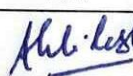
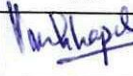
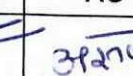




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				Group	TBEM																											
				W.O. No	88006																											
CUSTOMER				Uttar Pradesh Rajya Vidyut Utpadan Nigam Ltd. (UPRVUNL)																												
CONSULTANT				1. NTPC (Review Consultant) 2. DCPL																												
PROJECT				400kV Switchyard for Panki Thermal Power Station (1x660MW)																												
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Section 1: Scope, Technical Requirements and Quantities

1. SCOPE

- 1.1 This technical specification covers the requirements of **design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to project site, material reconciliation at site, supervision** of ETC works for Illumination System for Control Room Building, Switchyard & street lighting complete in line with specification. Performance test is in the scope of bidder.
- 1.2 This section covers the specific technical requirements **of Illumination System for Control Room Building, Switchyard & street lighting**. This constitutes minimum technical parameters for the above system as specified by the customer/NTPC. The offered system shall also comply with the Section-3 (Project Details and General technical requirements for all equipment under the Project) of this specification.
- 1.3 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. However, the bidder shall be responsible for the design and verification of the complete illumination system, demonstration of lux levels and other criterion at site.
- 1.4 After placement of order, the bidder has to design the system as per relevant standard/ codes to the satisfaction of BHEL/Customer.
- 1.5 It is not the intent to specify herein all the details of design and manufacturing. The equipment and the system shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to BHEL/Customer, who will interpret the meaning of drawings and specifications and shall be entitled to reject material, which in his judgment is not in full accordance herewith.
- 1.6 The bidder shall have deemed to have understood completely all the tender drawings and documents and quoted accordingly.
- 1.7 deleted
- 1.8 The specification comprises of following sections,

Section-1 : Scope, Project specific technical requirements
Annexure-BOQ: Bill of Quantities

Section-2 : Specific technical requirements for the equipment under scope of supplies.

Section-3 : Project Details and General technical requirements for all equipment under the Project.

In case of any discrepancies between the requirements mentioned under different Sections, order of precedence shall be Section-1, Section-2 & Section-3.
- 1.9 No deviation from the requirements specified in various clauses of this specification shall be allowed. A certificate to this effect have to be furnished along with the offer.

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1.10 The equipment is required for the following project:

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Name of Project: 400kV Switchyard for Panki Thermal Power Station (1x660MW)

Name of Consultants: NTPC (Review Consultant)
DCPL, Kolkata

1.11 The scope of supplies shall be as per commercial terms and conditions enclosed separately with the enquiry.

2. TECHNICAL REQUIREMENTS

The bidder should have experience of design & supply of Illumination System for at least one project of State Electricity Boards/ Central Utilities/State or Central Transmission Utilities/ Industrial Installations.

Documents to be submitted for Technical Requirements:

- Proof of design, by submitting the approved design documents and drawings of both indoor & outdoor areas.
- Purchase Order copy defining the scope & value.

3. SPECIFIC TECHNICAL REQUIREMENTS

3.1 As per UPRVUNL specification for Panki enclosed as Annexure-1 of Section-1 & equipment specification given in Section-2.

3.2 Illumination system requirement

Illumination system, illumination system design, Lux levels for various areas, luminaries type and low voltage power services for following areas shall be required,

- Switchyard control room building.
- Outdoor switchyard area & street light

3.3 Reference drawings:

SN.	BHEL Drawing No.	Drawing Title
1.	9962-001-TB-572-PVC-C-121	Architecture drawing for Control Room Building
2.	9962-001-TB-572-PVE-F-184	Electrical Layout plan and sectional elevation drawing of 400kV Switchyard
3.	9962-001-TB-572-PVE-F-190	Cable Trench (Outdoor) Layout of 400kV Switchyard
4.	9962-001-TB-572-PVE-F-191	Indoor Cable Trench Layout of Switchyard CRB

3.4 Detailed Illumination Design Calculation shall be submitted by bidder for approval of BHEL/Customer.

3.5 Lighting system will be designed to ensure adequate uniform visual performance, safety & reliability and will be free from excessive glare and flicker from discharge lamp. In main control

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room, particular attention will be given to ensure that illumination is proper and aesthetic. Control room lighting will be such as to prevent any glare/ luminous patch on control board /panel/ VDUs when viewed from an angle.

4. SCOPE OF SUPPLIES & SERVICES

- (i) System Design Engineering is included in vendor's scope, which includes design of complete lighting system for indoor and outdoor areas. Please refer the list of reference drawings for the tentative areas to be covered by the lighting system. The aspect of engineering covers preparation of electrical distribution and control schemes, quantity estimation, luminaire layout drawings, conduit layout drawings, wiring schemes upto luminaires, cable schedules and all associated design work not specifically mentioned in the specification. The quantity estimation to include all items required for the complete lighting system viz. lighting fixtures, lamps, Lighting DBs, Welding DBs, lighting panels, conduits, PVC wires, mounting hardware etc. complete in all respect.
- (ii) The main items to be furnished for Switchyard under this contract are detailed in **Bill of Quantity (Annexure-BOQ)** and shall be read in conjunction with other clauses of this specification.
- (iii) Supervision of Erection & Commissioning (as required by site) of lighting system is included in vendor's scope.
- (iv) Civil design for lighting mast / pole is included in vendor's scope.
- (v) Design rectification engineering (if any) is included in vendor's scope. In case of revised inputs or site feedback, preparation and submission of revised engineering outputs shall also be in the scope of vendor.
- (vi) Although Erection and Commissioning is not included in vendor's scope, the vendor shall be fully responsible for establishing the correctness of engineering and equipment at site.
- (vii) Review of sub-vendor's documents by the purchaser shall not relieve the vendor from the responsibility of design & supply.
- (viii) All associated items, though not specifically mentioned but required for safe and satisfactory operation of equipment/ system shall also be deemed included and the same shall be supplied at NO EXTRA COST to BHEL/ Customer.
- (ix) Further, in case any type of luminaire/ panels etc. not included below but are required to meet the technical specification shall be specifically brought out in the offer/ shall be deemed included in offer.
- (x) Lighting Panel/ Junction Box: The bidder shall supply junction boxes complete with terminals as required. The supports, brackets, bolts, nuts, screws etc. required for erection are also included in scope of the bidder.
- (xi) Bidder shall indicate in his offer, make and catalogue nos. of all equipment offered.
- (xii) The continuous conductor of specified GI wire shall be run all along each conduit run. The conductor shall be connected to each panel ground bus. All junction boxes, receptacles, switches,

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lighting fixtures etc. shall be connected to specified GI wire. Supply of GI ground wire shall be included in bidder's scope.

- (xiii) Supply of all other items such as wires, steel wire, lugs, cable glands (if cables are supplied by bidder), earthing material etc. required to complete the work is in bidder's scope.
- (xiv) Cable gland plate in all the panels shall be minimum 2.5 mm.
- (xv) The documents shall be in English language and MKS system of units.
- (xvi) Make of all equipment and components shall be as per attached Sub-Vendor List enclosed as per "Annexure-Vendor List".
- (xvii) All accessories shall be wired upto a terminal block or a separate weather proof metallic terminal box suitable for 2.5 sq. mm. copper wire termination.
- (xviii) Single line diagrams of power distribution upto Lighting Panels. Separate drawing for complete lighting distribution shall also be prepared by vendor.
- (xix) Preparation of **As-Built drawing** and submission of the same in hard copy 5 set & in CD ROM/ soft copies – 2 numbers.
- (xx) Conducting of lux level measurement as per approved designs to the satisfaction of owner / purchaser shall be under bidder's scope.
- (xxi)) Bidder shall ensure that sufficient quantity of commissioning spares is made available for timely completion of commissioning of the system. The bidder shall furnish a list of Commissioning spares that will be provided by him. The unused commissioning spares shall be returnable to the bidder.

5. EXCLUSIONS / BHEL ISSUED ITEMS FOR ILLUMINATION:

Following items shall be supplied by BHEL for illumination system. Remaining all items required for successful completion of illumination system is under scope of bidder. However, bidder has to submit **estimate and calculation sheet for BHEL supplied items** during contract stage.

- (i) 415V Main Lighting Distribution Board,
- (ii) 415V AC Emergency Lighting Distribution Board
- (iii) Lighting Transformers for MLDB & ELDB
- (iv) Multicore armoured power & control cable cables
- (v) 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. The quantity of the cables shall be free issued to the successful bidder as per the estimate given by bidder.
 - 2 core x 2.5 sq.mm (PVC/ Cu.)
 - 2 core x 6 sq.mm (PVC/ Al.)
 - 4 core x 6 sq.mm (PVC/ Al.)
 - 4 core x 10 sq.mm (PVC/ Cu.)
 - 4 core x 16 sq.mm (PVC/ Al.)
 - 3.5 core x 35 sq.mm (PVC/ Al.)

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- 3.5 core x 70 sq.mm (PVC/ Al.)
- 3.5 core x 300 sq.mm (XLPE / Al.)

- (vi) 75x10 & 50x6mm GI flat for earthing works, however GI flat of size less than 50X6 shall be supplied by bidder.
- (vii) 100/50mm GI/ PVC pipe for cabling works
- (viii) 40mm dia MS rod for earthing works

6. BILL OF QUANTITIES

Please refer “Annexure-BOQ”.

7. SYSTEM PARAMETERS FOR ILLUMINATION DESIGN

S. No.	Description	Unit	Value
1.0	SYSTEM DESIGN DATA		
1.1	Design ambient	°C	50
1.2	AC Supply		
a)	Rated voltage	V	415 (3-ph)
b)	Rated frequency	Hz	50
c)	Voltage variation (permissible)	%	+10% to -10%
d)	Frequency variation (permissible)	%	+5% to -5%
e)	Combined voltage & frequency variation (sum of absolutes permissible)	%	10%
f)	System fault level & duration	kA, sec.	50kA for 1 sec.
1.3	DC Supply		
a)	Rated voltage	V	220
b)	Voltage variation (permissible)	%	+10% to -10%
c)	System fault level & duration	kA, sec.	25kA for 1 sec.
2.0	APPLICABLE STANDARDS IS 60947 Low voltage switchgear and control gear IS 13703 Low voltage fuses for voltages not exceeding 1000V AC or 1500 V IS 10118 Code of practice for selection, installation and maintenance of switchgear and control gear IS 60898 Electrical Accessories - circuit breakers for over protection for household and similar installations IS 1901 Visual indicator lamps IS 60079 Explosive atmospheres IS 5572 Classification of hazardous areas (other than mines) having flammable gases and vapours for electrical installation IS:2551 Danger notice plates		

8. LIGHTING PANELS

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Lighting Panels shall be of following types:

Type	Incomer Feeder	Outgoing Feeder	Detail of Contents
LP-1	1No. 415V, 63 A, TPN MCCB (3.5Cx70sq.mm cable)	18 Nos., 20A, 240V MCB	Single Front, Fixed type, 415V, 63A, contactor and Programmable Digital Timer of 24 hour range 10A, 240V selector switch, fuse, etc. outdoor type and IP:55 degree of protection
LP-2	1No. 415V, 63 A, TPN MCCB (3.5Cx35sq.mm cable)	9 Nos., 20A, 240V MCB	Single Front, Fixed type, 415V, 63A, contactor and Programmable Digital Timer of 24 hour range 10A, 240V selector switch, fuse, etc. outdoor type and IP: 55 degree of protection
LP-3	1No., 4A fuse 3 KVA transformer, 40A TPN MCB	24 Nos., 16A, 45V MCB	Single Front, Fixed type, IP: 55 degree of Protection. Incomer shall be suitable for receiving 4Cx16 sq. mm cable and outgoing circuit shall be suitable for 2Cx16 sq. mm cable.
DCLP	1No. 220V, 32 A, DP MCB (2Cx35sq.mm cable)	6 Nos., 16A, 220V DP MCB	Single Front, Fixed type, 220V 32A DC Fuse, etc. outdoor type IP: 55 degree of protection.

9. LED LUMINARIES WITH FITTING (Integrated/ retrofitted LED lamp to be provided as a part of Luminaire)

FC02 (LED) Indoor Industrial type General purpose LED batten suitable for conduit/surface/ suspended mounting, aesthetically designed CRCA housing and frosted diffuser and having an integral driver. The luminaire shall have nominal system output of $3600 \pm 5\%$ lumens with nominal system power upto $40W \pm 10\%$. Fixtures suitable to meet the **Utility Area** aesthetic requirement, comparable to FC02.

FC06 (LED) Indoor Industrial type General purpose LED batten suitable for conduit/surface/ suspended mounting, aesthetically designed CRCA housing and frosted diffuser and having an integral driver. The luminaire shall have nominal system output of $3600 \pm 5\%$ lumens with nominal system power upto $40W \pm 10\%$. Fixtures suitable to meet the **Switchgear Room** aesthetic requirement, comparable to FC06.

FC26 (LED) Flat Panel, Decorative type recessed (1200mm X 300 mm) LED luminaire suitable for recess mounting in false ceiling, aesthetically designed powder coated CRCA housing with high purity anodizes aluminium mirrors having an integral driver. The luminaire shall have system power approx. 30W to 40W. Fixtures suitable to meet the **Control Room** aesthetic requirement, comparable to FC26.

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FC30 (LED)	Flat Panel, Decorative type recessed (600 mm X 600 mm) LED luminaire suitable for recess mounting in false ceiling, aesthetically designed powder coated CRCA housing with high efficiency opal diffuser having an integral driver. The luminaire shall have system power approx. 30W to 40W. Fixtures suitable to meet the Control Room aesthetic requirement, comparable to FC30.
FC32 (LED)	Decorative, surface mounted with mirror optic having an integral driver. The luminaire shall have nominal system output of $3600 \pm 5\%$ lumens with system power upto $40W \pm 10\%$. Fixture shall be suitable & comparable to FC32.
FC81 (LED)	Corrosion proof , totally enclosed type with sheet aluminium/ polycarbonate housing having an integral driver. The luminaire shall have nominal system output of $3600 \pm 5\%$ lumens with system power upto $40W \pm 10\%$. Fixture shall be suitable & comparable to FC81.
SS62 (LED)	Street light with one piece cast aluminium body having an integral driver, protection class IP55. The luminaire shall have nominal system output of $9000 \pm 5\%$ lumens with system power upto 90W. Fixture shall be suitable & comparable to SS62.
SS63 (LED)	Street light with two piece cast aluminium body having an integral driver, protection class IP55. The luminaire shall have nominal system output of $15000 \pm 5\%$ lumens with system power upto 150W. Fixture shall be suitable & comparable to SS63.
SF63 (LED)	Flood Light , Weather proof, dust proof, Cast Aluminium alloy body, dome type, protection class IP 55, The luminaire shall have system power upto 120W. Fixture shall be suitable for flood light requirement & comparable to SF66.
SF66 (LED)	Flood Light , Weather proof, dust proof, Cast Aluminium alloy body, dome type, protection class IP 55, The luminaire shall have system power upto 250W. Fixture shall be suitable for flood light requirement & comparable to SF66.
FC33 (LED)	Decorative, recessed type LED approx. 15W
FC07 (CFL)	Fluorescent, industrial box type base and vitreous enamelled side reflectors operating on 220V AC input supply with 18W CFL lamp
FC33 (CFL)	Fluorescent, decorative, recessed type with mirror optic reflector operating on 220V AC input supply with 18W CFL Lamp

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FC34 (CFL) Fluorescent, dust proof, totally enclosed type with sheet steel housing operating on 220V DC input supply with 18W CFL Lamp

NOTES –

Technical Requirement for LED

- i. Surge Protection for LED Luminaries
Indoor LED Luminaries - 3kV
Outdoor LED Luminaries - 5kV Internal & 10kV external
- ii. Ingress Protection Class for LED Luminaries
Indoor LED Luminaries - IP 20 (min.)
Outdoor LED Luminaries – IP 55
- iii. Burning Hours 50,000
- iv. Lumen Maintenance 70% at the End of Burning Hours
- v. System Efficiency of LED luminaire shall not be less than 90 Lm/W for LEDs upto 40 Watt rating and 95 Lm/W for LEDs above 40 Watt rating. Higher efficiency is desirable

** LED must comply all the parameters of IS 16105 – 2011 or IESNA LM-80-08. The Luminaire must comply all the parameters of IS 16106 – 2011 or IESNA LM-79-08. The LED driver should comply to IEC 61347-2-13, IS 15885: Part 2: Sec 13 IEC 62384, IS 16104 and CISPR 15. Complete with all accessories.*

10. JUNCTION BOX & SWITCH BOARD

10.1 Junction Box

- a) Enclosure material: CRCA Sheet.
- b) Enclosure thickness: 16 SWG
- c) Galvanized (applicable for CRCA sheet): Hot dip galvanised
- d) Degree of protection: IP-66 (indoor area)/ Weatherproof IPW-66 (outdoor area)
Flameproof (for hazardous area)

10.2 Street Light & Lighting Mast Junction Box

- a) Enclosure material: CRCA sheet/ Thermoplastic material with transparent cover/Better (to be finalised during contract stage)
- b) Enclosure thickness (min): 16 SWG (for CRCA sheet)/ 2 mm (for thermoplastic)
- c) Galvanized (applicable for CRCA sheet): Hot dip galvanised
- d) Degree of protection: Weatherproof IPW-66

Types of Junction Box:

JB-F Provided with four (4) way stud type terminals for terminating upto 2 nos. 4mm² stranded copper conductors on each terminal, suitable for outdoor installations.

JB-FE Same as above but with an additional epoxy coating of 50 micron thickness.

JB-S These are to be fitted with fuse base and fuse, also connecting terminals for low

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voltage cables. TBs shall be 1-4 way, stud type suitable for loop-in loop-out 4CX16 mm² Al. cables & tap off 2CX2.5 mm² Cu cable, including cable glands. Earthing screws with suitable bimetallic feature are to be provided for attaching the lead-coated copper conductor of the earthing system.

JB-M These are to be fitted with fuse base and fuse, also connecting terminals for low voltage cables. TBs shall be 1-4 way, stud type suitable for loop-in loop-out 4CX16 mm² Al. cables & tap off 3nos.2CX2.5 mm² Cu wire. Earthing screws with suitable bimetallic feature are to be provided for attaching the lead-coated copper conductor of the earthing system.

10.3 Switch Box/ Board

- a) Enclosure material: CRCA Sheet.
- b) Enclosure thickness: 14 SWG M.S. sheet with 6mm thick Bakelite cover
- c) Galvanized: Yes
- d) Degree of protection: IP-55

Type No.	Switch	Fan Regulator*	Socket
SWB 1	5 A - 2 Nos.	-	-
SWB 2	5 A - 3 Nos.	-	5A - 1.No.
SWB 3*	5 A - 5 Nos.	1	5A - 1.No
SWB 4*	5 A - 7 Nos	3	5A - 1.No.
SWB 5**	5 A - 5 Nos	-	5A - 1.No.

* Space provision shall be kept for fan regulator in switch boxes.

** Shall have the provision for mounting the 16 A contactor.

11. RECEPTACLES

11.1 Decorative Receptacle

- a) Enclosure material: MS Sheet
- b) Enclosure thickness: 1mm MS sheet
- c) Surface Treatment: Galvanized/ Electro-plated
- d) Weight of zinc: 460 g/ mm² (65 microns)
- e) Degree of protection: IP-42/ IP 62(dusty area)

11.2 Industrial/ Welding Receptacle

- a) Enclosure material: CRCA sheet steel
- b) Enclosure thickness: 2mm CRCA sheet steel
- c) Surface Treatment: Galvanised (Hot Dip)
- d) Weight of zinc: 460 g/ mm² (65 microns)
- e) Degree of protection: IP-42/ IP 62(dusty area)

RA 5/15A, 3-Pin, 240V AC **Decorative receptacle** with piano-key type switch for flush mounting in control room office, store, cabin etc.

