4 wire bus & one 63A, TPN MCB with ELCB(Earth leakage circuit breaker with 30 mA sensitivity) as incomer and 18 nos. 32A , 240V SPN MCBs as outgoing feeders. Provision of manual control shall be provided in split air conditioner Indoor Panel.

Remark 4: If extra items required for completion of Job but not covered above, shall be quoted separately as a list of items and same shall be submitted with the bid (price of supply and ETC to be quoted on Lumpsum basis).

Remark 5: Supply of earthing material of 30 m high mast between top and bottom of high mast shall be in Illumination supplier scope.

Remark 6: The technical parameters of lighting and welding isolation transformer are as follows.

Type of transformer	Dry type natural air cooled -3 phase double wound ,an encapsulated epoxy cast resin type with copper winding
Rating	200/100/50kVA
Voltage ratio	415/415V
No. of phases	3
Frequency	50Hz
Winding connection	Dyn-1
Class of insulation	F
Impedance	4%±10%
No. of taps and steps	±5% in step of 2.5%
Ref. standard	IS:2026

Remark 7: Luminaires mentioned as equivalent should have ±15% variation (maximum) in efficiency.

SECTION-2, DOC. NO - TB-360-316-015, Rev-0

SPEC.NO. – TCE.5750A-H-500-001	**TATA CONSULTING ENGINEERS LIMITED**	VOLUME IV SECTION:D17
PART B	**RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage-V, Units 7 & 8, at Suratgarh, Rajasthan** LIGHTING SYSTEM	SHEET 1 OF 16

1.0 Illumination shall be provided for complete power plant but not limited to the following:

a) Power plant buildings (all bays & floors)

b) Boiler including all platforms, Boiler area, Boiler bunker feeding conveyor area and entire boiler bunker bays.

c) ESP Control room, ESP area

d) Switchyard

e) Service building all floors

f) FOPH, Fuel oil storage area

g) Coal handling plant area

h) Transformer yard

i) NDCT, Chimney etc

j) Ash handling system

k) CW Pump house

l) Warehouse and other Administrative buildings

m) DM plant.

n) Clariflocculators

o) PT plant

p) Sewage treatment plant

q) ETP

r) Canteen.

s) Open yard & stores.

t) Workshop

u) Cooling tower

v) DG house.

w) Construction yard.

x) Condensate storage tank

y) Vacuum PH cum blower house

z) HFO/LDO area.

aa) Chemical house.

bb) Fire station

cc) Ash slurry PH.

ISSUE R1

dd) Ash bund area/Ash pond

ee) Service building.

ff) Security post

gg) Coal run off treatment

hh) Periphery lighting of buildings

ii) Lighting for security along the plant boundary

jj) Road lighting of all roads in the plant

kk) Equipment requiring operation/maintenance like tanks etc.,

ll) High mast (telescopic type) lighting of 30m height for switchyard, outdoor lighting and coal Handling marshalling yard, railway marshalling yard.

mm) 30m Lighting masts in Fuel Oil loading and unloading areas, Ash pit areas and Raw Water storage areas.

nn) Periphery lighting up to 3 Meters beyond the above buildings /structures.

oo) The plant shall be provided with necessary indoor and outdoor/periphery area lighting.

2.0 CATEGORIES OF LIGHTING

Energy efficient lighting system shall be provided at the power plant. The plant lighting system shall comprise the following four (4) categories:

(a) Normal 240V AC Lighting System

(b) Normal-cum-Emergency 240V AC Lighting System

(c) Emergency 220V DC Lighting System

~~(d) Maintenance 24V AC Lighting System~~

2.1. Normal 240V AC Lighting System

In this system, the lighting circuits shall be fed by the 3 phase, 4 wire normal AC supply from the normal lighting distribution boards. All the lighting fixtures connected to this system shall be available as long as supply is available from normal source through lighting transformer.

2.2. Normal cum emergency 240V AC Lighting System

Certain lighting fixtures considered essential shall be connected to this system. In this system the lighting circuits shall be fed from lighting distribution board connected to 415V Normal Emergency Switchgear. The lighting fixtures connected to this system shall be available whenever normal supply is available in the plant and also whenever DG set supplies the power to 415V Normal emergency switchgear.

2.3. Emergency DC Lighting System

2.3.1. During station emergency involving total AC failure, incandescent lamp DC lighting fixtures shall be provided for movement of personnel in important areas/buildings at strategic locations viz., near entrance, staircase, landings etc.

2.3.2. These fixtures shall be connected to lighting panels supplied from 220VDC battery in the plant. These lighting fixtures shall be normally 'OFF' and shall automatically get switched "ON" the moment AC power supply fail. When power supply is restored they shall be switched "OFF" manually.

2.3.3. In critical areas such as TG building, AHP area, CHP area, unit switchgear rooms, unit control rooms, DG room, switchyard control building, etc. in addition to the 220V DC lighting, 'Instalite' type fixtures with in-built batteries and connected to normal supply will also be provided. These instalites will switch 'ON' automatically once AC power supply goes 'OFF'.

2.3.4. In the other distant areas like CW pump house, fire fighting equipment building, service building, warehouse, fire station, compressor building, vacuum pump house, MCC/control room for water system, fuel oil building, gate & security complex, etc. 'Instalite' type fixtures will be provided

2.4. Maintenance 24V AC Lighting System

For lighting facilities comprising portable hand lamps and/or connection of portable hand tools etc., required during the routine maintenance work, 24V single phase 3 pin sockets with switches shall be provided at selected points in the areas listed below. Such sockets for routine maintenance shall be clearly identified by colour coding in order to distinguish them from the normal 240V power outlets. Necessary outlets shall be made on the inside walls of the building near equipments.

(a) Boiler area: Near inspection manholes on the boiler platforms and near boiler drum at different levels on all four sides.

(b) TG building : Near HP & LP heaters, turbine flash tank, blow down tank, near condenser water box and near bus duct termination of generator end.

(c) ESP columns : Near inspection manholes.

(d) Near deaerator

(e) Cable galleries.

(f) Any other areas considered necessary by CONTRACTOR.

3.0 The area wise distribution of lighting fixtures connected to the three systems covered under Clause 2.1 to 2.3 is indicated below:

Area-wise Distribution of Lighting System in the Plant

Area/building	Percentage Distribution of Lighting		
	Normal	Normal & emergency	Emergency DC
Turbine Generator Building (all the bays)	80%	20%	10%
Control Rooms (Main CR, Switchyard CR,ESP CR, Other CR)	80%	20%	10%
Boiler Area (Grade Level & Platforms)	80%	20%	5%
Transformer yard and Chimney	80%	20%	10%
Outdoor Switchyard	80%	20%	-
Electro static precipitator	90%	10%	5%
DG Room	60%	40%	10%
Administration Building, Service building, Technical office & workshop	100%	-	Instalite at strategic locations
Various pump houses and electrical switchgear rooms in Coal Handling & Ash Handling switchgear rooms, etc.	100%	-	220V DC & Instalites at strategic locations

4.0 LIGHTING SUPPLY DISTRIBUTION SYSTEM

4.1. Separate lighting transformers shall be provided for the main lighting along with Sub-lighting distribution boards located at required location. Lighting distribution system shall be distinct and separate from the LT main distribution. Separate lighting transformers shall be used to supply lighting load.

4.2. Each LP shall have three/single phase incomer controlled by ELCB+MCB and a number of single phase outgoing circuits controlled by MCBs. Lighting

panels feeding the boiler area shall be provided with contactors. Lighting fixtures of Boiler area Platforms shall 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 shall be 'ON' automatically through photocell. Provision shall be made for switching 'ON' the rest of the lights. Lighting fixtures in indoor areas shall be controlled from the respective lighting panels. Lighting panels shall be both indoor/outdoor.

4.3. Normal 240 V AC Lighting System

4.3.1. For this system, lighting points shall be supplied at 240 V AC through 415 V, 3-phase, 4-wire, 50 Hz, earthed network. The supply shall be derived from 415 V, 3-phase, 4-wire, 50 Hz switchgear/panel. Different circuits shall be used from different source. The whole lighting network shall be balanced as far as possible.

4.3.2. In unmanned premises, normally the intermittently installed lights shall be 'ON' with separate control. All other lights shall be made 'ON' or 'OFF', whenever required.

4.4. Normal/Emergency AC System

4.4.1. For this systems, the distribution shall be by 415V, 3-phase, 4-wire, 50 Hz supply with effectively earthed neutral. This supply shall be derived from 415 V, 3-phase, 4-wire, 50 Hz normal emergency switchgear for NE & lighting through delta/star lighting transformer. The secondary of lighting transformer shall be connected to respective 415 V, 3-phase, 4-wire AC lighting distribution board (LDB). The LDBs shall be provided with number of outgoing circuits controlled by triple pole and neutral SFUs to feed the lighting panels distributed in and around the plant.

4.5. 220 V DC Lighting System

Emergency DC lighting supply distribution shall be on 220 V DC, 2-wire unearthed system. This power supply shall be obtained from the nearest 220 V DC switchboard. DC lighting panel shall be provided for distribution of lighting supply. This panel shall have an incoming switch, under voltage relay and number of outgoing circuits controlled by switch fuses. On failure of AC supply from N/E distribution connected to the panel, undervoltage relay shall drop out and shall switch 'ON' the incomer DC contactor and thus the DC supply to lighting circuits. Necessary outgoing feeders for purchaser's use shall be provided.

4.6. Distribution of 24 V AC Maintenance Lighting System

24 V AC supply for maintenance purposes (for hand lamps and/or hand operated tools) shall be supplied from 24 V AC distribution panel, which receives 240 V power supply from 415 V/240V transformer modules of N/E switchgear. 24 V AC distribution panel consists of one incoming double pole switch with fuses and MCBs, one 240/26.5 V dry type transformer of

adequate rating and HRC fuses on 26.5 V side of the transformer. This shall be strategically located and suitable circuits shall be formed. This panel shall be wall / column mounting type.

5.0 ILLUMINATION LEVELS AND CHOICE OF LIGHTING FIXTURES

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

Sl. No.	Area/Structure	Average Illumination Level in Lux	Type of Fixture	Type of Luminaire
A .	**TURBINE GENERATOR BUILDING**			
1.1	General (auxiliary equipment areas)	200	Industrial well glass fixture, dust & jet proof, die cast aluminium body, stove enamel finish, vitreous enamel reflector integral mounted control gear/industrial bulk head with integral mounted control gear	1x70 W/ 1x150 W HPSV lamp
1.2	Cable vault	100	Industrial type FTL	Energy Efficient FTL
1.3	All switchgear room area	250	Industrial type with vitreous enamel reflector	Energy Efficient FTL
1.4	TG Building operating floor	200	Industrial high bay with anodised aluminium reflector with all accessories including control gear	1x400 W HPSV lamp
1.5	Unit control room	500	Decorative recessed with wide angle mirror optic antiglare type	Energy Efficient FTL
1.6	Battery rooms	150	Corrosion-proof	Energy Efficient FTL
1.7	TG building ground, mezzanine floor and misc. floors	200	Industrial well glass with integral control gear	1X250W HPSV bulb and 1x70 W HPSV well glass
1.8	Air washer room and A/C plant room	200	Totally enclosed vapour proof with clear acrylic cover	Energy Efficient FTL

Sl. No.	Area/Structure	Average Illumination Level in Lux	Type of Fixture	Type of Luminaire
1.9	Unloading and maintenance bay	300	Industrial high bay with anodised aluminium reflector	250 W HPSV lamp (for mounting height >9m)
1.10	Electrical laboratory, chemical laboratory (air-conditioned)	250	Decorative recessed with wide angle mirror optic anti-glare type	Energy Efficient FTL
1.11	Chemical laboratory (non-airconditioned)	250	Totally enclosed corrosion proof with clear acrylic cover	2x36W FTL
1.12	Chimney	Qty as per AAAI	As per AAAI	Flood light, Aviation warning lights and bulk head for staircase.
B.	**BOILER AREA**			
1.1	Boiler area and platforms, ESP area and platforms	100	Dust proof / dust tight well glass fixture	70 W HPSV lamp
1.2	Feeder floor areas	50	Dust proof / dust tight increased safety well glass	70 W HPSV lamp
1.3	ESP control room	300	Decorative recessed with wide angle mirror optic anti-glare type	Energy Efficient FTL
C.	**COAL /ASH HANDLING PLANT**			
1.1	Conveyors enclosed	100	Dust proof well glass with Reflector wire guard integral mounted control gear box.	1 x 70 W HPSV lamp