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- RB** **20A, 240V AC Industrial type** receptacles 2 pole, 3-pin (third pin scrapping earth) porcelain, metal clad socket with a metallic cover tied to it. The receptacles located in switchgear rooms, MCC rooms and control room shall have IP-42 degree of protection and those located in other dusty areas shall have IP-62 degree of protection. The receptacles to be provided at interval of 20m or part thereof. All receptacles will be controlled with a Rotary, heavy-duty 20A switch conforming to applicable standards. In hazardous area receptacles will be of flameproof type.
- RC** **63A, 3-phase, 4 pin, 415V AC Welding receptacles Industrial type** interlocked plug and isolating switch with earthing contact. Other requirements shall be same as Type RB. In hazardous areas these receptacle will be located in MCC room.
- RP** **250A, 3-phase, 415V AC outdoor, Industrial type receptacles with 250A, 4P/TPN MCCB** with handle, control fuse and earthing arrangement for Transformer Oil Filtration unit. Necessary arrangement for looping incoming supply cables shall be provided.

12. LIGHTING POLES & HIGH MAST (Also refer Customer specification)

Lighting poles shall be of following types,

Pole Type	Overall pole height	Overhang projection	Application
A1	11m	1.2m	For single street Light fixture.
A2	13m	1.8m	For single street Light fixture.
A3	13m	1.8m	With double arm for two street Light fixtures.
E1	4m	-	For post top lanterns.
MAST	30m	-	For flood light fixture

Lighting Mast shall be of continuously tapered polygonal cross section hot dip galvanised presenting a pleasing appearance. The Mast shall be of **30m height** with lantern carriage to enable raising/lowering for ease of maintenance, including the Head Frame, Double Drum Winch, continuous stainless steel wire rope, in built power tool, luminaires, suitable aviation warning light, lightning alongwith necessary power cables within the mast. The mast shall be delivered only in three/ four sections & shall be joined together by slip stressed fit method at site. No site welding or bolted joints shall be done on the mast.

- The Mast together with the fixtures shall be capable of withstanding the appropriate wind loads as per IS:875. The Mast shall be fabricated from special steel plates conforming to BS-EN10-025 and folded to form a polygonal section.
- Lantern Carriage shall be fabricated suitably and hot dip galvanised for fixing and holding flood light fixtures and their control gear boxes. **The steel structures of high mast for switchyard shall be double dip galvanized with zinc coating not less than 910 gm/sq.m.**

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- c. A suitable winch arrangement shall be provided to lower & raise the Lantern Carriage Assembly. Winch shall be of completely self sustaining type without the need for brake shoe, springs or clutches. The min. working load shall not be less than 750 kg. The winch drum shall be grooved to ensure perfect seat for stable and tidy rope lay with no chances for slippage. Winch shall be operated by an internally mounted three phase motor/power tool with necessary reduction gear mechanism. A handle for manual operation of winch shall also be provided. An adequate door opening shall be provided at the base of the Mast.
- d. Lighting mast shall be complete in all respect and shall be provided with feeder panel complete with power/control circuit along with 63A TPN MCB, contactors, timers, photocell, MCB's, motor protections (O/L & single phase), start/stop PB with indication lamps. Feeder pillar shall have provision of receiving 4Cx16 sq mm. cable. All necessary cables between feeder panel & JB-M and between JB-M & fixtures are also included in the scope of mast and same shall be of proven design.
- e. Mast shall be provided with 1200mm long air termination for the lightning protection (at top of the mast as per IS-2309). Suitable arrangement for connection of down conductor (not in the scope of vendor) shall be provided. Provision of earth connection of GI strip shall also be kept at a height of one metre from the ground (conductor size shall be informed during detailed engineering).
- f. Lighting Mast shall also be provided with suitable aviation warning lights.

13. TYPE TESTING

All supply items i.e. Luminaries, Lighting Panels, Junction box, Receptacles are to comply type test requirement as per relevant IS / IEC / Specification.

The bidder to submit the type tests reports for the tests conducted on the equipment identical or similar to those to be supplied under this contract and the test(s) should have been conducted **at an independent laboratory** (NABL approved) **not earlier than 02.11.2010**. If any type test report is found to be technically unacceptable, such type test(s) shall be conducted by the bidder without any cost and delivery implication to BHEL/Customer at an independent lab approved by customer.

All acceptance and routine tests as per relevant standards and specification shall be deemed to be included in the bidder's scope.

Additional Type test certificate on equipment, if any, shall be furnished, else the equipment shall have to be type tested, free of cost, to prove design.

Items like ceiling fans, Emergency Lighting unit, flexible conduit, earthing wire & flat, 24V supply module, ladder, switch boxes, exit sign, structural steel shall be cleared based on Certificate of Compliance.

The type test reports once approved for any projects shall be treated as reference. For subsequent projects of UPRVUNL/ NTPC, an endorsement sheet will be furnished by the

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manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.

14. QUALITY PLAN

The successful bidder shall submit the QP for BHEL/ Customer approval. In case bidder has reference QP agreed with Customer, same can be submitted for specific project after award of contract for BHEL/ Customer’s approval. There shall be no commercial implication to BHEL on account of QP approval.

All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan. The supplier shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and comply with the requirements of the specification. Charges for all these tests for all the equipment & components shall be deemed to be included in the bid price.

15. INSPECTION & TESTING

Before being fitted on the equipment, all components shall be subjected to routine tests at the bidder’s factory, provided by 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 each item in accordance with the applicable IEC/IS and the material shall be offered for final inspection by BHEL/Customer in accordance with agreed quality plan with 3 weeks’ advance information. The charges for these shall be deemed to be included in the equipment price.

16. PACKING

The material shall be packed in such a way to ensure protection against damage during transit, storage for prolonged periods (at least 1 year) at site (located at costal area) and handling.

17. PERFORMANCE TEST

It will be bidder’s responsibility to demonstrate performance of system fulfilling design / operational requirement. Bidder to arrange testing instrument on returnable basis.

18. SUBMISSION & APPROVAL OF DOCUMENTS

As per NTPC MDL following documents with project title block & document numbers as mentioned below are required to be submitted by bidder after award of order,

NTPC Doc. No.	Document Description
9962-001-TB-572-PVE-U-227	OUTDOOR ILLUMINATION DESIGN OF SWITCHYARD
9962-001-TB-572-PVE-U-228	INDOOR ILLUMINATION DESIGN OF SWITCHYARD

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9962-001-TB-572-PVE-G-229	LIGHTING LAYOUT OF OUTDOOR SWITCHYARD
9962-001-TB-572-PVE-G-230	LIGHTING LAYOUT FOR CONTROL ROOM
9962-001-TB-572-PVE-C-231	DRAWINGS OF LIGHTING PANELS, JB
9962-001-TB-572-PVE-C-232	DETAILS OF LIGHTING FIXTURES, LAMPS, SWITCHBOARDS, FANS
9962-001-TB-572-PVE-Y-233	DRAWINGS & GUARANTEED TECHNICAL PARTICULARS FOR LIGHTING TRANSFORMER
9962-001-TB-572-PVE-W-234	TYPE TEST REPORT OF LIGHTING TRANSFORMER
9962-001-TB-572-PVE-W-235	TYPE TEST REPORT OF LIGHTING PANELS
9962-001-TB-572-QVE-Q-298	MQP (Illumination Pkg)- Lighting Panels and Junction Boxes
9962-001-TB-572-QVE-Q-299	MQP (Illumination Pkg)-Lighting Transformer

Any additional document not mentioned above but is required as per specification for customer approval shall also be submitted by bidder after award of order. Section-2 may kindly be referred for detailed list.

Item-wise technical manufacturing clearance shall be given to vendor on the basis of approval of final BOQ & drawings/ documents of that particular item.

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COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.
2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'.
3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in BOQ-Cum-Price schedule of the specification shall not be considered (i.e. technical description & quantities as per specification shall prevail).

Signature of Authorized Signatory _____

Name and Designation_____

Phone / Mobile Number_____

Email ID_____

	Technical Specification for Illumination System	SPECIFICATION NO. TB-316-401-009
		ANNEXURE-1: UPRVUNL SPECIFICATION
	PROJECT: 400kV Switchyard for Panki Thermal Power Station (1x660MW) CUSTOMER: UPRVUNL REVIEW CONSULTANT: NTPC LTD. CONSULTANT: DCPL	

ANNEXURE - 1

UPRVUNL SPECIFICATION

(CHAPTER 27: ILLUMINATION SYSTEM)

Refer enclosed UPRVUNL specification (32 pages) for Illumination System. Following important points regarding scope of bidder's for Switchyard Illumination package may be noted:

1. All conventional fittings are to be replaced by LED fittings as mentioned in Section-1 & BOQ. Wherever conventional light fittings are mentioned equivalent LED fittings or those mentioned in Section-1 are to be provided by bidder.
2. DBs & lighting transformers are not in the scope of supply of bidder.
3. Energy Saving System for Panels are not applicable.
4. Only supervision of ETC is in scope of bidder.

CHAPTER 27 : ILLUMINATION SYSTEM**1.00.00 SCOPE OF WORK**

- 1.01.00 This scope of work shall cover the design, manufacture, assembly, testing at manufacturer's works, supply & delivery, properly packed for transport F.O.R. site of POWER PLANT INDOOR AND OUTDOOR LIGHTING SYSTEM, complete with all materials and accessories for efficient and trouble-free operation.
- 1.02.00 The scope of work shall include complete installation, testing, commissioning and putting into successful commercial operation of the Lighting System of Switchyard ~~Power House, Mill building, Transformer Yard~~ and all areas covered under power plant EPC package. This includes the supply of all labor, tools, implements and supplies.
- 1.03.00 The major areas to be illuminated under the scope of this package are listed in Section-1. The areas listed are however indicative only for the purpose of guidance to the bidder and is subject to change during detail engineering after finalization of plant layouts.

2.00.00 SCOPE OF SUPPLY

- 2.01.00 The equipment and materials within the scope of supply shall include but not limited to:
- i. ~~Lighting transformer.~~
 - ii. Lighting fixtures with lamps and accessories and LED type fixtures for all indoor, outdoor & street lighting.
 - iii. Lighting panels/boards: ~~Main lighting distribution boards, emergency lighting distribution boards, emergency DC lighting panels, lighting panels, street lighting panels etc. All panels shall be provided with Energy Saving System.~~
 - iv. Street lighting poles, flood lighting towers and high masts.
 - v. Ceiling fans, pedestal fans, receptacles, switches, switchboards, portable emergency lighting unit, portable 24V supply module including handset maintenance equipment etc.
 - vi. Cables, wires, splicing/termination kits/connection accessories.
 - vii. Conduit and accessories, junction and pull boxes, terminal blocks.
 - viii. Grounding materials and connections.
 - ix. All fittings, supports, brackets, anchors, clamps and connections.
 - x. Steel for field fabrication of supports and brackets.
 - xi. Datasheet and technical leaflets on each of equipments / devices.

3.00.00 SCOPE OF SERVICE

- i. Carrying out of detail engineering including detail design calculations, preparation of lighting layouts showing location of fixtures, cable wires and conduit, preparation of cable schedule, and other related drawings as detailed in subsequent clauses and also consider the Energy Saving System.
- ii. Furnishing of all labour (skilled and unskilled), supervisory personnel, erection tools and tackles, testing equipment, implements, supplies, consumables & hardware and transport for timely and efficient execution of the contract work.
- iii. Preparation of **AS-BUILT** drawings showing field modifications, if any.

Only supervision of ETC
in scope of bidder.

4.00.00 CODES AND STANDARDS

- 4.01.00 The design, manufacture and testing of equipment shall be carried out as per the latest Indian/International Standards, Indian Electricity Rules, Relevant Code of Practices and requirements of Govt. of Uttar Pradesh
- 4.02.00 All standards and codes of practice referred to herein shall be the latest edition including all applicable official amendments & revisions as on date of bid opening. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards & codes.
- 4.03.00 Lighting Fixtures and Accessories
 - IS: 1913 General and safety requirements for luminaires.
 - IS: 2148 Flame proof enclosures of electrical apparatus.
- 4.04.00 Lighting Panels, Switch-boxes, Receptacles and Junction Boxes
 - IS:2147 Degree of protection provided by enclosures for low-voltage switchgear and control gear.
- 4.05.00 Electrical Installation Practices & Miscellaneous
 - IS: 1944 Code of practice for lighting of public thorough fare
 - IS: 3646 Code of practice for interior illumination.
 - IS: 5572 Classification of Hazardous areas (other than Mines) having flammable gases and Vapours for electrical installation
 - IS: 6665 Code of practice for industrial lighting.
National Electrical Code
Indian Electricity Rules.
Indian Electricity Act

5.00.00 DESIGN CRITERIA

5.01.00 The system provides lighting and electric power supply to all plant areas covering both BTG and BOP. In addition, it also provides lighting to selected areas during plant emergency conditions.

5.02.00 The system will be installed in an adverse industrial environment. Equipment in some areas will be subject to vibration, coal-dust and oil / water vapours as prevalent in a thermal power generating plant.

5.03.00 The design shall be such as to provide minimum lighting levels & lighting fixtures for different areas as per Annexure.

The systems shall be suitable for operation on available power supply having characteristics as given in Annexure.

All fittings of control room/office shall be energy efficient type.

6.00.00 SYSTEM CONCEPT

The lighting system shall comprise of following sub-systems:-

6.01.00 Normal A.C. Lighting

This will be provided by A.C. lighting fixtures distributed throughout the plant. These lights will be ON as long as the A.C. supply is available.

A.C. lighting fixtures will be fed from respective area lighting panels, which in turn will be connected to main lighting distribution board. The main lighting distribution boards will be fed through respective unit ratio lighting transformer, which forms a part of the MLDB. Normal A.C. supply thus made available by the MLDB is 415V-3ph-4W-50HZ effectively grounded. Both the MLDB and the lighting panels shall be provided with at least 20% spare outlets.

6.02.00 Normal cum Emergency A.C. Lighting

Emergency A.C. lighting will be provided in selected areas of the powerhouse, boiler area, boiler galleries, in some selected areas close to the power house, Control room, DG set control room switchgear room etc. for general visibility, safe movements and operation of important auxiliaries.

The emergency LDBs (ELDB) are similar to the MLDB except that lighting transformers in this case are fed from station A.C. Emergency bus having D.G. System backup. Thus power for A.C. emergency lighting is 415V-3ph-4W, 50HZ, effectively grounded.

The lighting fixtures connected to this system will be available whenever normal supply is available in the plant and also when DG set supplies power to 415V A.C emergency bus.

At least 25% of the fixtures shall be fed from AC emergency source.

6.03.00 Emergency D.C. Lighting

During station emergency involving total AC failure, incandescent lamp A.C/ DC lighting fixtures shall be provided for movement of personnel in important areas/buildings at strategic locations in critical operating areas and emergency exits. Emergency DC lighting will be catered by DC emergency lighting distribution (DCELDDB) boards. These DCELDDBs will feed the DC emergency lighting fixtures directly and through a numbers of DC emergency lighting panels (DCELP) located suitably in respective areas.

The DC Emergency Lighting Distribution Boards will be fed from two power sources, namely –

- i. Main Lighting Distribution Board (MLDB)
- ii. 220V DC distribution boards (DCDB)

These lights will be ON all the time - normally from A.C supply, but on its failure from D.C. supply through automatic switching.

Lighted Exit signs shall be provided and installed in the control room, switchgear room, relay room, maintenance areas.

Underground conveyor tunnels & buildings (ex- Switchgear room and control room etc) located in other distant areas like coal handling, Ash handling plants, WT plants, Water system plants etc., the fixtures shall be 'Instalite' type which is permanently connected to normal supply charging a battery. These will switch "ON" automatically when AC power supply goes "OFF". Further, in underground areas flameproof fixtures shall be provided.

6.04.00 Remote Emergency Lighting

This will be provided in isolated building/area/mobile equipments viz. ~~Stacker-Reclaimer where D.C. supply is not available by self-contained battery/automatic charger/inverter/flood light units. These portable emergency light units will be energised automatically on loss of normal A.C. supply.~~

6.05.00 Street/Area Lighting

Time switch and photocell will be used for controlling streetlights with provision for manual override and also have the provision of latest Energy Saving Systems.

Same arrangement will also be used for controlling boiler gallery, ESP area , turbine floor (high bay), coal yard and railway marshalling yard lighting.

6.06.00 Receptacles

To cater to welding and other low voltage power requirement of the plant 63A TPN welding socket fed separate Welding receptacle distribution board shall be provided. For other services 15A, 3 pin socket shall be provided.

7.00.00 Not Used**8.00.00 RATING & REQUIREMENT**

- 8.01.00 The lighting system will be supplied from 415 V/415 V $\pm$ 5%, indoor, dry type lighting transformers. Rating of each transformer shall be decided to limit the fault level within 9kA.
- 8.02.00 All equipment and accessories shall be designed for continuous operation under site conditions without exceeding permissible temperature rise as stipulated in relevant standards.
- 8.03.00 Switch, miniature circuit breakers (MCB), MCCB, bus bars shall be fully rated for short circuit level at the point of application. MCB shall have back-up HRC fuse if its rating is less than the available short circuit current.
- 8.04.00 All equipment and accessories shall have proper enclosure to suit the site conditions. Hazardous areas shall have flame-proof enclosure.
- 8.05.00 All wiring from lighting panels to fixtures and receptacles shall be carried out by PVC wires in G.I. Conduits.
- 8.06.00 Heavy duty XLPE FRLS cables will be used only for connections :
- From main lighting distribution boards to area lighting panels.
 - From street/area lighting panel to street light poles/towers. From 415V MCCs to receptacles of 63A and above.
 - From Emergency Main Lighting Distribution Board (ACEMLDB) to Emergency Lighting Panels (ELP).
 - From DC Emergency Lighting Distribution Board (DCEMLDB) to DC Lighting Panels (DCLP).
 - From 415V PMCC /ACDB to receptacles of 63A and above.
- 8.07.00 Suitable number of Flood Lighting Towers / Lighting Masts with adequate HPSV Flood Light will be provided for crushed coal pile, entire railway marshalling yard and other necessary outdoor areas.
- 8.08.00 Lighting of all main streets, approach roads to various buildings shall be included.
- 8.09.00 Each lighting panel shall be provided with adequate number of outgoing miniature circuit breaker for controlling fixtures. 5A, 3Pin sockets shall be fed from the lighting panel through separate circuits.
- 8.10.00 ~~All A.C. Normal and Emergency A.C. lighting shall be provided with Energy Saving System.~~
- 9.00.00 METHOD OF CALCULATION**
- 9.01.00 Standard Lumen method shall be adopted for interior & exterior lighting in order to determine the number of lighting fixtures for obtaining the desired average level of illumination.
- 9.02.00 The coefficient of utilization shall be considered to take care of Lumen loss due to:

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

9.03.00 Additionally, a maintenance factor shall also be considered to account for the fall of illumination due to ageing, pollution like dust deposit etc.

Maintenance factors to be considered for various areas shall be as follows :

Area	Maintenance factor
Air conditioned offices/control rooms with false ceiling	0.75
Switchgear/MCC Rooms in TG Building/Service Building	0.65
Other indoor areas	0.6
Boiler area and other areas prone to chemical/dust pollution	0.55

9.04.00 **Utilisation Factor**

- Dusty area such as conveyor galleries/tunnels, TPs/ Crusher House etc. = 50% ceiling, 30% wall, 10% floor.
- Clear areas such as switchgear room / control room etc. = 70% ceiling, 50% wall, 10% floor.
- Working plain = a) At conveyor walkway level. B) At building floor level.

9.05.00 Voltage drop at the fixture from the MLDB bus shall not exceed 3%.

9.06.00 Circuit loading of each lighting panel shall be done in such a way that almost balanced loading in all the phases i.e. R, Y and B is achieved.