Sl. No.	Area/Structure	Average Illumination Level in Lux	Type of Fixture	Type of Luminaire
1.2	Underground conveyor tunnel	40	Flame proof industrial bulkhead with integral control gear box	1 x 70W HPMV
1.3	Crusher house, junction towers	100	Dust proof / dust tight well glass with reflector wire guard integral mounted control gear	1 x 70W HPSV
1.4	Coal yard	15 – 25	Flood light	1 x 400W HPSV
1.5	Coal unloading, Track hopper stacker reclaimer	25-50	Flood light	1 x 400W HPSV
1.6	Control room		Same as in Unit control room.	2 x Energy Efficient FTL
1.7	Ash Pond and Ash bund area	15 – 25	Flood light	1 x 400W HPSV
D.	Fuel Oil system & fire hazardous area	250	Flame proof industrial bulkhead with integral control gear box	1x250 HPSV/ 1x400HPSV
E.	**ROAD & YARD LIGHTING**			
1.1	Roads	15-20	Street light with clear acrylic cover cut-off type with integral mounted control gear. Auto switch ON/ OFF shall be provided.	1 x 125W HPSV

Sl. No.	Area/Structure	Average Illumination Level in Lux	Type of Fixture	Type of Luminaire
1.2	Perimeter (compound) lighting	10 – 20	- do -	- do -
1.3	Yard lighting	15 – 20	General purpose flood light	250W HPSV
1.4	Parking area	50	General purpose flood light, high/medium beam flood light	1 x 250 W HPSV
E.	Marshalling Yard/Railway line	25-50	General purpose flood light, high/medium beam flood light	1 x 250 W HPSV
F.	**GENERAL**			
1.1	Corridors, walkways, staircase, etc.	100	Industrial type with vitreous enamel reflectors/channel mounted box type	Energy Efficient FTL
1.2	Lockers, toilets, wash rooms, etc.		Channel mounted box type	Energy Efficient FTL
1.3	Building periphery lighting		Industrial well glass with integral mounted control gear/industrial bulk head with integral mounted control gear/ flood light fittings	70 W HPSV lamp / 400 W HPSV lamp
1.4	Office Rooms	300	Decorative recessed type FTL	Energy Efficient FTL
G.	**DC LIGHT FITTINGS**			
1.1	Control room	-	Decorative recessed type with cylindrical reflector	1x100 W incandescent lamp
1.2	Other areas	-	Industrial bulk head or industrial well glass with reflector	1x100 W incandescent lamp

NOTE:

(a) Energy efficient type tube light fittings shall be used.

(b) N/E AC lighting and DC lighting shall be identified with suitable colour code.

(c) CONTRACTOR may change the type of fixture to be used in different area against indicated above, provided minimum illumination level as indicated above is maintained. Lighting shall appear aesthetically good. CONTRACTOR shall measure the lux levels in the above areas (measured at the working plane) using suitable devices/meters as per relevant standards to prove the specified values.

~~(d)~~ For codes & standards refer ~~section D26~~. Annexure-A

(e) For chimney / Cooling Tower, aviation warning lights as per AAAI's recommendation shall be provided.

1 Medium intensity light should be used alone or in combination of low intensity lights where height is greater than 45 m. High intensity light should be used for heights more than 150 m as required to conform to the standard of Civil Aviation Department, directorate of air route and aerodromes, Government of India, DGCA, ICAO or any other statutory body and also to conform to IS: 4998 and as per the drawing. Each aviation warning light shall be of neon type having two lamps. Only one (1) lamp in a given fitting would be ON at a time and if the lamp fails, its failure would initiate an alarm and the next lamp in that particular fitting would be switched on automatically. Necessary control panel for control and annunciation shall be supplied. The control scheme of the control panel shall be to the approved of OWNER/Consultant.

2 One (1) photo controller along with suitable controller arrangement to be supplied by the bidder to switch ON and OFF the aviation warning light automatically based on the intensity of natural light during day/night. The aviation warning lights on each of the external platform and three (3) nos. of flood lights (250 W HPSV) at all external platform levels shall be connected to three different phases.

3 The warning lights shall be adequately secured to the chimney against the wind forces. The low intensity shall be of fixed red colour, medium intensity shall be flashing red and high intensity shall be of flashing white. In no case the intensity shall be less than 100 candles of light. Blinker rate of Aviation warning lights shall be as per Aviation standards.

4 The top light or lights shall be so arranged as to mark the point or edge of the obstruction-marking surface. The lights shall be placed between 1.5 meter and 3 meter below the top. The number and arrangements of lights at each level of platform be such that the obstruction is indicated from every angle in azimuths.

5 The lights shall be displayed on the points at each platform of the chimney so as to indicate the general definition and extent of the obstruction.

6 The aviation lighting distribution board shall have facility to receive two (2) incoming feeders, one (1) from the main DB of the chimney and the other from the emergency source of the power plant with auto changeover facility.

7 Temporary aviation lights with infrared bulbs shall be installed at each of the levels as instructed by OWNER as the construction work progresses and also above the top most point of the obstruction as construction progresses. These lights need to be installed only after the level of obstruction is greater than 45 meter above grade level. The lights shall continue to exist till permanent arrangement to provide such lights are completed.

6.0 LIGHTING SYSTEM DESIGN

6.1. The lighting system design shall comply with the acceptable norms and the best engineering practices. The system design shall consider principles of lighting specified in following paragraph. The lighting layout shall be designed to provide uniform illumination with minimum glare. The layout design shall meet all the statutory requirement, local rules etc.