9.07.00 At least two sub circuits shall be used for illumination of a particular area.

9.08.00 Sub circuit loading of each lighting panel shall be restricted to 2000W or 12 Nos. fixtures whichever ever is lower.

The working plane shall be considered at 0.85 m from the floor level.

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

10.00.00 **SPECIFIC REQUIREMENTS - SUPPLY**

EQUIPMENT AND MATERIAL



1 x 660 MW - Panki Thermal Power Station

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

10.05.00 Lighting Transformers

- 10.05.01 Lighting transformers shall be dry type, indoor type dusty vermin proof having ~~415 V/433 V~~ 415V/415V $\pm 2 \times 2.5\%$ with off load tap-changer on primary side. The vector-group shall be Dyn11. (The secondary side shall be solidly grounded through an additional neutral bushing exclusively used for grounding.). Rating of each lighting transformer shall be selected to cater to the maximum connected lighting. The casing of the transformer shall be grounded at least at two (2) points.
- 10.05.02 If necessary, apart from the main lighting transformers, separate small additional lighting transformers may be used at distance lighting points.

10.06.00 Lighting Fixtures

- 10.06.01 Lighting fixtures shall be designed for minimum glare. The surface finish shall be smooth, unobtrusive and scratch resistant.
- 10.06.02 Reflector shall be of sheet steel or aluminium, minimum 20 SWG thick, securely fixed by fastening device of captive type.
- 10.06.03 Fixture shall be suitable for 20 mm conduit entry and 16 SWG G.I. earth-wire connections. Fixture shall also be suitable for case coupling entry wherever required.
- 10.06.04 High bay fixtures shall have provision for vibration damper to ensure rated lamp life.
- 10.06.05 Fixture shall be furnished complete with lamps and integrally/non-integrally or separately mounted control gear & accessories or applicable for different types of fixtures. These shall include holders, ballast, capacitor, starter, igniters (separate type) etc.
- 10.06.06 Fixtures shall be fully wired up to respective terminal blocks, suitable for loop in and loop one connection of PVC wires of following sizes:-
- b) Lighting fixture : 2.5 Sq.mm Copper
 - c) Flood Light fixture : 2x2.5 Sq.mm Copper

10.07.01 Lamps

- 10.07.01 General lighting service (GLS) lamps shall be with clear glass and screwed caps. However, it is preferred to replace GLS lamp by CFL or other energy efficient lamps.
- 10.07.02 All fluorescent lamp shall be bi-pin rotary type and cool daylight. Lamp holder shall be spring loaded, low contact resistance type and shall have resistance to wear and tear.
- 10.07.03 Mercury/Sodium vapour lamp shall be colour corrected type with screwed cap.
- 10.07.04 Lamps shall be suitable for use in position and capable of withstanding small vibrations. Restrictions and special features, if any, shall be clearly indicated in the bid.
- 10.07.05 CFL and T5 fluorescent tube with electronic ballast or tri phosphorous tube.
- 10.07.06 Latest energy saving LED type lighting fixture/ lamps suitable for street light and other non critical areas. REFER TABLE-1 OF AMMENDMENT-1 ELECTRICAL

10.08.01 Ballast/Electronic Ballast

- 10.08.01 Ballasts shall be heavy duty, low loss, polyester-filled type with copper winding.
- 10.08.02 Ballast for Mercury/Sodium vapour lamp shall be provided with suitable tappings to set the voltage within range specified.
- 10.08.03 Ballasts shall be free from hum. Ballasts which produce humming sound shall be replaced without any implication by the Contractor.
- 10.08.04 In multi-lamp fixture, each lamp shall be provided with individual ballast.
- 10.08.05 Ballast windings shall have maximum operating temperature of 120 Deg.C without rated temperature rise marking.
- 10.08.06 Ballast for Control Room Area shall be heavy duty, low loss, high-grade silicon steel stampings, vacuum impregnated polyester resin filled with copper winding.

Ballast for other area shall be electronic type, flicker free pre heat lamp start type having power consumption less than 3-watts per ballast, power factor less than 0.98 and THD less than 10%. Ballast shall operate at operating frequency of more than 40 kHz. Power consumption of ballast for 36W Fluorescent Tube shall be less than 9.5W.

Electronic Ballast shall be suitable for 220V DC and also 240V AC.

Electronic Ballast shall be of such design that minimum 25% reduction in energy consumption at constant luminous flux compared with conventional gear.

Electronic Ballast shall provide constant light independent of mains voltage fluctuation.

10.09.01 Lighting Panel/Distribution Boards

1 x 660 MW - Panki Thermal Power Station

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- 10.09.01 Lighting Distribution Boards/panels shall be metal-enclosed, cabinet type, fabricated, fully drawout type from CRCA sheet steel minimum 2.5 mm thick for load bearing members and 2.0mm for non-load bearing members, suitable for either wall/column mounting on brackets or floor mounting on channel sills. The panel shall be provided with lifting hooks. The LPs will be connected to LDB only.
- 10.09.02 Indoor Lighting Distribution Boards & Lighting Panels shall be dust and vermin-proof, IP-54 or better. Outdoor panels shall be weather-proof with canopy, IPW-55 or better. The cubicle housing transformer shall be minimum IP-42.
- 10.09.03 Lighting Distribution Boards and Lighting Panels shall be so constructed as to permit free access to the terminal connections and easy replacement of parts. Front access doors shall have padlocking arrangements. The LDB shall be fixed on a bottom channel 75mm.
- 10.09.04 Lighting Distribution Boards shall have provision of cable entry from bottom and, panels shall have provision of cable entry from top and bottom, as required, with removable gland plates. Necessary double compression type brass cable glands, tinned copper/Aluminium cable lugs are to be furnished.
- 10.09.05 Two ground pads with M10 G.I. bolts and nuts shall be provided on each Lighting Distribution Board and Lighting Panel for connection to ground conductor.
- 10.09.06 Each Lighting Distribution Board shall be complete with designation and caution notice plates fixed on front cover and a directory plate fixed on inside of the front cover. This directory Plate shall contain details of the Lighting Panels being fed from the Distribution Board including their designation, location, loading etc.
- Each Lighting Panel shall be complete with designation and caution notice plates fixed on front cover and a circuit directory plate fixed on inside of the front cover. Circuit directory plate shall contain details of the points to be controlled by each circuit including the location of the point controlled, rating of the protective units and loading of each circuit. The plates shall be of anodized aluminium with inscriptions indelibly etched on it.
- 10.09.07 Bus bar shall be electrolytic grade hard drawn aluminium, colour coded for easy identification and designed for a maximum temperature of 85°C. Minimum size shall be 25 x 6 mm. The current density of Aluminium bus bar should not be below 0.8 Amp/Sq.mm. The bus bar shall be provided with heat-shrunk/cold-shrunk PVC sleeve.
- 10.09.08 Board / Panel shall be fitted with phase barriers such that it is not readily possible for personnel to touch the phase busbars. Insulation barriers shall preferably be fitted around the circuit breakers such that only the surface and the toggle of the circuit breaker is available on the front.
- 10.09.09 Incoming and outgoing circuits shall be terminated in suitable terminal blocks.
- 10.09.10 In lighting and receptacle panel 3-phase and 1-phase MCB should not be mixed.
- 10.09.11 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.

10.10.00 **Board/Panel Equipment**

10.10.01 Each board shall consist of one dry type transformer housed in the different cubicles one (1) V.T operated voltmeter with selector switch, one (1) C.T operated ammeter selector switch, VTs, CTs, three (3) nos. phase energized indication lamps backed up by fuses and incoming triple pole MCCB. Proper discrimination between outgoing MCCB of lighting distribution board and downstream MCCB of lighting panel shall be ensured.

10.10.02 Each lighting panel shall have an incoming triple pole MCCB with neutral link and a number of outgoing miniature circuit breakers (MCB).

10.10.03 Board/Panel access door shall be interlocked with incoming MCCB such that the door can be opened only when the switch is in OFF position. Means shall be provided to defeat this interlock.

10.10.04 All MCCB shall be single throw, air break and heavy duty type having quick-make quick-break contacts. Fuses shall be HRC link type.

Contactors shall be air-break electromagnetic type. Push buttons shall be push to actuate type.

10.10.05 MCB shall be suitable for manual closing and opening and also automatic trip on overload and short circuit.

10.10.06 Time switch in street lighting panels shall be photocell type with automatic voltage stabilizer and necessary electronic unit with provision for sensitivity adjustment depending on external light intensity. When the exterior illumination level shall fall below a preset value for a considerable period of time (adjustable 30 sec. to 180 secs.) the electronic unit shall generate signal for the output relay to pick-up and potential-free contact of the same shall be used for control of contactor for lighting system. Sustained normal illumination level being restored (adjustable 30 sec. to 180 sec.) the lights shall switch off.

10.10.07 Voltmeter / Ammeter shall be of accuracy class 2.0 or better as per IS:1248 Voltmeter / Ammeter selector switch shall be of reputed make.

10.11.00 **Receptacles**

10.11.01 Receptacles shall be heavy duty, complete with individual plug and switch.

10.11.02 The conduit box of the receptacle shall be provided with earthing screws with washer and nuts welded on the surface for grounding with 16 SWG G.I. wire. Arrangement shall be provided inside the conduit box for grounding of third pin.

10.11.03 Shrouded type plug shall be provided with corresponding matching arrangement at sockets to prevent accidental contact with finger during plug insertion.

10.11.04 Receptacles shall be of following types:



5/15A

1. Type RA-6A, 240V, 2 pole, 3 pin type with third pin grounded, suitable for flush mounting in MCC Room, office areas, control rooms, store rooms, cabins etc. The switch shall be of piano-key type, also flush mounted and decorative non-industrial type.

20A

2. Type RB-16A, 240V, 2 pole, 3 pin Industrial type with third pin grounded, metal clad with gasket having 19mm conduit entry and a metallic screwed cover tied to it with a metallic chain and suitable for installation in clean/dusty areas. The receptacles located in switchgear rooms, MCC rooms and control room shall have IP-42 degree of protection and those located in other dusty areas shall have IP-62 degree of protection. These receptacles shall be located at an interval of 50M along length of conveyor gallery/tunnel starting from one end and both sides of Track Hopper. Minimum one (1) no shall be provided in all equipment floor, feeder floor, boiler drum level, TPs Crusher House, Control Room, Pump House, Transformer Room and at suitable location in all other areas as required. In fuel oil area receptacles will be of flameproof type.

3. Type RC-63A, 415V, 3 phase, 4 pin Industrial type interlocked plug and switch with earthing contact. Other requirements shall be same as Type RB. Interlocking shall be so selected that the switch can be put to 'ON' position only when all the four (4) pins of the plug are housed with complete alignment. In 'OFF' position of the switch the socket outlet shall be completely dead and outgoing terminals isolated. Welding receptacles shall be connected with each other in loop-in loop-out connection to the extent of 3 Nos., located at an interval of 50 M. along the length of conveyor gallery/tunnel starting from one end and both sides of Track Hopper. and minimum one (1) no. shall be provided in all equipment floor, T.Ps, crusher house, wagon tippler, pump house, Cable spreader room, transformer room, boiler platform etc. Separate distribution board shall be used to feed these welding receptacles coming in TG building and boiler areas. At least one (1) no. shall also be provided in each offsite building, which will be fed from 415V MCC. In hazardous areas these receptacle shall be located in MCC rooms.

10.12.00 Fans & Regulators

10.12.01 The fan shall have three well balanced blades. And shall be reasonably free from noise. Pedestal fans shall also be provided as per Owner's requirement.

10.12.02 Fan motor shall be totally enclosed type with copper winding & class E insulation.

10.12.03 Regulator shall have minimum five steps. Electronic regulator with smooth control is preferred.

10.13.00 Switch & Switch Board

10.13.01 All switch boards/boxes shall be of bent steel construction, fabricated of 14 SWG M.S. sheet with 6 mm thick Bakelite cover with brass fixing screws.

10.13.02 Switch boards/boxes located in control room and office areas shall be flush mounted type on brick wall with only the switch knob projecting outside.

10.13.03 Switch boards / boxes shall have conduit knock outs on the sides. Adequate



provision shall be made for ventilation of these boxes.

10.13.04 Flush type receptacles where provided shall be so located that only the plug projects outside.

10.13.05 Switches shall have quick-make and quick-break mechanism operated by a suitable external handle complete with position indicator.

10.14.00 **Lighting Poles/Towers**

10.14.01 **Street Light Poles**

- i. Street light poles shall be swaged and welded steel pole, complete with fixing brackets, weather-proof junction box and all other accessories.
- ii. The pole shall be coated with bituminous preservative paint on inside as well as embedded outside surface. Exposed surface shall be coated with two coats of metal primer (comprising of red oxide and zinc chromate in synthetic medium).

10.14.02 **Flood Light Tower**

- 13 Flood light tower shall be a lattice structure with maintenance platform and approach ladder. All structural members and hardware shall be hot-dip galvanized.
- 14 Structures shall be designed for an additional load of 1500kg for maintenance crew. Deflection under maximum wind pressure shall not exceed 1 in 360. Structural design shall be as per IS-800 and subject to Owner's approval.

10.14.03 **Lighting High Masts**

Applicable standards

IS-875 (Part-III) 1987	-	Code and practice for design loads for Structures.
BSEN 10025/DIN 17100	-	Grade of M.S. Plates.
BS-5135/AWS	-	Welding
BS.ISO 1461	-	Galvanizing
TR. No. 7200 of ILE	-	UK Specification for Mast and foundation.

Structure

Lighting High Mast shall be of continuously tapered polygonal cross section, at least 20 sided, hot dip galvanized and presenting a good and pleasing appearance and shall be based on proven In-Tension design confirming to the standards referred to above, to give an assured performance, and reliable service. The structure shall be suitable for wind loading as per IS-875 Part-III, 1987. The masts dimensions shall be as per standards.

The Mast shall be of 30M height with lantern carriage to enable raising/lowering for ease of maintenance, including the Head Frame,



Double Drum Winch, continuous stainless steel wire rope, in built power tool, luminaries, suitable aviation warning light, lightning along with necessary power cables within the mast. The mast shall be delivered only in three sections & shall be joined together by slip stressed fit method at site. No site welding or bolted joints shall be done on the mast.

High mast shall be complete with feeder pillar panel for power distribution to lighting fixtures and winch motor. Feeder pillar panel shall be outdoor type stand mounting with dust and vermin proof, IP 55 and constructed of 14 swg sheet steel.

10.15.00 **Maintenance Equipment**

10.15.01 The Contractor shall supply one (1) no. of wheel mounted adjustable aluminium ladder for the maintenance of street lights.

10.15.02 For the maintenance of lighting fixtures within the power house, the contractor shall also supply two (4) nos. free standing adjustable aluminium ladder, adjustable from 5m. to 10m.

10.15.03 . For the maintenance of lighting fixtures within the CHP area, the Bidder shall supply two (2) nos. free standing adjustable aluminium ladder, adjustable from 5m. to 10m.

10.16.00 **Special Requirement**

10.16.01 All outdoor illumination fixtures, unless it is fed from photocell/time switch controlled lighting panel, has to be provided with outdoor type local switches.

10.16.02 In all the air filtration units and air handling units, one marine type lamp (of 100 Watt approx.) shall be supplied the wiring and fixing of the same has to be done by the contractor.

10.17.00 **Conduits and Accessories**

10.17.01 Conduits shall be rigid steel, hot-dip galvanised, furnished in standard length of 3 metres, threaded at both ends.

10.17.02 Conduits upto and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 20 mm.

10.17.03 Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushings at both ends.

10.17.04 Flexible conduits shall be made with bright, cold rolled annealed and electro-galvanized mild steel strips and coated with PVC.

~~10.17.05 Conduit Wiring for Chimney~~

- a) ~~Complete C.I. conduits, PVC insulated wires, G.I. grounding conductor, weather proof outdoor junction box and all accessories viz. supports, clamps, junction boxes, etc. to make the installation complete in all respects. Conduit wiring shall be from the lighting fixtures to the junction box located at the bottom of the chimney.~~

- b) All the obstruction lights shall be uniformly distributed over three single phase circuits. Conduit wiring for lighting installation shall be done with PVC cables drawn through the G.I. conduit of proper size. The GI conduits shall be terminated to a fuse box mounted on the chimney shell, at an accessible height from the ground. The cables shall be 1100/650 V Grade, 1/c, 10mm², PVC insulated and sheathed Stranded Aluminium conductor. The conduits shall be clamped at interval not greater than 600 mm. by means of approved type of saddles, clamps, etc. securely fixed on the shell/ladder. PVC bush shall be used at either end of the conduit. The minimum size of conduit to be used for the installations shall be 65mm. Pull boxes, at intervals of not more than 10 meters, inspection bends, etc. are to be provided at suitable locations to facilitate laying of wires. 8 SWG G.I. wire shall be run along the conduit for grounding purpose. All conduit accessories and junction boxes shall be hot-dip galvanized and of approved type. Wiring shall be done as per the relevant IS specification.

10.18.00 Junction Box

- 10.18.01 Junction boxes shall be of 16 SWG sheet steel hot-dip galvanized, dust and damp proof, generally conforming to IP-66.
- 10.18.02 Junction boxes shall be complete with gasketed inspection cover, conduit knock out/threaded hub and terminal blocks.
- 10.18.03 Junction boxes for outdoor use shall weatherproof IPW-66 and those for hazardous location shall be flame-proof type suitable for a particular zone / gas group in compliance with IS: 2148 / IS: 13346 and shall have certification from CIMFR, Dhanbad.
- 10.18.04 Junction boxes shall have following indelible markings :
- Circuit nos. on top
 - Circuit nos. with ferrules (inside) as per drawing
 - DANGER sign in case of 415V circuit

10.18.05 DELETED

10.19.00 Lighting Cables & Wires

- 10.19.01 Lighting Cable shall be heavy duty, 1100 Volt grade, multi-core stranded aluminium conductor, XLPE insulated, extruded PVC inner sheath, single round G.I. wire armoured and overall PVC sheathed with FRLSH conforming to IS 1554.
- 10.19.02 Lighting wires shall be 1100 Volt grade, PVC insulated, stranded conductor, single core cable conforming to IS 694, colour coded as below :
- RED for R-Phase BLACK for Neutral
- YELLOW for Y-Phase WHITE for +Ve D.C.

BLUE for B-Phase GREY for -'Ve D.C.

10.19.03 Wire size shall be as follows :

For point wiring beyond lighting panel : 10 Sq.mm. Aluminium.
i.e. from lighting Panel to junction Stranded conductor
box (main run)

From Junction box to lighting fixture : 2.5 Sq.mm. Copper.
Stranded conductor.

Receptacle : 4 Sq.mm. Copper

10.20.00 **Terminals**

10.20.01 Multi way terminal blocks of approved type, complete with screws, nuts, washers and marking strips shall be furnished for connection of incoming/outgoing wires.

10.20.02 Each terminal shall be suitable for connection upto 2 nos. 10 Sq.mm stranded aluminium conductors without any damage to the conductor or looseness of connectors.

10.21.00 **Portable Emergency Lighting Unit**

The portable emergency lighting unit shall be complete with storage battery (rechargeable), inverter, automatic charger, twin 6W fluorescent tube lamp and test switch. Contractor shall furnish make, type and catalogue.

10.22.00 **24V Supply Module**

10.22.01 Each 24V A.C. supply module shall have one(1) no. air-cooled two winding, 500VA, 1-phase, 50HZ, 240/24V transformer with 6A (240V side) and 16A (24V side) HRC fuse in primary and secondary side and necessary 240V and 24V terminals for incoming and outgoing connections. The 240V terminals of 24V AC supply module shall be fed from respective lighting panels. A group of 6A, 24V AC receptacles located near Boiler access doors and condenser area shall be wired up to 24V side of each 24V A.C supply module.