6.2. Indoor Lighting

The recommended values of illumination level for various areas in the plant are indicated in the Table above. Following factors shall be considered while arriving at the utilisation factor to determine the number of fixtures for each area/buildings in the plant.

6.2.1. Maintenance Factor:

(a) Air conditioned clean interiors like office rooms, Laboratories, Auditorium : 0.8

(b) Industrial areas with normal interiors such as workshops, stores : 0.7

(c) Industrial areas with dusty interiors : 0.6

(d) Industrial areas with very dusty interiors such as crusher house and junction towers : 0.5

6.2.2. Reflection factor for wall/ceiling

(a) White and very light colours : 0.7

(b)	Light colours	:	0.5
(c)	Middle tints	:	0.3
(d)	Dark colours	:	0.1

6.2.3. Utilisation factor considering the room index at applicable surface reflection factors. The working plane shall be considered at 0.85 m from the floor level.

6.2.4. The value of the ratio of spacing (S) to mounting height (H) shall be commensurate with the type of fittings selected and uniformity of illumination. The suspension height for suspended fixtures shall not exceed 1 meter.

6.3. Outdoor Lighting

The recommended illumination levels for outdoor areas are indicated in the above table.

6.3.1. Mounting height, spacing of flood lights shall be based on lamp wattage, uniformity of illumination and vertical angles. Ratio of minimum to average illumination shall not be less than 0.3 and for minimum to maximum shall not be less than 0.2.

6.3.2. Maintenance factor shall be generally 0.6 under average conditions.

6.3.3. Flood lights for area lighting shall be mounted on building structures. For outdoor lighting i.e. around the power plant building and transformer yard provision to be made with 400W outdoor type lamps mounted on wall/structures.

7.0 SWITCHES, RECEPTACLES & CEILING FANS

7.1. In the plant areas, the lighting circuits shall be controlled directly from the MCBs in the lighting panels. Wherever the lighting panel is not in the same area, separate switches shall be provided. For cabins, rooms, etc., separate switches shall be provided for each point. Similarly for entrances, building periphery lighting separate switches shall be provided.

7.2. 240V, 50 Hz, 3 pin Power Receptacles (5A and 15A) shall be provided in all building/areas of the plant. Inside a building, receptacles shall be provided at interval of 30m or part there of for hand tools, water coolers, exhaust fans etc. Inside each cabins atleast two receptacles shall be provided and the same shall be indoor/outdoor/flameproof as per the location. Minimum 2 nos of 5A and 1 no 15A receptacles shall be provided in each room. 20A sockets shall be used for AC & ventilation and shall be controlled through MCBs.

7.3. Ceiling fans/Exhaust fans

7.3.1. 1200mm sweep ceiling fans shall be provided for office rooms, store rooms and other un manned premises and other social buildings. Atleast one no of fan shall be provided for every 10 sq metre area. The ceiling fans shall be complete with electronic regulator.

7.3.2. Exhaust fans for toilets, battery rooms etc shall be provided with their control devices (MCBs) & louvers.

8.0 LIGHTING DISTRIBUTION BOARDS (LDB) & LIGHTING PANELS (LP)

8.1. The Main Lighting Distribution board shall be fed through 415V/415V lighting transformers with off circuit taps ± 5% in steps of 2.5%. The lighting transformer shall be cast resin dry type and shall be housed in a suitable enclosure. In general, the transformers shall confirm to the specification covered under 'Dry type transformers-section-D7-A'*. The main lighting distribution boards shall consist of incoming MCCB and required number of out going triple pole and neutral SFUs. Sub distribution panel/Lighting panel shall have three/single phase incomer controlled by ELCB+MCB and a number of single phase outgoing circuits controlled by MCBs. The MLDB shall be designed for the required short circuit level of 20 kA. All the distribution boards shall be sheet steel clad, dust and vermin proof, cubicle type with degree of protection conforming to IP-52. Outdoor panels shall be weather proof type with IP-55 protection. The thickness of sheet steel enclosures shall be 2 mm minimum for load bearing and 1.6 mm for other members. In main lighting, feeders for Purchaser's use and spare feeders shall be provided as required during detailed engineering.

8.2. Number of outgoing feeders in MLDB's, SLDB's shall be provided as per requirement including the spare feeders and feeders for "PURCHASER'S USE". Each outgoing MCB in LDB's shall be of 15 A, but load to be limited to 2 kW or maximum 10 nos. fittings to be connected to one MCB.

8.3. Individual control in office buildings shall be through single pole flush type switches/MCBs. In those areas where group controls are required, rotary switches shall be provided.

8.4. External area lighting shall be fed from separate boards located at suitable places. Automatic switching ON/OFF of these circuits shall be done through timers/photo cell.

8.5. In high bays, walkway shall be provided for maintaining light fittings. At other places suitable ladder / platform / approach shall be provided for maintaining / replacement of light fittings.

8.6. Each of the LDBs shall be provided with voltmeter and ammeter along with selector switches, 'SUPPLY ON" indicating lamps, etc. The switch boxes. receptacle boxes etc. shall be made up of 18 SWG sheet steel.

8.7. Two ground pads with bolts and nuts shall be provided on each board for connection to 50x6mm GS flat.

8.8. Painting : All sheet steel enclosures of panels, switchboards & receptacles shall be chemically cleaned rinsed, phosphated & dried. After the treatment steel surfaces shall be given two coats of finished enamel paint of approved shade.

*- Annexure-2 of section-1 of technical specification.

8.9. The distribution of lighting fixtures/receptacles shall be such that the loading on each phase of the LDB is approximately equal.

8.10. Bus and Busbar Connection

Panel busbar shall be electrolytic grade hard drawn aluminium colour coded for easy identification of required size.

9.0 CABLES AND WIRING

a) Heavy duty AYWY cables with FRLS, PVC inner sheath and outer sheath shall be provided for the following connections:

Incoming feeders to all LDBs, receptacles, lighting panels and emergency DC lighting panels.

b) Feeders connecting area lighting panels to outdoor lighting panels, etc. shall be of 3 core x 2.5 sq.mm, 1100 V grade FRLS, PVC stranded cable of copper.