The 24V A.C. supply modules shall be sheet steel enclosed with louvers and shall be suitable for outdoor use. The 24V A.C. supply modules shall be suitable for wall/steel structure/column mounting. Switches shall be mounted at the front on sheet steel enclosure.

10.22.02 Portable 24 V AC Supply modules having sheet steel enclosure with louvers as per above shall be supplied at entry and exit point of all room/ building. 24V halogen automobile lamp with reflector alongwith 1100 V twin core PVC sheathed 2.5 mm² stranded copper wire of 20 M length as handset.

10.23.00 **Indication Lamp**

Lamps shall be clustered of LED type. LED lamp shall be made in accordance with InP Technology (Aluminium Indium Gallium Phosphide Technology). The



body shall be made of Poly Carbonate Unbreakable Lens. LED shall be protected by inbuilt fuse with surge suppressor or leakage voltage glow protection. LED circuit shall be PCB mounted. Intensity shall be greater than 200 mcd. All Push Button lamps shall be as per LED indicating lamp.

10.24.00 **Contactors**

10.24.01 Contactors shall be three pole, air break type, with non_bouncing silver/silver alloy contacts. Contactor duty shall be class III _ category AC3 for unidirectional drives and AC4 for bi_directional and inching drives/class I _ category DC2.

10.24.02 Each contactor shall be provided with minimum two (2) N/O and two (2) N/C auxiliary contacts rated 10 A at operating voltage. The exact requirement of contacts shall be decided by the Vendors taking into account the scheme requirements and spares.

10.24.03 Contactor starters shall comply with the requirements of IS_8544 (Part _ 1) in respect of co_ordination of the characteristics of contactor, overload relay, and fuse. The type of co_ordination shall be Type _ C as per IS_8544.

10.25.00 **Remote Stop Push Button Station (RPB)**

10.25.01 Remote Push button shall be utilised for manual ON/OFF for group of lights is approved selected zone. RPB's shall be metal enclosed, fabricated from CRCA sheet steel minimum 2 mm thick and shall be provided with a STOP Push Button only wired up to terminal block. RPB's shall be suitable for wall / column mounting on brackets. RPB shall be dust & vermin proof, IP-54 or better. In case of outdoor it shall have IPW 65 with additional weatherproof protection RPB shall have provision of cable entry both from top & bottom, as required with removable gland plates, minimum 2 mm thick.

10.25.02 Push button shall be heavy duty, oiltight, push to actuate type with integral escutcheon plate marked with its function.

10.25.03 Each push button shall have one (1) normally open and one (1) normally closed contacts rated 10 A at 240V.

10.26.00 **Nameplate**

Nameplates shall be furnished for identification of devices and circuits. All switches, controls and indications shall be permanently and legibly marked in English as to their functions.

All lighting fixtures, receptacles, fans, junction boxes etc. shall be properly marked up indelibly with corresponding circuit numbers.

10.27.00 **Samples**

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

10.28.00 **Energy Saving System** NOT APPLICABLE

Panels



The energy saving system panel shall consists of loss less reactance coils with voltage tapping, contactor to select the tap, Micro-processor based TIMER along with real time clock for activating the contactor at a pre-set time. The unit shall be programmable so that at a pre-set time contactor on the lower voltage tap can be selected and reduced voltage can be applied across the circuit. It shall also be possible to modify the setting at site, if required.

The capacity of panels shall be 25/30 kVA or more as required. This system shall be incorporated in normal AC panels and Emergency AC panels.

Lamps

CFL and T5 fluorescent tube with electronic ballast or tri-phosphorous tube.

11.00.00 **SPECIFIC REQUIREMENTS-SERVICES**

11.01.00 **Consumables and Hardware**

11.01.01 The Contractor shall furnish all erection materials, hardware and consumables required for the completed installation.

11.01.02 The materials shall include but not limited to the following:-

- | | | | |
|----|-------------|---|---|
| a. | Consumables | : | Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials etc. |
| b. | Hardware | : | Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims etc. |
| c. | Materials | : | Junction boxes, terminal blocks, connectors, ferrules, lugs, brass glands, rigid/flexible conduits, cables, ground wires etc. |

11.01.03 Supply of cement, sand, stone etc. required for the execution of the contract shall be the responsibility of the Contractor.

12.00.00 **ERECTION TOOLS & TACKLES**

12.01.00 The Contractor shall provide all tools, tackle, implements, scaffoldings, ladders, etc. which are required for handling and erection of the equipment and materials.

Installation work shall be carried out in accordance with good engineering practices and also manufacturer's instructions/ recommendations where the same are available.

Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented

12.02.00 **Street Lighting Poles**



Erection of Street Lighting poles together with all its accessories including civil foundation work, installing lighting fixture, wiring and cabling work are included within scope of contractor.

12.03.00 **Flood Lighting Tower**

12.03.01 Erection of Flood Lighting Towers including civil foundation work shall be done by Contractor.

12.03.02 Contractor shall also mount assembled fixtures, outdoor & lockable type isolating switch cubicle install necessary cabling and wiring make connections.

Floodlights shall be mounted on steel base facing the tentative direction shown on the drawing. Fixing holes shall be provided with slot to turn the fixture about 5° on both sides. Bolts shall be finally tightened with spring washer.

The contractor shall supply and install the steel base for fixing the flood light on the flood light towers.

Terminal connections to the floodlight shall be made through PVC coated flexible metallic conduits.

12.04.00 **Receptacles**

Receptacles shall be installed at locations shown in the approved drawings.

12.05.00 **MLDB, EMLDB, DCELDB and Lighting Panel**

MLDB, EMLDB, DCELDB and Lighting Panels shall be erected at the locations indicated in approved drawings.

12.06.00 **Lighting High Masts**

Erection of Lighting Masts together with all its accessories including civil foundation work, installing lighting fixture, wiring and cabling work are included within scope of contractor.

12.07.00 **Lighting Fixtures**

12.07.01 Continuous rows of fluorescent tubes shall be mounted on a continuous M.S. angle for each row of lights.

12.07.02 In turbine hall, fixtures shall be mounted to maintain sufficient clearance from the overhead travelling crane trolley.

12.07.03 In boiler galleries, mounting height of fixtures shall be about 2500 mm from platforms except shown otherwise.

12.07.04 Bracket for fixture mounting shall be fabricated at site from 40 mm conduits with a reducing socket to suit the fixtures and clamped on to the handrails. The fixing shall be strong enough to withstand vibration and high wind velocity.

If a roof over platform is available, the fixture can be pendant mounted.



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- 13.00.06 Embedded conduits shall be securely fixed in position to preclude any movement. In fixing embedded conduit, if welding or brazing is used, extreme care should be taken to avoid any injury to the inner surface of the conduit.
- 13.00.07 Spacing of embedded conduits shall be such as to permit flow of concrete between them and in no case shall be less than 40 mm.
- 13.00.08 Where conduits are run on cable trays they shall be clamped to supporting steel at an interval of 600 mm.
- 13.00.09 For directly embedding in soil, the conduits shall be coated with an asphalt base compound. Concrete pier or anchor shall be provided where necessary to support the conduit rigidly and to hold it in place.
- 13.00.10 Conduits shall be installed in such a way as to ensure against trouble from trapped condensation.
- 13.00.11 Running threads shall be avoided as far as practicable. Where it is unavoidable, check nuts shall be used.
- 13.00.12 Conduits shall be kept, wherever possible, at least 300 mm away from hot pipes, heating device etc. when it is evident that such proximity may impair the service life of cables.
- 13.00.13 Slip joints shall be provided when conduits cross structural expansion joints or where long run of exposed conduits are installed, so that temperature change will cause no distortion due to expansion or contraction of conduit run.
- 13.00.14 For long run, junction/pull boxes shall be provided at suitable intervals to facilitate wiring.
- 13.00.15 Conduits shall be securely fastened to junction box or cabinets, each with a locknut and insulated bushing inside the box and locknut outside.
- 13.00.16. Conduit lengths shall be joined by screwed couplers. Couplers shall be clearly cut.
- 13.00.17 Conduit joints and connections shall be made thoroughly water tight and rust proof by application of a thread compound which will not insulate the joints.
- 13.00.18. White lead is suitable for application on embedded conduit and red lead for exposed conduit.
- 13.00.19. The battery Room installation shall be made with acid fume proof conduits.
- 13.00.20 Field bends shall have a minimum radius of four (4) times the conduit diameter. All bends shall be free of kinks, indentations or flattened surfaces. Heat shall not be applied in making any conduit bend.
- 13.00.21 The entire metallic conduit system, whether embedded or exposed, shall be electrically continuous and thoroughly grounded.
- 13.00.22 Lighting fixture shall not be suspended directly from junction box in the main conduit run.

- 13.00.23 Conduits and fittings shall be properly protected during construction period against mechanical injury. Conduits ends shall be plugged or capped to prevent entry of foreign material.
- 13.00.24 After installation the conduits shall be thoroughly cleaned by compressed air before pulling in the wire.
- 13.00.25 In control rooms and office areas provided with false ceiling conduct run shall be concealed type, embedded in the walls.
- 14.00.00 **Cabling**
- 14.00.01 In outdoor areas, main runs from lighting panels shall be by means of XLPE cables, directly buried in ground or laid in trenches for the underground portion and through conduit for the above ground portion.
- 14.00.02 Buried cables shall be laid and covered with sand/riddled earth, and protected from damage by bricks at sides and precast concrete slab at top. Buried cables shall have cable markers at 50M interval and projecting 150 mm above ground. At cable bends and joints markers shall be provided.
- 14.00.03 When buried cables cross road/railway track, additional protection to be provided in form of G.I. pipe.
- 15.00.00 **Grounding**
- 15.00.01 All lighting panels, junction boxes, receptacles, fixtures, conduit etc. shall be grounded in compliance with the provision of I.E. Rules.
- 15.00.02 Ground connections shall be made from nearest available ground grid. All connections to ground grid shall be done by arc welding.
- 15.00.03 Panels/Boards shall be directly connected to ground grid by two nos. 35 x 6 mm G.S. flats. (for panels/two nos. 50x6 mm G.S. flats (for distribution boards).
- 15.00.04 All junction boxes, receptacles, lighting fixtures etc. shall be grounded with 8 SWG G.S. wire.
- 15.00.05 Each street lighting Pole shall be grounded at two points by two nos. 50x6 mm G.S flat risers from two (2) nos. earthing spike 40 mm dia & 3m long directly driven into ground at a depth of 1m from ground level. The junction box at each lighting pole is grounded at two (2) points from two (2) nos. earthing terminals by 16 SWG GS wire. One 16 SWG G.S wire shall be taken upto the junction box from lighting fixtures and connected to grounding point.
- 15.00.06 Two (2) nos. earthing spike 3m long & 40 mm dia directly driven into ground at a depth of 1m from ground level shall be provided for each flood lighting tower.
- The sheet steel cubicle housing the power supply Isolator at base of flood lighting tower shall be connected at two (2) points from these earthing risers by 16 SWG G.S. wire - The flood lighting fixtures shall be grounded by one (1) 16 SWG G.S wire running through the lighting conduct upto the distribution box.

Two (2) nos. separate spike of 3m long & 40 mm dia directly driven into ground at a depth of one (1)m from ground level shall be provided for connection of the lighting must on top of flood lighting tower through two (2) nos. 50x6 mm G.S. flat down conductor.

A continuous ground conductor of 12 SWG G.S. wire shall 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 shall be connected to each panel ground bus.

16.00.00 **Foundation & Civil Works**

16.00.01 Equipment foundations panel foundations and all other civil work will be provided by the Contractor.

16.00.02 Concrete trenches, cable trays and other civil work will be provided by the Contractor. The Contractor can make use of those trenches, cable trays etc. for conduit installation.

17.00.00 **Excavation and Back Filling**

17.00.01 The Contractor shall perform all excavation and backfilling as required for buried cable and ground connections.

17.00.02 Excavation shall be performed upto the required depth. Such sheeting and shoring shall be done as may be necessary for protection of the work.

17.00.03 The Contractor shall make use his own arrangements for pumping out any water that may be accumulated in the excavation.

17.00.04 All excavation shall be backfilled to the original level with good consolidation.

18.00.00 **Steel Fabrication**

18.00.01 All supports, hangers & brackets shall be fabricated by the Contractor. Necessary steel shall be supplied by the Contractor.

18.00.02 Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edge.

18.00.03 Every effort shall be made to minimize the wastage of steel as far as practicable during fabrication. The wastage in no case shall exceed 3% of the total quantity of steel fabricated.

19.00.00 **Painting**

19.00.01 Street light poles shall be given two coats of aluminium paints after installation.

19.00.02 All steel fabrication shall be given two coats of red-oxide primer followed by two coats of Siemens gray (RAL-7032).

19.00.03 All equipment shall be given touch-up paint as required after installation.

20.00.00 **Cleaning up of Work Site**



- 20.00.01 The Contractor shall, from time to time, remove all rubbish resulting from execution of his work. No materials shall be stored or placed on passage or drive ways.
- 20.00.02 Upon completion of work, the Contractor shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.
- 21.00.00 **Inspection & Testing**
- 21.00.01 On completion of erection works, the Contractor shall request the Engineer for inspection and tests with minimum fourteen (14) days advance notice.
- 21.00.02 The Engineer shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor.
- 21.00.03 The installation shall be then tested and commissioned in presence of the Engineer and put on trial run for stipulated contract period.
- 21.00.04 All rectification, repair or adjustment work found necessary during inspection, testing, commissioning and trial run shall be carried out by the Contractor without any extra cost.
- 22.00.00 **TESTS**
- 22.01.00 **Shop Tests**
- 22.01.01 All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant Indian Standards at manufacturer's works and in the presence of Owner's representatives.
- 22.01.02 Tests on Control gear / Lighting Distribution Boards / Lighting Panels shall include:
- Wiring continuity tests.
 - High voltage and insulation tests.
 - Operational tests.
- 22.01.03 The tests on lighting fixtures shall include:
- All routine tests as per relevant I.S.
 - Rain-proof test for outdoor type luminaries and respective control gearbox as type test.
 - Temperature rise test on ballast/choke as type test. Dust proof test as type test.
- 22.02.00 **Site Tests**
- 22.02.01 Contractor shall thoroughly test and meggar all cables, wires and equipment to prove the same are free from ground and short circuit.
- 22.02.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.

- 22.02.03 All equipment shall be demonstrated to operate in accordance with the requirements of this specification.
- 22.02.04 Illumination in different areas are as per designed lux level generally confirming with Indian Standards. The lux level shall be verified by photometer at site location.

Test Certificates:

Certified copies of all tests carried out at works and at site shall be furnished in requisite no. of copies for approval of the Owner.

The equipment shall be dispatched from works only after receipt of Owner's written approval of shop test reports.

Type test certificates on any equipment, if so desired by the owner, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

ANNEXURE-I

ILLUMINATION LEVELS

Lighting System will provide the following illumination levels. The lighting fixture/clamp type and quantity will be selected to achieve the illumination level at different condition of the plant.

Sl. No.	Area/Structure	Average Illumination Level in Lux	Type of Fixture	Type of Luminarie
1.0	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
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 (airconditioned)	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	2x28W FTL

1.12	Chimney	Qty as per AAAI	As per AAAI	Flood light, Aviation warning lights and bulk head for staircase.
2.0	BOILER AREA			
2.1	Boiler area and platforms, ESP area and platforms	100	Dust proof / dust tight well glass fixture	70 W HPSV Lamp
2.2	Feeder floor areas	50	Dust proof / dust tight increased safety well glass	70 W HPSV Lamp
2.3	ESP control room	300	Decorative recessed with wide angle mirror optic antiglare type	Energy Efficient FTL
3.0	COAL /ASH HANDLING PLANT			
3.1	Conveyors enclosed	100	Dust proof well glass with Reflector wire guard integral mounted control gear box.	1 x 70 W HPSV lamp
3.2	Underground conveyor tunnel	40	Flame proof industrial bulkhead with integral control gear box	1 x 70W HPMV
3.3	Crusher house, Junction towers	100	Dust proof / dust tight well glass with reflector wire guard integral mounted control gear	1 x 70W HPSV
3.4	Coal yard	15-25	Flood light	1 x 400W HPSV
3.5	Coal unloading, Track hopper stacker reclaimers	25-50	Flood light	1 x 400W HPSV
3.6	Control room		Same as in Unit control room.	2 x Energy Efficient FTL
3.7	Ash Pond and Ash bund area	15-25	Flood light	1 x 400W HPSV
4.0	Fuel Oil system & fire hazardous area	250	Flame proof industrial bulkhead with integral control gear box	1x250 HPSV/1x400HPSV
4.1	Fuel unloading area,	25-50	Flood light	1 x 250W/400W HPSV
5.0	ROAD & YARD LIGHTING			
5.1	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
5.2	Perimeter (compound) lighting	10-20	-do-	-do-
5.3	Yard lighting	15-20	General purpose flood light	250W HPSV
5.4	Parking area	50	General purpose flood light, high/medium beam flood light	1 x 250 W HPSV
5.5	Marshalling	25-50	General purpose flood	1 x 250 W

ROAD & YARD LIGHTING REPLACED WITH TABLE-1 OF AMMENDMENT -1 ELECTRICAL (see page 32 of 32 of Annexure-1)



	~~Yard/Railway line~~		~~light, high/medium beam flood light~~	~~HPSV~~
6.0	GENERAL			
6.1	Switchyard	50	Flood Light	1X250/400W MH
6.2	Corridors, walkways, staircase, etc.	100	Industrial type with vitreous enamel reflectors/channel mounted box type	Energy Efficient FTL
6.3	Lockers, toilets, wash rooms, etc		Channel mounted box type	Energy Efficient FTL
6.4	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
6.5	Office Rooms	300	Decorative recessed type FTL	Energy Efficient FTL
7.0	DC LIGHT FITTINGS			
7.1	Control room	-	Decorative recessed type with cylindrical reflector	1x100 W incandescent lamp
7.2	Other areas	-	Industrial bulk head or industrial well glass with reflector	1x100 W incandescent lamp

NOTE:

- a) Energy efficient type FTL-T5 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 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 or 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.

ANNEXURE-II

LIGHTING & LIGHTING TRANSFORMER

Lighting transformer is not in bidder's scope of supply.

Sr. No.	ITEM	Unit	
1.0	AUXILIARY POWER SUPPLY		
1.1	SYSTEM VOLTAGE		
	Lighting equipment and accessories shall be designed for satisfactory operation from the following power supply sources.		
1.1.1	A.C Supply		415 Volt, 3 phase, 50hz, 3 wire effectively grounded system Fault level 50kA rms symmetrical
1.1.2	DC Supply		Fault level 25kA symmetrical 220V, 2wire, ungrounded system.
1.2	PERMISSIBLE VARIATION		
	Equipment and accessories shall be suitable for operation over the entire range of voltage/frequency variations as listed below:		
1.2.1	A.C Supply		Voltage $\pm 10\%$ Frequency $\pm 5\%$ Combined voltage and frequency 10% (absolute sum)
1.2.2	D.C Supply		Voltage 198 to 242 Volt
3.0	LIGHITNG TRANSFORMER		
3.1	Type		Cast Resin Dry type, non-encapsulated VPI with nomex insulation
3.2	KVA rating		100kVA (Min.)
3.3	Voltage rating		~~415 V/433 V~~ 415V/415V
3.4	Cooling		AN
3.5	P.U. Impedance		*0.04 $\pm 10\%$
3.6	Voltage control		Off load tap switch/link with change of $\pm 5\%$ in step of 2.5% tapping full capacity
3.7	Vector Group		Dyn11
3.8	Class of Insulation		F (155 Deg.C)
3.9	Maximum Temperature rise over 50 Deg C. ambient in winding by resistance		90 Deg.C
3.10	Neutral		Solidly grounded

Notes:

The secondary neutral of the transformer shall be brought out for getting a grounded four (4) wire supply. Each transformer shall be routine tested and one transformer shall be type tested in accordance with relevant standard.

The transformer shall be liable for rejection if the tolerance on the quoted values of losses, impedance, temperature rise, etc. exceeds the specified values of relevant standard.

The transformer shall be mounted inside sheet steel enclosure which shall be an integral part of Lighting Distribution Board.

Typical Transformer rating of 100kVA and impedance is indicated in Annexure. However rating of transformer required shall be worked out by the bidder. Calculations for the same shall be submitted with bid.

Each lighting fixture shall be furnished complete with associated lamp, holder and control gear fully wired up. Control should include copper ballast, copper choke, capacitor starter, electronic- igniter (separate type). Fuse connector block etc.

For well glass fittings for HPSV lamps higher wattage (250/400 W) floodlight luminaire, the control gear will be separate/ non integral type whereas for high bay, streetlight and mini flood light fixture, the control gear shall be integral type.

Make, type & catalogue no. of lighting fixtures are indicated herein with the intent to elaborate the physical appearance/ constructional features only pertaining to the particular type of fixture.

The supply also includes associated junction boxes, brackets supports, hangers and wires wherever applicable.

ANNEXURE -III**FITTINGS AND ACCESSORIES OF LIGHTING TRANSFORMER**

Each transformer shall be equipped with fittings and accessories as listed below :

1. 150 mm dia. winding temperature indicator with maximum reading pointer and electrically separate sets of contacts for trip and alarm.
2. Handling and lifting lugs both for enclosure and core-coil assembly.
3. Jacking pad for core-coil assembly.
4. Inspection cover for cable and box.
5. Door handle operated safety limit switch with 1NO + 1NC contact.
6. Ground bus.
7. IP-55 junction box.
8. Rating and terminal marking plates.

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



1 x 660 MW - Panki Thermal Power Station
AMENDMENT ELECTRICAL SYSTEM
 Attachment
 Table-01

Sl. No.	Area/ Structure	Average Illumination Level in Lux	Type of Fixture	Type of Luminarie
5.0	ROAD & YARD LIGHTING			
5.1	Roads	15-20	Street light with pressure die cast housing cover glass, best in energy saving having IP66 degree of protection, similar to PHILIPS make : GreenLine Xtra. Auto switch ON/ OFF shall be provided.	125 W LED
5.2	Perimeter (compound) lighting	10-20	-do-	-do-
5.3	Yard lighting	15-20	Flood light with split design to support diffuser combination, die cast aluminium housing, having IP66 degree of protection similar to PHILIPS make : eW Reach Powercore gen2	250 W LED
5.4	Parking area	50	-do-	-do-
5.5	Marshalling Yard/Railway line	25-50	-do-	-do-

Note: If any clarification issued earlier found contrary to the above amendments, the amendment shall supersede the clarification.

SN	ITEM DESCRIPTION	Unit	QTY
1	Supply of Indoor Lighting Panel - Type LP-1	Nos.	2
2	Supply of Indoor Lighting Panel - Type LP-2	Nos.	2
3	Supply of Indoor DC Lighting Panel DCLP	Nos.	1
4	Supply of Outdoor Lighting Panel - Type LP-1	Nos.	2
5	Supply of Outdoor Lighting Panel - Type LP-2	Nos.	2
6	Supply of Switchboard - Type SWB-1	Nos.	8
7	Supply of Switchboard - Type SWB-2	Nos.	33
8	Supply of Switchboard - Type SWB-3	Nos.	6
9	Supply of Switchboard - Type SWB-4	Nos.	3
10	Supply of Switchboard - Type SWB-5	Nos.	2
11	Supply of Receptacle - 5/15A (Decorative) RA type	Nos.	29
12	Supply of Receptacle - 20A (Industrial) RB type	Nos.	12
13	Supply of Receptacle - 20A (Industrial) RB type - Flameproof	Nos.	2
14	Supply of Receptacle - 415 V, 63A, 3-PH (Industrial) Indoor Receptacle - RC type	Nos.	5
15	Supply of Receptacle - 63A, 415V 3-Phase, 4-Pin Interlocked industrial grade rotatry switch socket, Outdoor Receptacle - RC type (Necessary arrangement for looping incoming supply cables shall be provided)	Nos.	6
16	Supply of Receptacle - 415V, 250A. 3-Phase, 4-Pin TPN MCCB Industrial type Outdoor Receptacle with earthing contacts - RP type for Oil filtration machine (Necessary arrangement for looping incoming supply cables shall be provided)	Nos.	1
17	Supply of Outdoor Junction boxes -Type JB-F	Nos.	6
18	Supply of Outdoor Junction boxes -Type JB-FE	Nos.	1
19	Supply of Outdoor Junction boxes -Type JB-S	Nos.	1
20	Supply of Outdoor Junction boxes -Type JB-M	Nos.	1
21	Supply of Indoor lighting fixtures - FC02 (LED) type	Nos.	70
22	Supply of Indoor lighting fixtures - FC06 (LED) type	Nos.	11
23	Supply of Indoor lighting fixtures - FC26 (LED) type	Nos.	90
24	Supply of Indoor lighting fixtures - FC30 (LED) type	Nos.	5
25	Supply of Indoor lighting fixtures - FC32 (LED) type	Nos.	2
26	Supply of Indoor lighting fixtures - FC81 (LED) type	Nos.	15
27	Supply of Indoor lighting fixtures - FC33 (LED) type	Nos.	30
28	Supply of Emergency DC lighting fixtures - FC07 (CFL) type	Nos.	1
29	Supply of Emergency DC lighting fixtures - FC33 (CFL) type	Nos.	1
30	Supply of Emergency DC lighting fixtures - FC34 (CFL) type	Nos.	1
31	Supply of Street lighting fixtures - SS62 (LED) type	Nos.	5
32	Supply of Street lighting fixtures - SS63 (LED) type	Nos.	45
33	Supply of Flood lighting fixtures - SF63 (LED) type	Nos.	14
34	Supply of Flood lighting fixtures - SF66 (LED) type	Nos.	120
35	Supply of 35W LED Post Top Lantern fixture - Outdoor type	No.	4
36	Supply of Marine type luminaires 100W lamp with accessories	No.	1
37	Supply of Occupancy based Infra Red Sensors	Nos.	10
38	Supply of Exit Sign Boards	Nos.	10
39	Supply of Exhaust fans - 600 CMH @ 7mm WC Exhaust fans with metal sheet crawl & bird screen for Toilets	Nos.	2
40	Supply of Exhaust fans - 1000 CMH @ 7mm WC Exhaust fans with metal sheet crawl & bird screen for Pantry	Nos.	1
41	Supply of Exhaust fans - 1500 CMH @ 7mm WC Exhaust fans with metal sheet crawl & bird screen for Pantry	Nos.	1
42	Supply of Exhaust fans - 2000 CMH @ 7mm WC Exhaust fans with metal sheet crawl & bird screen for Pantry	Nos.	1
43	Supply of Ceiling fans 1200mm sweep with electronic regulator, fan hook, suspension rod etc.	Nos.	14
44	Supply of Wall mounted fans 400mm sweep	Nos.	10
45	Supply of Free-standing Aluminium Ladder, height adjustable (from 5m to10m height)	Nos.	1
46	Supply of Wheel mounted Adjustable aluminium ladder for maintenance of Street Lights	Nos.	1
47	Supply of Portable emergency lighting unit - 2X6W Flourescent Tube Lamp/ equivalent LED	Nos.	1
48	Supply of 30m high Lighting High Mast with Lantern Carriage (Winch type) for Switchyard Lighting along with feeder pillar & junction box (JB-M)	Nos.	6
49	Supply of 11m high Lighting Pole for Street Lighting - Type A1 including JB-S	Nos.	48
50	Supply of 13m high Lighting Pole for Street Lighting - Type A2 including JB-S	Nos.	1
51	Supply of 13m high Lighting Pole for Street Lighting - Type A3 including JB-S	Nos.	1
52	Supply of 4m high Lighting Pole for Post-top Lantern - Type E1 including JB-S	Nos.	4
53	Supply of Galvanized rigid conduit of 20mm size with accessories	Mtr.	2000
54	Supply of Galvanized rigid conduit of 25mm size with accessories	Mtr.	500

SN	ITEM DESCRIPTION	Unit	QTY
55	Supply of Galvanized heavy duty steel conduit of 25mm size with accessories with additional epoxy coating for corrosive areas	Mtr.	50
56	Supply of Galvanized rigid conduit of 40mm size with accessories	Mtr.	10
57	Supply of 20mm Flexible conduits made with bright, cold rolled annealed and electro galvanized mild steel strips and coated with PVC	Mtr.	50
58	Supply of 1C, 1.5 sqmm PVC insulated stranded Cu. Wire Red/Yellow/Blue/Black/Grey (ISI marked with valid CML number). Colour coded.	Mtr.	1000
59	Supply of 1C, 2.5 sqmm PVC insulated stranded Cu. Wire Red/Yellow/Blue/Black/Grey (ISI marked with valid CML number). Colour coded.	Mtr.	4100
60	Supply of 1C, 4 sqmm PVC insulated stranded Cu. Wire Red/Yellow/Blue/Black/Grey (ISI marked with valid CML number). Colour coded.	Mtr.	1000
61	Supply of 2C, 2.5 sqmm PVC insulated stranded Cu. Wire	Mtr.	500
62	Supply of 1C, 10 sqmm PVC insulated stranded Al. Wire	Mtr.	500
63	Supply of Earthing Material - 25x6mm GI Flat	Mtr.	100
64	Supply of Earthing Material - 3m , 20mm dia ms rod electrode	Nos.	70
65	Supply of Earthing Material - 3m , 40mm dia ms rod electrode	Nos.	50
66	Supply of Earthing Material - GI wire for Earthing of size 8 SWG	Mtr.	200
67	Supply of Earthing Material - GI wire for Earthing of size 16 SWG	Mtr.	2400
68	Supply of Portable type 24V supply modules with 500VA Transformer	Nos.	1
69	Supply of Portable 24V halogen lamp unit	Nos.	1
70	Supply of 5A, 24V industrial type sockets	Nos.	1
71	Supply of Temperature Transducer	Nos.	5
72	Supply of Telephone points- single outlet telephone socket including cable/wire and accessories	Nos.	6
73	Supply of Telephone JB suitable for 20 pair Indoor type	Nos.	1
74	Supply of Supply of 2 wire telephone cable (ISI marked).	Mtr.	200
75	Supply of LAN points including accessories	Nos.	5
76	Supply of LAN Cable	Mtr.	200
77	Supply of Erection items for indoor like 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,25mm,PVC conduit,Coupling,Swing out bracket,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 , epoxy coated conduits for corrosive areas , 1.5, 2.5 , 4, 6 & 10 sq. mm wires, GI wire/ FRLSH cu wire for earthing, lugs for wires etc to complete	Lot	1
78	Supply of Erection items for outdoor like 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., 2.5 sqmm wire from STREET LIGHT POLE JB to fixture, Earth wire from J.B. to lighting fixtures,Mounting brackets for outdoor lighting fixtures, GI wire for earthing, lugs for wires etc to complete	Lot	1
79	Supply of spares: Lighting fixtures without lamps (1 nos. or 10% of installed capacity of each type)	Set	1
80	Supply of Lighting Panel spares: Switch-fuse (1 no. of each type & rating)	Set	1
81	Supply of Lighting Panel spares: MCB (5 nos. of each type & rating)	Set	1
82	Supply of Lighting Panel spares: Contactor (5 nos. of each type & rating)	Set	1
83	Supply of Lighting Panel spares: Switches (5 nos. of each type & rating)	Set	1
84	Supply of Lighting Panel spares: Receptacles with plug (5 nos. of each type & rating)	Set	1
85	Supply of Lighting Panel spares: Rotary switches (1 no. of each type & rating)	Set	1
86	Supply of spares: Junction Boxes (1 nos. or 10% of installed capacity of each type)	Set	1
87	Services of Illumination System Design - Lux Level Design Calculations for Indoor & Outdoor area	Lot	1
88	Services of Illumination System Design -Lighting Layout for indoor & Outdoor area	Lot	1
89	Services of Illumination System Design -Conduit Layout for indoor areas	Lot	1
90	Services of Illumination System Design -Cable Schedule, Power Distribution scheme, Control Schemes, any other drawing, document, design required for complete illumination system	Lot	1
91	Services of Illumination System Design -Bill of Quantity (separate for outdoor area & indoor area)	Lot	1

SN	ITEM DESCRIPTION	Unit	QTY
92	Services of Supervision of Erection Testing & Commissioning for illumination system on per day basis for the days present at site. (Rates quoted for supervision include boarding, lodging & travel expenses.)	Mandays	150
93	Services of Site Test - Lux Level Measurement and demonstration to customer at site including arrangement of necessary test equipment on returnable basis	Lot	1

Remark -1: 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 $\pm 30\%$ of total value during execution of contract. The quantity of individual items may however vary upto any extent.

Remark -2: 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 to be quoted on Lumpsum basis).

Remark-3 : 1.5 sqmm FRLSH PVC insulated multistrand single core copper conductor cable shall be used as earth continuity conductor for light, fan, plug, call bell and switchboards etc.

Remark-4 : Any shortage in quantity of erection material (item no. 77, 78) to be completed by bidder free of cost. Within permissible quantity variation of main items, no price implication shall be admissible for Lot items against 77 & 78. Quantity required as per actual requirement at site shall be quoted.

Remark-5: No wiring material / erection items required for spares.

Remark-6: Multiple visits are envisaged for supervision work

Remark-7: Rates quoted for supervision include boarding, lodging & travel expenses.

Remark-8: Lighting Panels (LP) - scope of supplies includes accessories / mounting hardwares / anchor fastener / foundation bolt etc as applicable for successful installation of the same. Energy saving system is not considered for panels.

Remark-9: Lighting Luminaires - scope of supplies included accessories i.e. mounting hardwares, anchor fastener, screw, nut bolt, mounting brackets for wall , ceiling, false ceiling, structure, street light pole, lighting mast, hanger pipe / chain etc complete in all respect for successful installation of the same. Bidder to submit detailed drawing & bill of quantity for mounting arrangement for each type of luminaries installation.

Remark-10: Bidder to offer customer approved Make of the components and fitments at contract stage. In case the offered make is not approved by the customer, then alternate make shall be supplied without any commercial implications to BHEL.

PROJECT: PANKI THERMAL POWER STATION (1X660MW) Package: EPC Sub Package : Switchyard			LIST OF ITEMS REQUIRING QUALITY PLAN APPROVAL AND ACCEPTABLE SUB-VENDOR			DOC.NO. : 14A14-SPC-G-0001/SYD REV.NO. : 0 DATE : 02.07.2018	
S.No.	Item Description	QP/Insp Cat	Proposed Sub-Supplier	Place	Sub-Supplier Approval status/ category	Sub-supplier details submission schedule	Remarks DOC.NO. : 14A14-SPC-G-0001/SYD REV.NO. : 0 DATE : 02.07.2018
1	SF6 CIRCUIT BREAKER (Item subject to Sub QR approval)	I	GE T&D	CHENNAI	DR		
			SIEMENS	AURANGABAD	DR		
			CGL	NASIK	DR		
			ABB	VADODARA	DR		
2	Isolator (Item subject to Sub QR approval)	I	GR POWER	HYDERABAD	DR		
			HIVELM	CHENNAI	DR		
			SIEMENS	HYDERABAD	DR		
			ELEKTROLITES	JAIPUR	DR		
			SWITCHGEAR & STRUCTURALS	HYDERABAD	DR		
			S&S POWER	PONDICHERRY	DR		
3	CURRENT TRANSFORMER (Item subject to Sub QR approval)	I	GE T&D	HOSUR	DR		
			BHEL	BHOPAL	DR		
			BHEL	JHANSI	DR		
			ABB	VADODARA	DR		
			CGL	NASHIK	DR		
			MEHRU	BHIWADI	DR		UP TO 220 KV
			VISHAL TRANSFORMER	MEERUT	DR		UP TO 132 KV
			HEPTACARE	MEERUT	DR		UP TO 33KV
4	CVT (Item subject to Sub QR approval)	I	BHEL	BHOPAL	DR		
			ABB	VADODARA	DR		
			GE T&D	HOSUR	DR		
			CGL	NASHIK	DR		
			MEHRU ELECTRICALS	BHIWADI	DR		UP TO 132 KV
5	Surge Arrestors (Item subject to Sub QR approval)	I	OBLUM	Hyderabad	DR		
			CGL	Nasik	DR		
			LAMCO	Hyderabad	DR		

Ding:-

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27/10/18

S.No.	Item Description	QP/Insp Cat	Proposed Sub-Supplier	Place	Sub-Supplier Approval status/ category	Sub-supplier details submission schedule	Remarks DOC.NO. : 14A14-SPC-G- 0001/SYD REV.NO. : 0 DATE : 02.07.2018
6	Control & Relay Panel / Substation Automation System, BCU, GRP, Energy Meter, Numerical Relays Switchyard Protection (Item subject to Sub QR approval)	I	ABB	Peenya			* : Inspection category of the item shall be same as mentioned in MQP of SAS
					DR		
			SIEMENS	Kalwa	DR		
			SCHNEIDER	Noida	DR		
			GE	Chennai	DR		
			BHEL	Bhopal	DR**		
7	Components for Control & Relay Panels, Protection Panels, Islanding Scheme & Bay Control Unit						
a	Energy Meter (Item subject to Sub QR approval)	*	Conzerv	Bangalore	DR		
			Elster	Mumbai	DR		
			GEC Meters	UK	DR		
			Landis & GYR	Switzerland	DR		
			SEMS	Udaipur/Solan	DR		
b	RELAYS (Item subject to Sub QR approval) (NUMERICAL AND AUXILLARY)	*	ABB	Sweden / Bangalore	DR		
			GE T&D	UK/CHENNAI	DR		
			SCHNEIDER	UK	DR		
			SIEMENS	GERMANY	DR		
			SCHNEIDER	Noida/Chennai	DR		
c	EVENT LOGGER	*	GE T&D	UK / FRANCE	A		
			HATHWAY	UK	A		
d	TIME SYNCHRONIZING EQUIPMENT	*	ARBITER	USA	A		
			HOPF	GERMANY	A		
			HATHWAY	UK / USA	A		
			SERTEL	CHENNAI	A		
			SIEMENS	GERMANY	A		
			Masibus	Gandhinagar	A		

Signature 22/07/18

Signature

Signature
12/16/18

S.No.	Item Description	QP/Insp Cat	Proposed Sub-Supplier	Place	Sub-Supplier Approval status/ category	Sub-supplier details submission schedule	Remarks DOC.NO. : 14A14-SPC-G-0001/SYD REV.NO. : 0 DATE : 02.07.2018
e	RELAY TEST KIT.	*	OMICRON	USA/AUSTRALIA	A		
			DOBBLE	USA	A		
			MEGGER	UK	A		
f	DISTURBANCE RECORDER	*	GE T&D	USA	A		
			SIEMENS	GERMANY	A		
			ABB	FINLAND	A		
			HATHWAY	UK	A		
g	LARGE VIDEO SCREEN (LVS)	*	DELTA	Gurgaon	A		
			BARCO	Noida	A		
			Planner	USA	A		
8	Bus Post Insulator	I	ADITYA BIRLA	Halol	A		
			IEC	Bhopal	A		
			SARVANA GLOBAL	CUDDALORE	A		
			MODERN INSULATORS	Abu Road	A		
			WSI	Chennai	A		
9	Aluminium Tube	I	Alom Extrusions	KOLKATA	A		
			HINDALCO	ALUPURAM	A		
			HINDALCO	Renukut	A		
			Jindal	Bangalore	A		
			SUDAL	Nasik	A		
10	ACSR Conductor	I	APAR	Silvassa	A		
			DIAMOND	Vadodra	A		
			GUPTA POWER INFRA	Bhubaneshwar	A		
			ANVIL CABLES	JAMSHEDPUR	A		
			JSK	Silvassa	A		
			SHARAVATHY	Bangalore	A		
			DYNAMIC CABLES PVT LTD	JAIPUR	A		
			HUIL	KHURDA	A		
			HUIL	GWALIOR	A		
			SHASHI CABLES	LUCKNOW	A		
			MAHAVIR	DEHRADUN	A		
11	1.1kV Grade Power, Control Cables (Item subject to Sub QR approval)	I					Refer Cabling List