9.1. Wiring from lighting DBs/panels to individual fixtures, plug points, fans. etc. shall be of single core, 2.5 sq.mm, 650 V grade PVC stranded copper conductors through surface mounted or concealed medium duty GI conduits confirming to IS 1239 with earth wire. The wires shall occupy 60% of the conduit area.

9.2. 650 V / 440 V grade stranded copper conductor, PVC insulated, colour coded, wires laid in GI conduits shall be used for lighting in non-hazardous area. In the hazardous area, outdoor areas like transformer yard and road lighting, cable wiring shall be adopted. The specification of cable shall conform to the details indicated in "Cabling System" section.

9.3. Minimum size of wires in case of conduit wiring shall be 2.5 sq.mm. copper in case of lighting and 4 sq.mm. copper in case of receptacle wiring.

9.4. Wires of different phases shall be run in separate conduits. However, wires of same phase but having different circuit nos. can be run in same conduit. Wires of lighting and power receptacles shall be carried out in separate conduits and on separate circuits. Wires of AC and DC lighting system shall be carried out in separate conduits..

9.5. For outdoor lighting, the cable shall be buried at a minimum depth of 750 mm from ground level or run in cable trays. The buried cables shall have suitable bedding, protective covers and markers.

9.6. Material used for saddles, clamps, JBs, etc. shall be galvanised.

9.7. Office buildings, laboratory buildings shall have concealed wiring with 2.5 sqmm cable using PVC conduits. In heat zones, i.e. in the areas where ambient temperature is 60°C and above, heat resistant control cables shall be used in hot dip galvanised rigid steel surface mounted conduits.

10.0 LIGHTING CIRCUIT DESIGN

10.1. In an area, the lighting fixtures shall be arranged in different phase / LPs such that even in case one lighting panel is faulty complete lighting is not affected. In *all* locations the lighting shall be arranged from two phases.

10.2. The circuit loading on each circuit shall be restricted to 80% of the MCB rating.

10.3. The voltage drop from LDB and any fixture shall not exceed 3%.

11.0 CABLING AND PLATFORM LIGHTING FOR CHIMNEY

11.1. CONTRACTOR shall supply and install GI pipe conduit risers of 36 NB diameter or higher as required. Conduits shall be embedded in the stack. Conduit shall be separate for medium aviation warning lights, high intensity aviation warning lights, flood lights/internal platform lighting, lift cables, I and C cables and spare.

11.2. GI pull boxes, provided on inner face of concrete wall by suitable anchor fasteners shall be installed at 2.5 metre intervals vertically, unless specified elsewhere. The lowest pull box shall be located 450 mm above grade. Each conduit riser shall run from the lowest pull box to the highest junction box. The conduit risers shall be run adjacent to the staircase such that pull boxes are easily accessible. Suitable surface cleated pipe conduits shall also be provided from the lowest pull box to a suitable outlet point at the base of the chimney to receive cables.

11.3. Each conduit riser other than those provided for instrumentation shall be connected to a circumferential conduit at each platform level. The circumferential conduit at each level of the platforms shall be provided with necessary GI junction boxes, equally spaced, at the location of the aviation warning lights or lighting fixtures as the case may be. Suitable surface cleated conduits shall also be provided from the junction box to the respective light point. The GI pull boxes and junction boxes shall be fabricated from 16 SWG sheet steel and shall be of size 200 x 200 x 100 mm.

11.4. Each internal platform shall be provided with one power receptacle rated for 1 ph, 230V, 63A and dust proof, dust tight well glass lighting fixtures suitable for 70W HPSV lamp. Cables and wires for these fixtures and receptacles shall also be included in CONTRACTOR's scope. Minimum cable size for these lighting fixture and receptacle shall be 2C x 2.5 mm² Cu. wire & 2C x 4 mm² Cu. respectively.

11.5. CONTRACTOR shall also provide two (2) Nos. 63A TP-N switch fuse units, at a height of 1500 mm above ground level, one for power receptacle circuit and the other for aviation warning beacons. One(1) three phase lighting panels with adequately rated MCB's shall be provided to control the lights. The conduits which are embedded on the inner face of the shell shall be electrically connected to the down conductors at suitable intervals.

11.6. Contractor shall provide two numbers of embedded conduit for instrument air to respective analyser. Purchaser's terminal point for instrument air will be at

the ground level at one point. Further distribution till the analyser shall be included in contractor's scope.

11.7. The mounting arrangement of the fixture for aviation warning beacons shall be such that the inspection/maintenance of the same could be easily carried out from the platform. Wiring of aviation warning lights and other light fixtures shall be carried out using 1100V grade, copper conductor, HR PVC insulated and overall HR PVC sheathed cables. CONTRACTOR shall also supply and install necessary flexible metallic conduits required for running cables for aviation warning beacon from the junction boxes.

12.0 TESTS

Acceptance tests and routine tests for the lighting fixtures and accessories, LDBs shall be carried out as per relevant standards.

Test to be carried out for LDB shall be as follows :

(a) IR test before and after HT test.

(b) HV test by HV megger.

(c) Checking for functions of components for each module.

(d) Checking for interchangeability of similar components.

(e) Checking of tightness of earth connection.

(f) Testing and calibration of all indicating meters.

(g) Check output of each feeder after energisation.

Annexure-A

	APPLICABLE STANDARDS	IS	BS	IEC	ANSI / IEEE
6.	Accessories for rigid steel conduits for electrical wiring	3837			
7.	Fittings for rigid steel conduits for electrical wiring	2667			
8.	Fittings for rigid non-metallic conduits	3419			
9.	Flexible steel conduits for electrical wiring	3480			
10.	Flexible non-metallic conduits for electrical installation	6946			
11.	Adaptors for flexible steel conduits	4649			
12.	Plugs and socket outlets	1293			
13.	Lightning arrester	3070	BSEN-60099	60099	
E.	**LIGHTING**				
1.	General and Safety Requirements for luminaires	1913	4533	60598	
2.	Code of practice for industrial lighting	6665			
3.	Industrial luminaire with metal reflectors	1777		60598	
4.	Decorative lighting outfits	5077			
5.	Dust proof electric lighting fittings	4012		60598	
6.	Dust tight electric lighting fittings	4013			
7.	Electric lighting fittings for division 2 areas	8224	4533		
8.	Luminaires	10322	4533		
9.	Water proof electric lighting fittings	3528	4533 / 5225		
10.	Watertight electric lighting fittings	3553	4533 / 5225		

Annexure–A

	APPLICABLE STANDARDS	IS	BS	IEC	ANSI / IEEE
11.	Bayonet Lamp Holders	1258	BSCN: 61184	60061	
12.	Edison Screw Lamp Holders	10276	BSCN: 60238		
13.	Bi-pin Lamp Holders for Tubular fluorescent lamps	3323			
14.	Starters for fluorescent lamp	2215	BSCN: 60155		
15.	Holders for starters for tubular fluorescent lamps	3324	BSCN: 60400		
16.	Ballast for Fluorescent lamps	1534	BSCN: 60920	60400	
17.	Transistorised ballasts for fluorescent lamps	7027			
18.	Ballasts for HP Mercury Vapour Lamps	6616		60923	
19.	Capacitors for use in tubular fluorescent, HPMV & LP Sodium Vapour Discharge Lamp Circuits	1569	BSCN: 61048		
20.	Vitreous enamel reflector for use with illuminating device.	8017			
21.	Tubular Fluorescent lamps for general lighting service	2418	BSCN: 60081	60081	
22.	High pressure mercury vapour lamps	9900	3677	60188	
23.	Tungsten filament general service electric lamps	418	6179	60432	
24.	Cast acrylic sheets for use in luminaires	7569			
25.	High pressure sodium vapour lamps	9974			
26.	Emergency lighting units	9583			
27.	Code of practice for interior illumination	3646	8206		

Annexure-A

	APPLICABLE STANDARDS	IS	BS	IEC	ANSI / IEEE
28.	Code of practice for selection, Installation and maintenance of transformers	10028			
29.	Code of practice for maintenance and supervision of mineral insulating oil in equipment	1866	5730	422	
30.	Code of practice for Installation and maintenance of induction motors	900			
31.	Indian Electricity Act 1910, (As amended)				
32.	Electricity Supply Act, 1948, (As amended)				
33.	Indian Electricity Rules, 1956 (As amended)				
F.	**FIRE PROTECTION**				
1.	Code of practice for fire safety of industrial buildings : Electrical Generating and Distributing Stations	3034			
2.	Components of automatic fire detection system : Introduction		5445		
3.	Specification for manual call points		5839		ANSI UL38
4.	Smoke detectors for use in automatic fire alarm system	11360	5445		UL 268
5.	Smoke detectors for duct application				UL268A
6.	Single & multiple station smoke detectors				UL 217
7.	Heat sensitive fire detectors for use in automatic fire alarm system	2175	5445		
8.	Specification for high temperature heat detectors		5445		
9.	Methods of test of sensitivity to fire		5445		

SECTION-3

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other respective sections and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

a)	Customer/ Purchaser/ Owner	Rajasthan Rajya Vidyut Utpadan Nigam Ltd. , Jaipur
b)	Consultant	Tata consulting Engineer Ltd. , Bangalore
c)	Project Title	2X660MW Super –Critical Thermal Power Station, Stage –V, Unit 7 & 8-400kV Switchyard at Suratgarh
d)	Location	Prabat Nagar , Suratgarh Sriganganagar district, Rajasthan
e)	Altitude and longitude	Lattitude:29 deg. 10 min. N Longitude: 74 deg. 01 min. E
f)	Elevation above mean sea level	186 m(approximately)
g)	Transport Facilities	Suratgarh project is located 27 km from Suratgarh , 15 km from Suratgarh to Biradhwal on NH15. 12km in east from NH15.
h)	Postal Address	To follow
SITE CONDITIONS		
a)	Mean of daily maximum temperature	32.3 deg. C
b)	Mean of daily minimum temperature	19.6 deg. C
c)	Highest temperature recorded	50 deg. C
d)	Lowest temperature recorded	-2.8 deg. C
e)	Design ambient temperature for electrical equipment design	50 deg. C
f)	Relative humidity	Varies between 21 % and 81%
g)	Pollution Severity	Heavily Polluted
h)	Seismic zone	II
i)	Basic Wind speed	47 m/sec

j)	Annual mean wind speed	4km/hr
k)	Terrain category	2
l)	Annual average rain fall	312 mm

SYSTEM PARAMETERS

Nominal system voltage	**400 kV**	**11kV**
Highest system voltage	420 kV	12kV
Basic Impulse level(dry /wet)	1425kVP	75kVP
Power frequency withstand voltage	630kVrms	28kVrms
Switching Impulse withstand voltage	1050 kVP	NA
Rated short time current	50 kA for 3 sec	40 kA for 3 sec
Frequency	50 Hz	50 Hz
Creepage distance	31mm/kV	31mm/kV
System Earthing	Effectively Earthed	Effectively Earthed

AUXILIARY POWER SUPPLY

3 phase A.C power supply	415V ± 10%, 50 Hz, 3-phase 4 wire, solidly earthed with variation in frequency of ± 5%
1 phase A.C power supply	240V ± 10%, 50 Hz, 1-phase , 2 wire , AC supply with variation in frequency of ± 5%
D.C. power supply	220V ±15%, 2-wire ungrounded 48V ±10%, 2 wire system positively earthed

Combined variation of voltage and frequency shall be +/- 10%

3.2 GENERAL TECHNICAL REQUIREMENT

3.2.1 TYPE TESTS

All equipment/systems to be supplied shall conform to type tests as per relevant standards and proven type. The Bidder / Contractor shall furnish the reports of all the type tests carried out within last **five years from the date of opening of the tender** (i.e. 03.12.2012) as listed in relevant clauses in respective electrical specification and relevant standards for all components / equipment / systems. These reports should be for the tests conducted on identical/ similar components /equipment/systems to those offered / proposed to be supplied under this contract.

Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off.