S.No.	Item Description	QP/Insp Cat	Proposed Sub-Supplier	Place	Sub-Supplier Approval status/ category	Sub-supplier details submission schedule	Remarks DOC.NO. : 14A14-SPC-G- 0001/SYD REV.NO. : 0 DATE : 02.07.2018
12	Instrumentation Cable (Item subject to Sub QR approval)	I					Refer C&I List
13	OLTE	I	Commnet Networks Private Limited	Navi Mumbai Maharashtra	DR		
			ABB	MUMBAI	DR		
			GE	NOIDA	DR		
19	AC-DC DISTRIBUTION BOARDS	I					Refer Switchgear List (LT Switchgear Boards)
20	BATTERY SYSTEMS (Item subject to Sub QR approval)	I					Refer Switchgear List
21	BATTERY CHARGER (Item subject to Sub QR approval)	I					Refer Switchgear List
16	Clamps & Connectors and Welding Sleeves	II	EMTT	Kolkata	A		
			EXALT	MUMBAI	A		
			KLEMMEN	Chennai	A		
			PEE VEE ENGG	Bangalore	A		
			MILIND	Mumbai	A		
			Raychem	Vadodara	A		
			Deccan Engg Works	Bangalore	A		
			MEGHA ENGG	Chennai	A		
14	BMK	II	BCH	FARIDABAD	A		
			C&S	Noida	A		
			Jakson	Noida	A		
			MAKTEL	VADODARA	A		
			Bose Engineering	Kolkata	A		
			Pyrotech	Udaipur	A		
			Schneider	Nashik	A		
			Spaceage Switchgear	Gurgaon	A		
			Unilec Switchgear	Gurgaon	A		
			Nitya Electrocontrols Pvt Ltd	Noida	A		
			Enterprising Engineers	Bhopal	A		
14	INSULATING HARDWARE, CONDUCTOR ACCESSORIES & EARTHWIRE ACCESSORIES	II	RASHTRA UDYOG	KOLKATA	A		
			EMTT	KOLKATA	A		
			ITPL	MUMBAI	A		
			EMI TRANSMISSION	MUMBAI	A		
			IAC ELECTRICAL	KOLKATA	A		

S.No.	Item Description	QP/Insp Cat	Proposed Sub-Supplier	Place	Sub-Supplier Approval status/ category	Sub-supplier details submission schedule	Remarks DOC.NO. : 14A14-SPC-G-0001/SYD REV.NO. : 0 DATE : 02.07.2018
	DISC INSULATOR/ PIN INSULATOR		IEC	BHOPAL	A		
			ADITYA BIRLA	RISHRA	A		
			SARVANA	CUDDALORE	A		
			IMPERIAL CERAMICS	BIKANER	A		UP TO 90 KN
			BHEL	BANGALORE	A		
			WSI	CHENNAI	A		
16	LIGHTING TRANSFORMER(DRY TYPE - UPTO 100KVA)	II	POWERPACK	MUMBAI	A		
			INDCOIL	THANE	A		
17	AC KIOSK	II	I COMM TEL	HYDERABAD	A		
			Isolloyd	Baddi	A		
			JINDAL MEC TEC	GURGAON	A		
			U-FOAM	HYDERABAD	A		
			SVARN TELECOM	HARDWAR	A		
18	JB (All Types) / Lighting Panel	II	C&S	Noida	A		
			Jakson	Greader Noida	A		
			MAKTEL	BARODA	A		
			Pyrqtech	Udaipur	A		
			Bose Engineering	Kolkata	A		
			Schneider	Nashik	A		
			Space Switchgear	Gurgaon	A		
			TRICOLITE	SAHIBABAD	A		
			Unilec Switchgear	Gurgaon	A		
			Nitya Electrocontrols	Noida	A		
			Enterprising Engineers	Bhopal	A		
15	Lighting Pole	III	Main Contractor Approved Sources				
15	LIGHTING MAST	III	Main Contractor Approved Sources				
22	Leakage Current Analyser	III	ISA	ITALY	A		
			Scope T&M	Pune	A		
			DOBLE ENGG	USA	A		
23	SF6 GAS FILLING AND EVACUATING PLANT, GAS RECYCLING & PURIFYING PLANT, GAS LEAKAGE DETECTOR	III	AI QUALITEK	USA	A		
			DILO	GERMANY	A		
			ENERVAC	CANADA	A		
			VACCUUM PLANT INDUSTRIES	PUNE	A		
			WIKA	USA	A		

S.No.	Item Description	QP/Insp Cat	Proposed Sub-Supplier	Place	Sub-Supplier Approval status/ category	Sub-supplier details submission schedule	Remarks DOC.NO. : 14A14-SPC-G-0001/SYD REV.NO. : 0 DATE : 02.07.2018
24	OPERATIONAL ANALYSER WITH DCRM KIT	III	~~CONCRETE~~ DOBBLE SCOPE VIC	~~USA~~ USA PUNE USA	~~#~~ A A A		
25	GS Flat / MS Flat / 40 MM Dia. M.S. Rod / M.S. Earth Rods/U Clamp / GI Earth Pipe / GI Pipe / GI Conduit (Including Bends) / PVC Pipes	III	Main Contractor Approved Sources				
26	Cable Tray, Bends, Coupler Plates	III	Main Contractor Approved Sources				
27	Cable glands	III	Main Contractor Approved Sources				
28	Cable Lugs	III	Main Contractor Approved Sources				
29	Lighting Fixtures & Luminaries	III	Main Contractor Approved Sources				
30	Industrial Receptacles	III	Main Contractor Approved Sources				
31	GS Earthwire / Lighting Wire	III	Main Contractor Approved Sources				
32	Bay Identification Tags, Phase Markers, Danger Plates, Phase Plates, Circuit Plates, Number plates, Vibration Dampers, Hanger Rod, ACD, Bird Guard, J Bolt, U Bolt, D Shackle, Barbed Wire, etc.	III	Main Contractor Approved Sources				
33	Air Conditioning and Ventillation System (Item subject to Sub QR approval)	III					Refer AC Ventilation List
34	Fire Protection System (Item subject to Sub QR approval)	III					Refer Fire Protection List
35	AC for AC Kiosk	III					Refer AC Ventilation List

Signature *2nd*

12/10/18

1. All testing and inspection shall be carried out as per approved Quality Plan.
 2. This approval is only for vendors for non-3K items. Approval of 3K (sub QR) item vendors shall be accorded separately on submission of documents by BHEL, in line with the provenness criterion as per bid specification. Any 3K item vendor inadvertently approved in this list, shall be treated null and void.

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36	GALVANISED STEEL STRUCTURES (Lattice and Pipe)	I	GOODLUCK STEEL TUBES	SIKANDRABAD	A		
			RICHARDSON & CRUDDAS (1972) LTD	NAGPUR	A		
			NEW MODERN TECHNAMECH	MAYURBANJ (ODISHA)	A		
			R.S. INFRAPROJECTS PVT LTD	SURAJPUR	A		
			NAMPA STEEL	HOWRAH	A		
			VSP ENTERPRISES PVT LTD	SONEPAT	A		
			UNIQUE STRUCTURES & TOWERS PVT LTD	RAIPUR	A		
			VIJAY TRANSMISSION LTD	RAIPUR	A		
			ADVANCE STEEL TUBES	SAHIBABAD	A		
			ASSOCIATED POWER STRUCTURES	VADODARA	A		
			RS INFRAPROJECTS PVT LTD	SIKANDRABAD	A		FOR PIPE STRUCTURES ONLY
			RELIABLE SPONGE PVT LTD	SUDERGARH, ODISHA	A		
37	FOUNDATION BOLTS, STRUCTURE/EQUIPMENT FIXING HARDWARES(NUTS, BOLTS AND WASHERS)	III	MAIN CONTRACTOR APPROVED SOURCES				
Note							
1	SYSTEM SUPPLIERS/SUB-SUPPLIERS APPROVAL STATUS CATEGORY						
	A-For this items proposed vendor is acceptable in NTPC.To be indicated with letter "A" in the list along with condition of approval,if any						
	DR-For these items "Detailed required for OWNER"s review.To be identified with letter "DR" in the list.						
2	QP / INSPN CATEGORY						
	CAT-I :For these items the Quality Plans approved by NTPC & final acceptance will be on physical inspection witness by NTPC						
	CAT-II :For these items the Quality Plans approved by NTPC.However no physical inspection shall be done by NTPC.The final acceptance by NTPC shall be on basis of documents as approved QP						
	CAT-III:For these items Main supplier approves the Quality Plans.The final acceptance by NTPC shall be on basis of certificate of conformance by the main supplier.						
3	UNITS/WORKS : Place of manufacturing Place of Main Supplier of multi units/works.						
4	Vendors approved by NTPC for any other projects are acceptable after formal proposal to UPRVUNL						

(DEPTOSSI)
BHEL TBH

Satish Mohite
(BHEL TBH)

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SECTION - 2

1.0 INTENT OF SPECIFICATION

- 1.1 This specification covers the general description of **design, manufacture and construction features, testing, supply, supervision of installation and commissioning** of the Station Lighting system equipment.
- 1.2 The requirements given in specification for supply of equipment and system design engineering shall be fully complied with.
- 1.3 For the equipment of supply in vendor's scope, the "design" shall broadly cover the selection of components, materials, sizes etc. and complete responsibility of establishing the correctness of equipment design rests with the vendor.
- 1.4 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship, and shall be capable of performing required function in a manner acceptable to Purchaser, who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his judgement is not in full accordance herewith.
- 1.5 Make of all equipment and components shall be to the approval of Purchaser. Bidder to comply to Sub-vendor list enclosed as "Annexure:Sub-Vendor", however same shall be subjected to end client approval without any commercial implication.

2.0 CODES & STANDARDS

- 2.1 The material shall comply with all currently applicable safety codes and statutory regulations of India as well as of the locality where the material is to be installed.
- 2.2 The material, construction, manufacture, inspection and testing shall conform to the latest revisions of standards and as specified in Section-1.
- 2.3 In case of conflict between the applicable reference standard and this specification, stringent requirement shall govern.

3.0 CODES AND STANDARDS

All standards and codes of practice referred to herein shall be the latest edition including all applicable official amendments & revisions as on date of bid opening. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards & codes.

3.1 Lighting Fixtures and Accessories

- | | |
|----------|---|
| IS: 1913 | General and safety requirements for luminaires. |
| IS: 2148 | Flame proof enclosures of electrical apparatus. |

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IS: 418	Tungsten filament general service electric lamps.
IS: 1258	Bayonet lamp holders.
IS: 1534	Ballast for fluorescent lamps.
IS: 1569	Capacitors for use in tubular fluorescent, high pressure mercury vapour and low pressure sodium vapour discharge lamp circuit.
IS: 1777	Industrial luminaire with metal reflectors.
IS: 2215	Starters for fluorescent lamps.
IS: 2418	Tubular fluorescent lamps for general lighting services.
IS: 3323	Bi-pin lamp holders for tubular fluorescent lamps.
IS: 3324	Holders for starters for tubular fluorescent lamps.
IS: 4013	Dust-tight electric lighting fittings.
IS: 8224	Electric Lighting fittings for Division 2 areas.
IS: 10276	Edison screw lamp holders.
IS: 10322	Luminaires.
IS: 13021	AC Supplied Electronic Ballasts for tubular fluorescent lamps.

3.2 Lighting Panels, Switch-boxes, Receptacles and Junction Boxes

IS: 2147	Degree of protection provided by enclosures for low-voltage switchgear and control gear.
IS: 1293	Plugs & socket outlets of rated voltage upto and Including 250volts & rated current upto and including 16 Amps.
IS: 2551	Danger notice plates.
IS:13947	Low voltage switchgear and controlgear
IS: 3854	Switches for domestic and similar purposes.
IS: 6875	Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages upto and including 1000 V AC and 1200 V DC.
IS:13703	Low voltage fuses for voltages not exceeding 1000V AC or 1500 V DC.

3.3 Conduits, Pipes and Accessories

IS: 2667	Fittings for rigid steel conduit for electrical wiring.
IS: 3837	Accessories for rigid steel conduits for electrical wiring.
IS: 9537	Conduits for electrical installations.

3.4 Lighting Wires/Cables

IS: 694	PVC insulated cables for working voltages upto and including 1100 V
IS: 3961	Recommended current ratings for cables.(PVC Insulated and PVC sheathed heavy duty cables and light duty cables).
IS: 8130	Conductors for insulated electric cables and flexible cords.
IS: 10810	Methods of tests for cables.

3.5 LED Luminaries

16101: 2012	General Lighting. LEDs and LED modules Terms and definitions
16102(Part 1):	2012 Self Ballasted LED Lamps for General Lighting Services. Part-1 Safety Requirements.
16102(Part 2):	2012 Self Ballasted LED Lamps for General lighting Services. Performance Requirements.

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16103(Part I):	2012 LED modules for General lighting Safety Requirements.
15885(Part 2/Sec. 13):	2012 Lamp control gear Part 2 particular Requirements Section 13 d.c. or a.c. Supplied Electronic control gear for LED modules
16104:2012	D.C. or A.C. Supplied Electronic control gear for LED modules – Performance Requirements.
16105:2012	Method of Measurement of Lumen maintenance of Solid-state Light (LED) Sources.
16106:2012	Method of Electrical and photometric Measurements of Solid State Lighting (LED) Products
16107:2012	Luminaires Performance
16108:2012	Photobiological safety of Lamps and Lamp Systems
IS 513	Cold rolled low carbon steel sheets and strips
IS 12063	Classification of degree of protection provided by enclosures.
IS 14700	Electro magnetic compatibility (EMC) – Limits (Part 3/Sec. 2) for Harmonic current emission – THD < 15% (equipment, input current < 16 Amps. per phase.
IS 9000	(Part 6) Environment testing: Test Z – AD: composite temperature/humidity cyclic test.
IS 15885	Lamp control gear: particular requirements for (Part 2/Sec. 13) DC or AC supplied electronic control gear IS 16004 – 1 and 2) for LED modules.
IS 4905	Method for random sampling.

3.6 Electrical Installation Practices & Miscellaneous

IS:1944	Code of practice for lighting of public thorough fare
IS:3646	Code of practice for interior illumination.
IS:5572	Classification of Hazardous areas (other than Mines) having flammable gases and Vapours for electrical installation
S:6665	Code of practice for industrial lighting. - National Electrical Code - Indian Electricity Rules. - Indian Electricity Act
IS:5	Colour for ready mixed paints & enamels.
IS:280	Mild steel wires for general engineering purposes.
IS:374	Electric ceiling type fans & regulators.
IS:732	Code of practice for electrical wiring installations.
IS:1255	Code of practice for installation and maintenance of power cables Upto and including 33KV rating.
IS:2062	Steel for general structural purposes
IS:2629	Recommended practice for hot-dip galvanizing of iron and steel.
IS:2633	Methods for testing uniformity of coating of zinc coated articles.
IS:2713	Tubular steel poles for overhead power lines.
IS:3043	Code of practice for earthing
IS:5216	Guide for safety procedures and practices in electrical work.
IS:5571	Guide for selection of electrical equipments for hazardous areas.
BS:6121	Mechanical cable glands

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4.0 LIGHTING SYSTEM DESCRIPTION (CONCEPTUAL VIEW)

- 4.1 All areas of plant (indoor and outdoor) shall be provided with suitable lighting arrangement to meet the functional requirements by use of various types of luminaires so as to achieve the desired quality and level of illumination.
- 4.2 Lighting system shall also cover the low voltage power services such as power receptacles and single phase feeders.
- 4.3 Lighting system shall be fed through various power sources such as AC Normal, AC Emergency and DC Emergency supply to achieve the desired reliability.
- 4.4 Power tapped from various sources shall be distributed through lighting distribution boards and lighting panels upto the various luminaires and power outlet sockets / feeders.

5.0 SYSTEM DESIGN ENGINEERING

Engineering shall be done by the vendor only during the contract engineering stage as the same is covered in his scope. During tender stage, bidder shall make his quotation on the basis of BOQ furnished by the purchaser with the tender document.

- 5.1 **ENGINEERING INPUTS:** Complete engineering shall be done by the vendor on the basis of documents listed below. The engineering inputs shall be furnished by purchaser. However, furnishing of these inputs shall not absolve the vendor of responsibility to visit site and get acquainted with actual site conditions.

5.1.1 Indoor Areas

- a) Room dimensions (details as covered in various layout drawings)
- b) Lighting System Design Data (LSDD) covering typical values for various types of indoor areas, indicating:
 - i. Required average illumination level
 - ii. Reflection factors for walls, ceiling and floor
 - iii. Maintenance factor
 - iv. Type of luminaire
 - v. Mounting height of luminaire
 - vi. Height of working plane
- c) AC Emergency lighting requirements
- d) DC lighting requirements
- e) Requirement of sockets
- f) Requirement of exhaust fans and fan points

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5.1.2 Outdoor Areas

- a) Area geometry (details as covered in various layout drawings)
- b) Lighting System Design Data (LSDD) covering typical values for various types of outdoor areas, indicating:
 - i. Average illumination level
 - ii. Type of luminaire
 - iii. Pole heights / mounting height
 - iv. AC Emergency lighting requirement
 - v. DC lighting requirements
 - vi. Maintenance factor
- c) Requirement of sockets

5.1.3 Other inputs

- a) Suggestive location of LDBs
- c) Suggestive power distribution scheme (SLDs)
- d) Control schemes
- e) Single phase feeder details
- f) No. of sockets / criteria for computation of no. of sockets / location of sockets etc.
- g) LDB/WDB details
- h) LP details
- i) Poles & Masts details
- j) Conduit sizes
- k) Wire sizes
- l) Earthing material sizes

5.2 DESIGN CRITERIA:

5.2.1 General Requirements of Design

- a) Lighting system shall be provided to ensure adequate visual performance, safety and reliability and shall be free from excessive glare and flicker from discharge lamps. Particular attention shall be paid to ensure that level of illumination is satisfactory in all

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respects including viewing of all instruments, alarms, annunciations and indicating lamps.

- b) Complete system design shall be done on the basis of inputs provided by the purchaser and in line with the laid down criteria.
- c) Requirements of sockets shall be as per the criteria / number of sockets given by the purchaser during detailed engineering stage.
- d) Complete power distribution system shall be designed keeping following criteria in view :
 - Simplicity
 - Controlled voltage drop
 - Cost effectiveness

5.2.2 Sources of Power Supply

- a) The illumination of various indoor and outdoor areas in the Switchyard and off site areas shall comprise of one or more of the following systems:
 - Normal AC Lighting System
 - Emergency AC Lighting System
 - DC Lighting System
- b) Arrangement and distribution of power shall depend upon the functional requirements of areas and therefore supply from all types of power sources shall not be made available to all areas.

5.2.3 Lighting philosophy

a) Normal AC Lighting System

Normal AC lighting system 415V, 3 phase, 4 wire, will be fed from lighting panels (LPs) which in turn will be fed from the lighting distribution boards (LDBs). Street lights/ flood lights shall be fed from Street Lighting Panel (SLP), Welding receptacles shall be fed from Welding DB/ MCC in offsite areas.

b) Emergency AC Lighting System

This system shall be provided for certain important areas in the Switchyard. The lighting fixtures connected to this system shall be normally "ON" along with the normal AC system. These will be fed from emergency lighting panels (ELPs) which in turn will be fed from 3-phase, 4-wire supply from the emergency lighting distribution boards (ELDB'S). These lights will go off for a few seconds in case of AC supply failure at Emergency Switchgear, but shall be automatically restored when Emergency Switchgear is energised by Diesel generator set.