In case Contractor is not able to submit report of type test(s) conducted in last five years, or in case type test report(s) are not found to be meeting the specification/relevant standard requirements, then all such tests shall be conducted under this contract by the Bidder free of cost to Employer/Purchaser, and reports shall be submitted for approval. No charges shall be paid under this contract. All acceptance and routine tests as per relevant standards and specification shall be deemed to be included in the bid price.

3.2.3 CODES AND STANDARDS

All materials and equipment shall generally comply in all respect with the latest edition of relevant international electro-technical commission (IEC) or any other internationally accepted standard which ensure equal or better quality or relevant Indian standard(IS) mentioned against each equipment and this specification.

3.3 MATERIAL/WORKMANSHIP

3.3.1 General Requirement

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood that the same must be new, of highest grade of the best quality of their kind conforming to best engineering practice and suitable for the purpose for which they are intended.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from purchaser.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be

accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacture's limits suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness.
The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him. All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case, he shall declare in the proposal, where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

3.3.2 Provisions For Exposure to Hot and Humid climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

3.4 COLOUR SCHEME AND CODES FOR PIPE SERVICE/PANELS

The contractor shall propose a color scheme for those equipment/Items for which the colour scheme has not been specified in the specification for the approval of purchaser. The decision of purchaser shall be final. The scheme shall include:

Finishing colour of Indoor equipment

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.

All the steel works shall be thoroughly cleaned of rust , scale , oil , grease, dirt and scarf by pickling , emulsion cleaning , etc. The sheet steel shall be phosphated /oven dried and then painted with two coats of zinc rich primer paints . After application of the primer, two coats of

finished synthetic enamel paint shall be applied. The colour of the finished coats inside shall be **glossy white** and exterior of the treated sheet steel shall be **shade 631 of IS 5 /RAL 7032** for all switchboard /MCC/distribution board , control panels etc.

Sufficient quantities of touch paint shall be furnished for application at site. All the indoor cubicles shall be the same as exterior surface and for other miscellaneous items, colour scheme will be approved by the purchaser.

3.5 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.6 FUNGI-STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

3.7 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or other wise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

3.8 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support channels,

structures, shall be hot dip galvanized conforming to latest version of IS:2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvanized. Minimum weight of zinc coating shall be **610 gm/sq.m** and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM. Average weight of zinc coating shall be **750gm/sq.m.**

3.9 PACKING

The following details are to be clearly indicated in the material forwarding documents:

a) Name and address of the consignee.
b) Purchase order number.
c) Name of supplier/s.
d) Description of equipment / material.
e) Net weight.
f) Gross weight.

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the purchaser, the Contractor shall also submit packing details/associated drawing for any equipment material under his scope of supply, to facilitate the purchaser to repack any equipment/ material at a later date, in case the need arises. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost. The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbol i.e. fragile, handle with care, use no Hooks etc.

3.10 HANDLING, STORING AND INSTALLATION

Contractor may engage manufacturer's Engineers to supervise if required for unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

3.11 DEGREE OF PROTECTION

The enclosures of the Control Cabinets, Junction boxes and Marshalling boxes panels etc to be installed shall be provided with degree of protection as detailed here under:

a) Installed out door: IP-55

b) Installed indoor in air conditioned area: IP-42

c) Installed in covered area IP:52

d) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS:13947, (Part-1)/IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval.

3.12 RATING PLATES, NAME PLATES AND LABELS

Type or serial number together with details of the loading conditions under which the item of the substation in question has designed to operate and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirements.

All such nameplate instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternately two separate plates one with Hindi and other with English inscriptions may be provided.

3.13 EARTHING

Circuit breakers, LA, Isolator, CVT , CT , BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat. Control panels, Relay panel, outdoor marshalling boxes, Junction boxes, Lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

3.14 TERMINAL BLOCKS AND WIRING

Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All Inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.

Terminal blocks shall be **650 V** grade and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be **non-disconnecting stud type equivalent to Elmex type CATM4,** Phoenix cage clamp type of Wedge or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

Terminal block for current transformer and voltage transformer secondary leads shall be provided with **test links and isolating facilities.** The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable. The terminal blocks shall be of extensible design. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, non deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

All circuits except CT circuits :	Minimum of 2 nos. of 2.5 sq.mm, copper flexible.
All CT circuits :	Minimum of 4 nos. of 2.5 sq.mm, copper flexible..

The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. At least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets.

All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The supplier shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

3.15 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of sheet steel . Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled . The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

Cabinet /boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of gaskets shall be such that it does not get damaged/cracked during the operation of the equipment.

All door, removable covers and plates shall be gasketed all around with suitably profiled **Neoprene gaskets**. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting atleast 150 mm above from the base of the Marshalling Kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project atleast 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required

3.16 SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.

One or more adequately rated, thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heater shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heater to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and air and shall consist of coiled resistance wire centered in metal sheath and completely encased in a highly compacted powder of Magnesium Oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of a resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and air. Alternatively, they shall consist of resistance wire mounted into a tubular ceramic body built into an envelop of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in glaze the surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

3.17 QUALITY

BHEL quality plan to be followed subject to TBEM / customer's approval.

3.18 DOCUMENTATION

3.18.1 LIST OF DOCUMENTS

The bidder shall submit a detailed list of drawings / documents along with the bid proposal which he intends to submit to the Employer after award of the contract.

The supplier shall necessarily submit all the drawings / documents unless any thing is waived.

All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under this specification shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

3.18.2 DRAWINGS

All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials.

weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearances and spaces required for installation and interconnection between various portions of equipments and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, name of consultant, the unit designation, RRVUNL contract no. and the name of the Project .If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Employer if so required.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

3.18.3 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Employer would be discussed and finalised at the time of award. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. The following schedule shall be followed generally for approval.

i.	Approval/comments/by employer on Initial submission	Within 3 weeks of receipt
ii.	Resubmission	Within 2 (two) weeks (whenever from date of comments required) Including both ways postal time.
iii.	Approval or comments	Within 2 weeks of receipt of resubmission
iv.	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The contractor may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

The title block of drawings shall contain the following information incorporated in all contract drawings. Please refer enclosed **sheet** for details of Title block.