- c) **DC Lighting System** *(refer Section-1 Customer specification for project specific requirement)*

At strategic locations in the CRB, a few lighting fixtures fed from 220V DC supply, shall be provided to enable safe movement of operating personnel and access to important control points during an emergency, when both the normal AC and Emergency Lighting system fail. These lighting fixtures will be fed from 220V DC LPs which in turn will be fed from DC LDBs.

The supply to the DC lighting panels shall be automatically switched ON in case of loss of AC supply at station service switchgear as well as Emergency switch-gear. The DC supply will be automatically switched OFF after about 3 minutes following the restoration of supply to normal AC or emergency AC lighting system.

In auxiliary /off site buildings, emergency DC lighting is to be provided through self contained DC emergency fixture at strategic locations. The fixtures shall be switched 'ON' automatically in case of failure of AC supply.

d) Street Lighting/ Flood Lighting

Street lights / flood lights will be fed from Street Lighting Panel (SLP). The number of street lights / flood lights shall be grouped in such a way that they will be fed from the nearest SLP available. Street lights shall have provision of automatic switching ON and OFF in any one of the following modes and as per the purchaser's scheme:

- i. Manual
- ii. Automatic through 00 - 24 hrs time switch
- iii. Automatic through combination of 00 - 24 hrs time switch and a remote sensing device for monitoring external illumination level. Each SLP shall be provided with a time switch and a remote light sensing device.

5.2.4 Number of Luminaires

- a) All calculations shall be done as per the input data covered under "Engineering Inputs".
- b) Total AC luminaires

Total number of AC luminaires for indoor and outdoor areas shall be calculated on the basis of point to point method by an established computer program. Optimisation criteria shall form part of street lighting calculations.

For AC emergency lighting, a specified percentage of total AC luminaires shall be considered as AC emergency luminaires. The percentage shall be informed during detail engineering.

5.2.5 Layout Considerations

a) General Layout Considerations

- i. Layout of equipment such as LDBs and LPs shall be on the basis of following criteria :
 - Ease of operation
 - Maintainability
 - Aesthetics

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- ii. Luminaires shall be located to meet the functional requirements of the area. Aesthetics shall form part of layout considerations.
- iii. Due considerations shall be given to the mounting arrangement depending upon location and type of area.
- iv. While preparing lighting system layout drawings for air conditioned control rooms/areas having false ceilings, the vendor shall be required to interface with the Air Conditioning / Ventilation Duct layout and false ceiling layout drawings to avoid fouling / interference.
- v. The poles shall be located 1.5m away from the road edge. The buried cable shall run in hume pipe / duct bank wherever it is crossing the roads.
- vi. 240V AC, 5/15A universal socket (at least two number) shall be provided in office, store, cabin etc. The receptacles shall be provided at interval of 20m or part thereof for hand tools etc. One no. 20A, 240V AC industrial type receptacle shall be provided at suitable location in all other area as required. The receptacles shall be controlled through switch/MCBs. In hazardous area, receptacles shall be flame proof.
- vii. Suitable nos. of 63A/125A, 3 phase, 415V industrial receptacle with switch shall be provided at specific points in power plant area for welding purposes. At least one 63A/125A receptacle shall be provided in each off-site building.
- viii. 1200mm/ 1400mm sweep ceiling fans with stepped electronic regulator shall be provided for office room, store rooms and social buildings which are not covered by air-conditioned and ventilation system.
- ix. All fans including pedestal fans shall comply to relevant IS.
- x. Aviation warning lights shall be provided as per the recommendations of ICAO and Director General of civil aviation, India. The arrangement of light should be marked such that the object is indicated from every angle in azimuth. The aviation warning lighting system shall also conform to the latest Indian standard IS 4998.
- xi. Contractor shall demonstrate the average lux level achieved for different areas as per specification requirements, after completion of the lighting work, at site to the satisfaction of engineer-in-charge.
- xii. The illumination level for outdoor switchyard shall be **20 lux in general** and minimum **50lux on equipment boxes**. No lighting fixture shall be mounted on gantries, they shall be mounted on lighting masts only.

b) Occupancy based Passive Infra-red sensors

The sensors shall be recess mounted, programmable type suitable for lighting load of 6A with variable off delay settings. The detection area shall be minimum 5 metres for standard room height of 3mt. All the calibrated settings shall be stored in non-volatile memory of PIR sensor which shall be unaffected by power supply fluctuations.

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Necessary 16A contactor shall be supplied along with each sensor & shall be located inside the switch box.

c) Conduit System

- i. Unless indicated otherwise, conduits shall originate from respective lighting panels and shall continue upto the luminaires for all indoor areas.
- ii. Conduits shall run in straight runs, parallel to building columns, walls etc. as far as practicable.
- iii. Unnecessary bends and crossings shall be avoided.
- iv. In the corrosive environment, conduit installations shall be made with corrosion proof conduits. Such requirements shall be clearly indicated while preparing BOQ.
- v. Conduits in control room and other air-conditioned areas shall be surface mounted on the roof above false ceiling. However vertical drops of conduits shall be through column flanges or grooved to the wall, finally covered for better aesthetics.

c) Wiring

- i. Each circuit from LP shall be taken in a separate conduit.
- ii. Wiring of AC normal, AC emergency & DC emergency lighting system shall be carried out in separate conduits.
- iii. Receptacle wiring shall be distinct from lighting conduits. No two phase circuits shall be run in the same conduit. However different circuits of same phase may be laid in the same conduit.
- iv. Maximum three nos. of receptacles shall be loop-in & loop-out in a circuit.
- v. Filling area of wires in conduit shall not exceed 40% of the conduit area.
- vi. Wiring shall be done with following conductor sizes :
 - Luminaires – 2.5 sq. mm
 - 5A plug & socket – 2.5 sq. mm
 - 5/15A and 20A plug & socket – 4 sq.mm
- vii. Wiring shall be designed for the uniformly distributed spread of luminaires on each phase i.e. R, Y,B. Distribution of luminaires on these phases shall be such so that there is generally uniform light intensity in the event of failure of one or two phases.
- viii. Luminaires located in offices, stores, laboratories, toilets etc. shall be individually or group controlled.

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d) Cabling

- i. Cables shall be considered wherever it is not desirable to run the insulated wires due to long runs or for any other valid reason.
- ii. Cable Schedule shall be prepared for all cable connections.

5.3 ENGINEERING OUTPUTS:

Vendor shall prepare and submit following documents and drawings for purchaser's approval:

- a) Lighting calculations for indoor areas covering details such as room dimensions (length, width, height), illumination level, reflection factors (walls, ceiling, floor), maintenance factor, type of luminaire, mounting height of luminaire, room index, coefficient of utilisation, no. of luminaires (AC Normal & AC Emergency), lumen output of each luminaire, reference drawings and remarks.
- b) Lighting calculations for outdoor areas covering average illumination level, type of luminaire, chart for illumination level at various points in the area; location (coordinates), number and height of poles; type, number (normal + emergency) and orientation of luminaires etc. Calculated values of average and minimum illumination level as obtained through computer package shall also be furnished. Dot density plots for lux level shall be furnished if available in the computer package.
- c) Single line diagrams of power distribution upto Lighting Panels. Separate drawing for complete lighting distribution shall also be prepared by vendor.
- d) Loads on each phase of LP and LDB with consideration of diversity factor for sockets.
- e) Layout drawings for each indoor area indicating location of luminaires, sockets, fan points, exhaust fans, LDBs and LPs. Details of type of luminaires, source of power supply (AC Normal, AC Emergency, DC Normal and DC Emergency). Bill of Material shall also be covered which shall include unit wise requirements of luminaires and other items.
- f) Layout drawings for each outdoor area indicating location of poles / towers, orientation of luminaires, sockets and LPs. Details of pole height / mounting height, type of luminaires, source of power supply (AC Normal, AC Emergency, DC Emergency). Bill of Material shall also be covered for various types of luminaires.
- g) Conduit layout drawings with wiring and load distribution details as superimposed on the area layout drawings indicated above. Drawings shall include Bill of Material for conduits, wires etc.
- h) Wiring and load distribution details for outdoor areas.
- i) Master Bill of Material (to be submitted at regular intervals of engineering progress) including all items required for the complete lighting system viz. lighting fixtures, lamps, Lighting DBs, Welding DBs, lighting panels, conduits, PVC wires etc.

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- j) In case of revised inputs or site feedback, preparation and submission of revised engineering outputs shall also be in the scope of vendor.
- k) Calculation for selection of number and size of containers
- l) Packing procedures and drawings.

6.0 LUMINAIRES, ACCESSORIES AND LAMPS

6.1 GENERAL REQUIREMENTS OF LUMINAIRES

- a) All luminaires and accessories shall be designed for continuous operation and shall be suitable for the system design data given in Section-1.
- b) Luminaires shall be complete with accessories mounted inside the luminaire assembly. Lamps shall be supplied separately as per BOQ.
- c) All luminaires and accessories shall be suitable for operation in the atmospheric conditions prevailing at site.
- d) Power factor for fluorescent lamp luminaires shall be 0.9 or more and that for HPMV/ HPSV luminaires shall be 0.85 or more. Power factor correction capacitors shall be provided for this purpose.
- e) Luminaires shall be designed for minimum glare. No bright spots should appear from the lamp or from the reflectors.
- f) All accessories shall be wired upto a terminal block or a separate weather proof metallic terminal box suitable for 2.5 sq. mm. copper wire termination.
- g) All internal wiring shall be of PVC or silicon rubber insulation, capable of withstanding the maximum temperature to which it will be subjected under specified service conditions without deterioration.
- h) All luminaires and accessories including the breathing holes shall be vermin proof.
- i) Surface Treatment:
 - All surfaces after manufacture shall be thoroughly cleaned and degreased. Pre-treatment of surfaces shall be as per the applicable standard. Pretreated surfaces shall be free from rust, sharp edges, scales and burrs.
 - Finish of surfaces shall be non-porous, smooth and unfaded.
- j) All metal parts of the luminaires shall be bonded and connected to the earthing terminal. Earthing terminal shall be suitable for connecting 14 SWG GI wire.
- k) Flood lights shall be provided with base frame / base plate for mounting on structural steel members / wall.

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- l) All weather proof luminaires shall have the control gear housed in a weather proof enclosure with necessary gaskets, mounting bracket, locking screws etc.

6.2 LUMINAIRE TYPES & OTHER ITEMS

6.2.1 General requirements depending upon type of luminaire are listed below. Specific requirements of each luminaire are indicated in “Luminaire Details” enclosed as “ANNEXURE-LUMINAIRE”

a) Channel Mounted Luminaires (Fluorescent Luminaires)

- Channel mounted luminaires, except the special purpose luminaires, shall have CRCA sheet steel base plate / rail / channel / box / side panels / housing as per “Luminaire Details”. Sheet shall be completely stove enameled unless mentioned vitreous enameled in “Luminaire Details”. Colour of enamel shall be grey on all non-reflecting surfaces and white on reflecting surfaces.
- Twin fluorescent luminaires shall be wired in lead-lag circuit to minimise stroboscopic effect.
- Luminaires suitable for surface mounting shall also be suitable for pendant mounting. Knockouts of 20mm ET conduit fixation shall be provided for this purpose.

b) Decorative Fluorescent Luminaires

- Decorative luminaires shall be provided with one of the following as per “Luminaire Details” :
 - i. Perspex acrylic diffuser.
 - ii. High purity, anodised aluminium, mirror optic reflectors with anodised aluminium matt finish transverse fins to control glare.
 - iii. Opal polystyrene louvers and sheet steel side panels.
 - iv. Vertical metallic louvers finished in stove enamelled white and with sheet steel side panels.
- End plates of decorative luminaires shall be of high impact polystyrene or sheet metal finished in black colour.
- Diffusers and louvers for the fluorescent lamps shall be made of high impact polystyrene sheet and shall have no yellowing property over a prolonged period of use.
- Recessed type decorative luminaires shall be suitable for mounting with gypsum boards / luxalon / plaster of Paris/aluminium frame false ceiling of standard size as per “Luminaire details”.

c) Industrial Fluorescent Luminaires (General Purpose)

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- Additional reflectors, wherever provided, shall be easily removable type.

d) Industrial Fluorescent Luminaires (Special Purpose)

- Luminaires for chemical vapour (acidic / alkaline) laden environment shall be of cast aluminium controlgear box and end boxes. Controlgear housing shall have detachable, one piece neoprene gasket cover to make it weather proof. Design shall be suitable for chemically charged environment.
- Luminaires for corrosive and dust laden environment shall be made of tray type sheet steel housing and transparent acrylic visor supported by a galvanised sheet steel frame, fitted to the housing with gasket all around. Cable entry shall be from the side of luminaire. Luminaire shall be totally dust and vapour proof.
- Luminaires for highly corrosive environment shall have with sheet aluminium/ polycarbonate housing. controlgear housing, CRCA sheet steel controlgear tray with a stove enamelled white reflector. A clear acrylic cover of dish shape, secured to canopy by stainless steel toggle and neoprene gasket lining, shall be provided at the bottom.
- Luminaires for drip proof environment such as street lighting fluorescent luminaire shall have sheet aluminium canopy, a detachable reflector-cum-controlgear housing, clear ribbed acrylic cover held in aluminium frame. Luminaire shall have the degree of protection IP: 55 unless mentioned otherwise in Data Sheet A. Luminaire shall be suitable for side entry mounting with the pole bracket arm.

e) Bay Type Luminaires

- Luminaires shall be designed for following indoor applications:
 - i) High bay
 - ii) Medium bay
 - iii) Low bay
- Luminaires shall have top mounted, cast aluminium controlgear housing. Housing shall have cooling fins and canopy for easy access to the components. Canopy shall be hinged at one end and wing screw bolted at the other end.
- Controlgear shall be connected to the detachable lamp housing at the bottom such that heat dissipation is proper and distributed.
- Lamp housing-cum-reflector shall be made from spun aluminium, electrochemically brightened and anodised.
- Lamp housing for the dust laden environment shall be totally enclosed type. A clear toughened glass cover shall be attached to the lamp housing with an aluminium frame and neoprene gasket. Luminaire shall be provided with a safety chain for toughened glass.

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- Mounting arrangement shall consist of MS brackets with an anti-vibration eye-bolt.
- Side mounted controlgear box shall be provided for low bay luminaires, if mentioned in “Luminaire Details”.

f) Well Glass Luminaires

- Well glass luminaires shall be suitable for dust and vapour laden environment.
- Luminaires shall be provided with a die-cast aluminium canopy and heat resistant well glass, fitted with a ring type gasket.
- All well glass luminaires shall be provided with vitreous enamelled reflector.
- Zinc plated MS wire guard shall be provided for protection of well glass.
- Separate side mounted and top connected control gear box shall be provided for use with HPMV & HPSV lamps.
- Integral control gear box, where applicable, shall be of die cast aluminium material with one piece neoprene gasket between the box and its cover to make it dust and vapour proof.
- Luminaires shall be conduit mounted type for incandescent lamps and surface mounting type for HPMV & HPSV lamps.

g) Flame Proof Well Glass Luminaires

- Housing material shall be cast aluminium alloy LM6. Housing outer surface shall be provided with cooling fins.
- Flame proof luminaires shall be provided with heavy toughened well glass cemented in a retaining ring.
- Zinc-coated / chrome-plated MS chain connected to the main body and glass retaining ring shall be provided.
- A detachable terminal box at the top shall be provided.
- Neoprene gaskets, where needed, shall be provided for weather proof construction and indoor and outdoor application.
- Two cable entries of 20mm ET conduit shall be provided with one flame proof plug.
- Luminaires shall be suitable for the hazardous areas as classified in Data Sheet A. Design of flame proof luminaire shall be supported by the type test report for flame proofness from a government or government approved independent laboratory.

h) Street Lighting Luminaires (Other than Fluorescent Luminaire)

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- These luminaires shall be suitable for street lighting and general purpose outdoor area lighting.
- Luminaire housing shall be one piece cast aluminium alloy to accommodate lamp housing and controlgear for lamp wattage upto 150 watts. For lamp wattage above 150 watts, controlgear housing shall be of cast aluminium alloy whereas lamp housing shall be of deep drawn aluminium.
- Inside finish of the lamp housing shall be stove enamelled white. Optical control shall be provided with two high purity, electro brightened and anodised side reflectors.
- Clear acrylic bowl fitted with a rubber gasket and easily removable type shall be secured to the lamp housing.
- Provision shall be made for adjustment of lamp location for proper focussing.
- Luminaires shall be suitable for mounting with pole bracket arm.

i) Flood Lighting Luminaires

- Flood light lamp housing and reflector shall be separate from controlgear box. Requirements of controlgear box are specified elsewhere.
- Lamp reflectors shall be of high purity spun aluminium attached to the cast aluminium lamp holder housing at the rear. Lamp holder housing shall be provided with cooling fins.
- Reflector shall be closed from the front by heat resistant toughened glass and synthetic “S” type weather proof gasket.
- Luminaire shall be provided with special lamp centering and focussing device ensuring good beam control.
- MS mounting bracket shall allow fixation of the flood light in any position in a horizontal plane and the flood light can be locked in at any set angle in the vertical plane. Cast iron base and / or two protector scales shall also be provided where specified in “Luminaire Details”
- Design shall permit replacement of lamp from the rear without disturbing the previously set aiming angles. Special guide pins shall also be provided for protecting the lamps from damage while replacing.

j) Halogen Flood Lighting Luminaire

- Luminaires shall be compact in design with aluminium alloy housing and three piece highly polished and anodised reflector assembly.
- Toughened glass panel in the front shall be provided with silicon gaskets.

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- Lamp replacement from the front is also acceptable.

k) Post Top Lanterns

- Luminaire shall comprise of a spun aluminium canopy, opal acrylic diffuser and a cast aluminium spigot.
- Controlgear shall be integral type and shall be housed in the spigot.
- Luminaire shall be supplied without mounting pole.

l) Bulk Head (Flame Proof)

- Bulk head luminaires shall be used for the locations where explosion or fire hazard exists.
- Luminaire shall be made of cast iron housing with integral terminal box.
- Front of the luminaire shall be covered with flat toughened glass cemented into a retaining ring.
- Lamp replacement shall be from the front.
- Controlgear box for HPMV lamps shall be integral to the housing.
- MS fixing straps shall be provided for mounting.
- Luminaire shall be stove enameled grey outside and white inside.
- Terminal box shall be provided with 20 mm ET conduit entry.
- Complete luminaire shall be suitable for the hazardous area as classified in Data Sheet A. Type test certificate for flame proofness test from government or government approved independent laboratory shall be submitted.

m) Bulk Head (Weather Proof)

- Luminaire shall be suitable for indoor / outdoor applications having weather proof features.
- The luminaire shall comprise of die cast aluminium alloy body of dish shape.
- Luminaire shall have a heat resistant prismatic cover held in a weather proof gasket.
- Luminaire shall be stove enamelled grey outside and white inside.
- Glass cover shall have a galvanised wire protection.
- Luminaire shall be provided with locking arrangement with Allen key to prevent pilferage.