3.18.4 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

1) Drawings
2) Guaranteed Technical Particulars
3) Type Test Reports
4) Manufacturing Quality Plan

3.18.5 DOCUMENTATION SCHEDULE

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
			Prints	Prints	CDs
1	Drawings and Data Sheets	1	7	8	-
2	Drawings "As Built "	-	-	8	05
3	Type Test Reports	1	3	4	-
4	Erection Manuals	-	7	8	-
5	Operation and Maintenance Manuals	-	7	8	-
6	Manufacturing Quality Plan	1	7	8	-
7	Field Quality Plan	1	7	8	-
8	Inspection Test Reports	-	-	8	-

Soft copies of drawings at contract stage shall also be submitted in **PDF format**.

Drawings will also be submitted in CD in AUTOCAD package for all major items.

Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top.

REV.	DATE					

OWNER

RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LIMITED

PROJECT

2X660MW THERMAL POWER PLANT,SURAT GARH STAGE -V, UNIT 7 & 8 AT SURATGARH , RAJASTHAN

OWNER'S ENGINEER

TATA CONSULTING ENGINEERS LIMITED

EPC CONTRACTOR

BHARAT HEAVY ELECTRICALS LTD
TRANSMISSION BUSINESS GROUP

DEPT CODE		NAME	SIGN.	DATE
	DRN			
	DESN			
	CHD			
	APPD			

TITLE

CV	ME	EL	MAC			DEPT	SCALE	BHEL/SUB VENDOR DRG NO.
						SIGN		SHT No. REV.
						DATE		

SECTION-04, DOC. NO - TB-360-316-015, REV-0

SPEC.NO. TCE.5750A-H-500-001	**TATA CONSULTING ENGINEERS LIMITED**	VOLUME IV SECTION:D17
PART B	**RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan** DATA SHEET B LIGHTINIG SYSTEM	SHEET 1 OF 3

ENQUIRY/SPECIFICATION NO.: BIDDER:

SL. NO.	DESCRIPTION	UNITS	BIDDERS DATA
	Indoor Lighting		
1.0	Name of manufacturer	:	
2.0	Make of light fittings		
3.0	Make of main DB	:	
4.0	Make of sub-lighting DB	:	
5.0	Type of fitting for periphery lighting and control for same	:	
6.0	Cable laying method	:	
7.0	Control operations	:	
8.0	Escape lighting	:	
9.0	Type of cable proposed	:	
10.0	Make of cables	:	
11.0	Type of fittings at various locations	:	
12.0	DC emergency lighting control board with necessary contactor	:	
13.0	Type of incomer for main and sub-DBs	;	
14.0	Type of outgoing for main and sub-DBs	:	

NOTES TO BIDDER

1. ITEMS WHICH DEVIATE FROM THE SPECIFICATION SHOULD BE MARKED WITHIN ASTERISK (*) AND DETAILS TO BE GIVEN IN SCHEDULE OF DEVIATIONS.
2. THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY SHALL BE ENCLOSED WITH EACH COPY OF THE BID.

SIGNATURE OF BIDDER & DATE

ISSUE R1

ENQUIRY/SPECIFICATION NO.: BIDDER:

SL. NO.	DESCRIPTION	UNITS	BIDDERS DATA
15.0	Second source of supply considered for all the areas	:	
16.0	a) Degree of protection for main and sub-DB enclosure	:	
17.0	b) Mounting details for DBs	:	
18.0	Phase to phase and phase to earth clearances in main and sub-DBs	:	
19.0	Busbar arrangement in Sub-DBs	:	
20.0	Make of ballast	:	
21.0	Make of switches	:	
22.0	Erection accessories such as junction boxes, clamps, saddles	:	
23.0	Make of ceiling fans	:	
24.0	Make of exhaust fans	:	
25.0	Make of flame-proof fittings and catalogue numbers	:	
26.0	Rating of exhaust fans	:	
27.0	Deviations, if any, on technical design data	:	
28.0	OUTDOOR LIGHTING		

NOTES TO BIDDER

1. ITEMS WHICH DEVIATE FROM THE SPECIFICATION SHOULD BE MARKED WITHIN ASTERISK (*) AND DETAILS TO BE GIVEN IN SCHEDULE OF DEVIATIONS
2. THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY SHALL BE ENCLOSED WITH EACH COPY OF THE BID.

SIGNATURE OF BIDDER & DATE

ENQUIRY/SPECIFICATION NO.: BIDDER:

SL. NO.	DESCRIPTION	UNITS	BIDDERS DATA
29.0	Name of manufacturer	:	
	Type of fittings envisaged		
30.0	Make of fittings	:	
31.0	Lux level to be obtained	:	
32.0	Provision of escape lighting	:	
33.0	Location of main and sub-DBs		
34.0	Control of lighting	:	
35.0	Automatic	:	
36.0	Cable laying above ground	:	

NOTES TO BIDDER

1. ITEMS WHICH DEVIATE FROM THE SPECIFICATION SHOULD BE MARKED WITHIN ASTERISK (*) AND DETAILS TO BE GIVEN IN SCHEDULE OF DEVIATIONS.
2. THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY SHALL BE ENCLOSED WITH EACH COPY OF THE BID.

SIGNATURE OF BIDDER & DATE

ISSUE R1

DEVIATION SCHEDULE

SCHEDULE OF TECHNICAL DEVIATIONS

Bidder shall list below all technical deviation clause wise w.r.t. tender specifications:

S.No.	Page No.	Clause No.	Deviation	Reason / Justification

Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date: Tenderer's Stamp & Signature

SECTION 6

ENCLOSURES TO SPECIFICATIONS

Sl no.	Description	Drg. No. ,	Rev. no.
1.	Plot plan	PE-DG-392-100-M001	3
2.	Layout Plan drawing of 400kV s/s	TB-0-360-316-002	3
3.	Section drawing of 400kV s/s	TB-0-360-316-003	3
4.	Conceptual Control room building Layout	TB-3-360-316-009	3
5.	Layout Plan and elevation drawing of 11kV s/s	TB-3-360-316-016	0
6.	Outdoor trench layout	TB-0-360-316-005	2