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- Luminaire shall be suitable for use with incandescent lamp upto 100W.
- Provision for 20 mm ET conduit entry shall be provided at the bottom.

n) LED type Luminaires:

- LED Luminaires shall be used for the lighting if specified in BOQ as part of NIT.
- In false ceiling area LED luminaires shall be recessed mounting type & in non-false ceiling area the LED luminaires shall be surface mounting type.
- The individual lamp wattage for LED shall be upto 3 watt.
- The LED chip efficacy shall be min 120 Lm/W. The luminaire efficacy shall be not less than 80 Lm/W.
- The LED used in the luminaires shall have colour rendering index (CRI) of Min 80. Colour designation of LED shall be “cool day light” (min 5700K) type for indoor areas. However for outdoor areas, the colour temperature of LED shall be min. 4000K, including rough & dust prone areas. LED shall conform to the LM 80 requirements.
- The LED luminaire shall have minimum life of 25,000 burning hours with 80% of lumen maintenance at the end of the life.
- The beam angle for LED chip shall be 120 degrees.
- The max. junction temperature of LED shall be 85 deg C, further the lumen maintenance at this temperature shall be min 90%.
- The THD of LED Luminaires shall be less than 10%. Further the EMC shall be as per IS 14700. The power factor of the luminaire shall not be less than 0.9.
- The marking on luminaire & safety requirements of luminaire shall be as per IS standards.
- Suitable heat sink with proper thermal management shall be designed & provided in the luminaire.
- The connecting wires used inside the system, shall be low smoke halogen free, fire retardant PTFE cable.
- Fuse protection shall be provided in input side specifically for LED luminaires.
- Care shall be taken in the design that there is no water stagnation anywhere. The entire housing shall be dust and water proof protection as per IS 12063.
- Driver Circuit: LED modules and drivers shall be compatible to each other. The LED module driver's ratings and makes shall be as recommended by corresponding LED manufacturer. LED Drivers may have following control & protections:

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- Suitable precision current control of LED.
- Open Circuit Protection
- Short Circuit Protection
- Over Temperature Protection
- Overload Protection
- Surge Protection

o) Emergency Lighting Luminaires

- The luminaire shall be automatic having in-built battery.
- Battery shall have integral charging unit.
- Charger shall be suitable for operation as per system design data.
- The battery enclosure shall be suitably painted and ventilated for the performance with sealed lead acid battery, as applicable.

5.3 CONTROLGEAR BOX (NON-INTEGRAL TYPE)

- a) Boxes shall have weatherproof construction and shall be provided with one piece neoprene gasket.
- b) Boxes shall be provided with HRC fuse mounted on a removable tray. Boxes shall be provided with all necessary components having a neat layout arrangement such that it is possible to test, inspect or replace any component without difficulty.
- c) Boxes shall be suitable for mounting on structures, walls and columns.
- d) Suitable number of terminals shall be provided for looping-in and looping-out of cable connections and also connections to the luminaire(s).
- e) Cable / conduit knock-outs shall be for each loop-in and loop-out connection and also connection to the luminaire(s).

5.4 REFLECTORS

- a) Reflectors shall be made of sheet steel or aluminium as applicable.
- b) The aluminium reflectors shall be made of high purity aluminium sheet. Sheet will be polished, electrochemically brightened and anodised.
- c) Wherever reflectors are separate from housing, they shall be securely attached to the luminaire by means of easily accessible fastening devices such that they are readily removable from the housing for maintenance.

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5.5 LAMP HOLDERS

- a) Holders shall be resistant to wear and shall be smooth in operation.
- b) Contacts shall be of durable quality.
- c) Holders shall hold the lamp under condition of shock and vibration.
- d) Lamp holders for fluorescent lamp shall be spring loaded, bi-pin, rotor type with low contact resistance.
- e) Live parts of the holder shall not be exposed when the lamp is inserted or removed in case of fluorescent luminaires.
- f) Lamp holders for HPMV & HPSV lamps shall be of porcelain material.
- g) Holders shall be screw type for HPSV & HPMV lamps. Holders for incandescent lamps shall be screw type, unless mentioned otherwise in Data sheet A.
- h) Lamp holders for incandescent lamps shall be of brass or porcelain.

5.6 STARTER HOLDERS

- a) Starter holders shall be designed and manufactured as per the applicable standard.

5.7 BALLASTS

- a) Fluorescent fixtures shall have electronic ballasts. Ballasts shall be totally enclosed type.
- b) Ballasts shall be easily removable type.
- c) Core shall be made of low loss, electrical grading stampings.
- d) End connections shall be made available in a terminal block, rigidly fixed to the ballast enclosure.
- e) Ballasts shall be free from humming.
- f) Ballast shall be provided separately for each lamp in a multi-lamp luminaire.
- g) Tappings shall be provided to set the voltage within range for HPMV & HPSV luminaires.

5.8 STARTERS

- a) Starters shall be made of aluminium material. Plastic or any other material if used shall be subject to purchaser's approval.
- b) Starters shall have bi-metal electrodes.

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- c) Starter shall be replaceable without the use of any tool and without disturbing any accessory or lamp.
- d) Starters shall have high mechanical strength.
- e) Starters shall be provided with radio interference suppressing capacitors.
- f) Starters shall have brass contacts.

5.9 CAPACITORS

- a) Capacitors shall have constant value of capacitance, suitable for operation at supply voltage.
- b) Capacitors shall be hermetically sealed, preferably in a metal enclosure to prevent seepage of impregnant and ingress of moisture.

5.10 LAMPS

- a) Lamps shall be suitable for use in any position.
- b) Lamps shall be capable of withstanding small vibrations without breakage to filaments / electrodes and lead-in wire.

5.10.1 Type of Lamps

- a) Fluorescent Lamp
 - i. Anode rings shall be provided to prevent blackening of the ends.
 - ii. Lamp caps shall be two pin type at each end.
- b) Incandescent (GLS) Lamps
 - i. Incandescent lamps shall be “clear” type.
- c) Mercury Vapour Lamps
 - i. Lamp caps shall be screw type.
- d) Sodium Vapour Lamps
 - i. Lamps shall be ovoid shaped with diffusing powder coating.
 - ii. Lamps shall be provided with external igniters and rapid restart facility.
 - iii. Lamp caps shall be screw type.
- e) Halogen Lamps
 - i. Lamps shall be double ended linear type.

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- ii. Lamps shall be of immediate start type.
- iii. Design of lamps shall ensure high performance and high efficiency.

5.11 JUNCTION BOXES

- a) Junction boxes with terminals shall be supplied for branching and terminating lighting wires/cables whenever required, as specified.
- b) Construction Features
 - i. The junction boxes shall be fabricated out of material & thickness as specified in Section-1 and shall be of rectangular shape. The cover shall be hinged or bolted with captive nuts and bolts and shall be provided with neoprene gasket lining all over.
 - ii. The junction boxes shall be provided with suitable knock outs/ gland plates for conduit/ cable connection. The conduit connection shall be properly sealed. The junction boxes meant for cable connection shall be complete with removable gland plates, glands and cable lugs, as required. The junction boxes shall be provided with two earthing terminals suitable for GI earthing wires.
 - iii. The junction boxes shall be weather proof type conforming to IP-55.
 - iv. The boxes and cover shall be hot dip galvanised. Junction boxes for corrosive areas like DM Plant, water treatment plant etc. shall have additional epoxy/acrylic coating of thickness not less than 50microns on outer surface.
 - v. The junction boxes shall be suitable for mounting on wall, columns, etc. The brackets, bolts, nuts, screws and any other erection accessories required for erection shall be included.
- c) Terminals
 - i. Multiway terminal blocks of approved type and make complete with galvanised screws, nuts, washers and marking strips shall be furnished for terminating the lighting wires.
 - ii. All the terminals blocks shall be of 650V grade one piece construction with insulating barriers. These terminals shall be made of copper alloy and shall be stud type. Each terminal provided on junction box shall be suitable for terminating two numbers of aluminium conductors of the size as specified without any damage to the conductors or looseness.
- d) The junction boxes shall be of following types:

Type	Description
JB-F	Provided with four (4) way stud type terminals for terminating upto 2 nos. 4 mm ² stranded copper conductors on each terminal, suitable for outdoor installations.

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- JB-FE Same as above but with an additional epoxy coating of 50-micron thickness.
- JB-S Provided with four (4) way stud type terminals, each terminal suitable for terminating upto two nos. of 3.5Cx50 mm² stranded aluminium conductors & with one no.6A HRC fuse and link.

5.12 RECEPTACLES

- a) Receptacle unit shall consist of socket outlet with associated switch and plug. The socket outlet and switch shall be flush mounted on a box which shall be suitable for mounting on wall or steel structures.
- b) Receptacle boxes shall be fabricated from material with thickness mentioned in Section-1.
- c) Steel boxes shall be hot dip galvanised/ painted as specified in Section-1 and as per the requirements of applicable standard corresponding to the sheet thickness.
- d) The boxes shall have conduit knock-outs and shall be suitable for cable entry of the size to be specified by purchaser during detailed engineering.
- e) The boxes shall be provided with neoprene rubber gaskets to make them moisture and dust proof.
- f) Suitable loop-in and loop-out terminals shall be provided inside the box. Terminals for incoming and outgoing shall be suitable for the size of conductor of cables.
- g) The receptacle units shall be of the following types:
 - I. Type RA: It shall have the following:
 - i. Combination of 5A & 15A, 240V, 1-phase, 2 pole, 3-pin, third pin grounded socket with integral piano key type 15A switch, flush mounted on decorative bakelite (6 mm thick)/ perspex (3 mm thick) sheet as cover of the boxes.
 - ii. Loop-in loop-out terminals similar to type RA shall be provided. These will be located in office areas.
 - II. Type RB: It shall have the following:
 - i. 20A, 240V, 1-phase, 2 pole, 3-pin (third pin scrapping earth) porcelain, metal clad socket with a metallic cover tied to it.
 - ii. Rotary, heavy duty 20A switch conforming to applicable standard.
 - iii. Shrouded, die-cast aluminium plug.
 - iv. It shall be combined interlocked weather proof industrial unit.
 - v. Mechanical interlock shall be provided as follows :

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- Switch can be put ON only when plug is fully engaged.
 - Plug can be withdrawn only when switch is in OFF position.
 - Cover can be opened only when switch is in OFF position.
- vi. The arrangement should ensure that water does not enter the plug when socket is ON.
- vii. Loop-in loop-out terminals shall be provided inside the box suitable for 4 mm² copper conductor.
- III. Type RC: It shall have the following:
- i. 63A, 415V, 3-phase-neutral earth, metal clad socket with cover
 - ii. Rotary, heavy duty 63A switch conforming to applicable standard.
 - iii. Shrouded, die-cast aluminium plug
 - iv. It shall be combined, interlocked weather proof industrial unit.
 - v. Mechanical interlock shall be same as that are applicable for RB type receptacles
 - vi. The receptacle boxes shall be suitable for entry and exit of 3.5CX70 mm² Al conductor PVC cable and loop-in loop-out terminals for the same shall be provided such that not more than one core is terminated at one terminal. Removable, undrilled cable gland plate shall be provided. Tinned copper lugs and double compression cable glands shall also be supplied by the bidder.
- IV. Type RD: It shall have the following:
- i. 125A, 415V, 3-phase-neutral earth, metal clad socket with cover.
 - ii. Rotary, heavy duty 125A switch conforming to applicable standard.
 - iii. Shrouded, die-cast aluminium plug
 - iv. It shall be combined, interlocked weather proof industrial unit.
 - v. Mechanical interlock shall be same as that are applicable for RC type receptacles
 - vi. The receptacle boxes shall be suitable for entry and exit of 3.5CX95 mm² Al conductor PVC cable and loop-in loop-out terminals for the same shall be provided such that not more than one core is terminated at one terminal. Removable, undrilled cable gland plate shall be provided. Tinned copper lugs and double compression cable glands shall also be supplied by the bidder.
- V. Type RE: It shall have the following:

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- i. 5A, 240V, 1-phase, 2 pole, 3-pin, third pin grounded socket with integral piano key type 5A switch, flush mounted on decorative bakelite (6 mm thick)/ perspex (3 mm thick) sheet as cover of the boxes.
- ii. Loop-in loop-out terminals similar to type RA shall be provided. These will be located in office areas.

5.13 CEILING FAN & REGULATORS

- a) The bidder shall supply the following ceiling fans complete with suspension rod, canopy and accessories and regulators:
 - i. 1200 mm sweep
 - ii. 1400 mm sweep
- b) The fan motor shall be totally enclosed. The motor winding shall be of copper wire provided with double or reinforced class-E insulation.
- c) The fan shall have three (3) well balanced blades. Precaution shall be taken in the manufacture of fan as well as regulators to ensure reasonable degree of silence at all speeds.
- d) The regulator shall be electronic type with stepped/smooth (step less) control of approved make.

5.14 LIGHTING CONTROL SWITCH-BOXES

- a) The switch-boxes shall be of bent steel construction, fabricated of 1.6 mm thick MS steel with 6 mm thick decorative bakelite or 3 mm thick perspex sheet cover. The boxes shall be hot dip galvanised.
- b) The switch-boxes shall be suitable for surface mounting as well as flush mounting in brick walls. They shall be flush mounted in the walls in the office areas where false ceiling is provided.
- c) Switch-boxes shall have conduit knock-out on two sides. Adequate provision shall be made for ventilation of these boxes. Conduit knock-out sizes shall be as per conduit layout drgs.
- d) Switches shall be of piano-key type having quick-make, quick-break mechanism, provided with position marking, suitable for mounting on insulating plate. The switches shall be suitable for 1-phase, 240V, 50 Hz supply. They shall conform to relevant standards. The switches shall be supplied loose and shall be fixed at site according to requirement.
- e) All components housed in the switch-boxes shall be wired to an outgoing junction box by 1.5 mm² Cu wire. The junction box shall have adequate nos. of terminals.

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- f) The size of switch-boxes shall be adequately chosen to accommodate the no. of switches and fan regulator boxes specified elsewhere in specification. Fan regulators shall be supplied separately.

5.15 CABLE GLANDS

- a) Whether specifically mentioned or not, **cable glands of suitable sizes shall be supplied along with each equipment for power and control cables.**
- b) Rubber components used in the gland shall be of neoprene.
- c) Name / trade name of manufacturer, type no. and applicable range of outer diameter of cable shall be engraved / indelibly printed on the cable gland.

5.16 CABLE LUGS

- a) **All equipment shall be supplied with the power and control cable lugs of suitable size,** whether specifically mentioned or not.
- b) Name / trade name and size of lug shall be engraved/ indelibly printed on each cable lug.

5.17 FLEXIBLE METALLIC CONDUITS AND FITTINGS

- a) Flexible metallic conduits shall generally conform to the requirements of IS: 3480.
- b) Flexible conduits shall be made of strip steel, which shall be of cold rolled mild steel. The strip shall be of uniform width and thickness throughout.
- c) The strip for making flexible conduit shall be wound tightly and so overlapped in subsequent helicals that no openings are seen in normal position.
- d) The surface of the strip shall be thoroughly cleaned before application of protective coating. Pre-treatment, before galvanization, shall conform to IS: 6005.
- e) The strip shall be electro-galvanized to a minimum thickness of 25 microns as per IS 3480.
- f) Flexible conduits shall be lead coated for application in high temperature zones if specifically mentioned in Data Sheet A.
- g) The conduit shall have uniform diameter throughout its length. The internal surface of all conduits shall be free from burrs and sharp edges and suitable for pulling insulated cables and wires without damage.

5.18 PVC CONDUITS

- a) PVC conduits shall generally conform to the requirements of IS: 9537(Part I & Part III).

6.0 SURFACE TREATMENT

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- 6.1 All metal parts and the surfaces (exterior & interior) of equipment, unless stated otherwise in case of reflectors, shall be degreased by dipping in hot alkaline solution and rubbed with wire brush to remove oil & scale from them & then rinsed in water. Alternatively, they may be shot / sand blasted.
- 6.2 Parts shall be pickled by dipping in hydrochloric acid tank to remove the rust from the surfaces formed during storage of sheets & then rinsed to remove traces of the acid. The cleaning and pretreatment of all metal parts shall be as per applicable standard.
- 6.3 The surfaces to be painted shall then be prepared by phosphatizing to protect them from further rusting & to create a good bond with the paint. The pretreatment shall conform to the applicable standard.
- 6.4 All parts shall then be subjected to a coat of red oxide primer paint.
- 6.5 All inside and outside surfaces of panel shall be spray painted with synthetic enamel of the shade as per Data Sheet A.
- 6.6 Electrostatic or powder painting shall be acceptable subject to purchaser's approval.
- 6.7 Wherever possible, finished parts shall be coated with peelable compound by spraying method to protect the finished product from scratches, grease, dirty and oily spots during handling and transportation.

7.0 PACKING

- 7.1 Vendor shall furnish packing procedure along with packing drawing at contract stage for applicable items for purchaser approval.
- 7.2 Containers adequate for storing 70% of P.O. quantity material at site are to supplied. Vendor shall furnish suitable justification to purchaser during detailed engineering for the number and size of containers being supplied.
- 7.3 Specification for the sea worthy packing, if enclosed, for the export jobs shall form part of the specification.

8.0 GUARANTEED PERFORMANCE REQUIREMENTS

- 8.1 The vendor shall guarantee satisfactory performance of the equipment supplied under all conditions and requirement as laid down by this specification.
- 8.2 Vendor shall ensure satisfactory performance for lighting system designed by them at site.

9.0 TESTS

a) All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out not earlier than 02.11.2010. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

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b) However if the contractor is not able to submit report of the type test(s) conducted not earlier than 02.11.2010 or the type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.

2.5.3 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

2.5.4 Selection of samples for type test, acceptance test & routine test and acceptance criteria for all the items shall be as per relevant I.S.

2.5.5 Type test reports of the following items as per technical specification requirements/ standards shall be submitted for approval.

SL NO.	DESCRIPTION
i.	Lighting fixtures of each type
ii.	Lighting panel of each type (Degree of Protection)
iii.	Junction Box of each type.

Type test reports for LED as per standards for following shall be submitted for approval.

1. Visual and Dimension check
2. Proof of procurement of LEDs
3. Safety tests
 - a) Marking
 - b) Construction
 - c) Provision for Earthing
 - d) External and Internal wiring
 - e) Protection against electrical shock
 - f) Endurance and Thermal
 - g) Insulation resistance & electrical strength
 - h) Resistance to heat fire & tracking
 - i) Resistance to Humidity
4. Fire Retardant test
5. Performance tests (electrical, Photometric color and Life)
6. Burn-in Test
7. Power Cycling
8. Temperature rise test
9. Emission Tests
 - a) Radiated & conducted emission
 - b) Harmonics & flickers
10. Immunity tests

In addition, following test reports to be submitted for LED chip/ LED luminaire:

- a) LED parameters like Lumen per watt, CRI, Beam angle from manufacturer.

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- b) LM 80/IS: 16105 report.
- c) LM 79/IS: 16106 report.

2.5.6 Acceptance Test and Routine Test

2.5.6.1 All lighting fixtures, lamps and other items shall be subjected to acceptance and routine test, as per relevant specified standards.

2.5.6.2 Junction boxes, switch boxes, receptacle enclosure etc. shall be subjected to physical and dimensional checks also.

2.5.7 Galvanizing Tests

2.5.7.1 The quality of galvanizing shall be smooth, continuous, free from flux stains and shall be inspected visually.

2.5.7.2 In addition following tests shall be conducted as acceptance tests.

(a) Uniformity of coating - The coating of any article shall withstand for one (1) minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.

(b) The quality of cadmium/zinc plating on items with screw threads shall be free from visible defects such as unplated areas, blisters and modules and shall be inspected visually.

(c) In addition, the plating thickness shall be determined microscopically/ chemically or electronically.

10.0 INSPECTION & TESTING

10.1 Bidder shall confirm compliance with the BHEL Standard Quality Plan without any deviations. The equipment which are not covered in the Quality Plan shall be tested as per the QP to be submitted by bidder. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ ultimate customer's approval. There shall be no commercial implication to BHEL on account of any changes in QP during contract stage.

10.2 All the components and completely assembled equipment shall be tested as per the latest edition of standards. Charges for these tests shall be deemed to be included in equipment price.

10.3 All the specified type and routine tests shall be carried out to verify the rating and performance of the equipment. Where valid type test certificates in evidence of equipment performance claimed are available & approved by purchaser, the requirements for conducting type tests may be waived. The general arrangement of object under test shall be to purchaser's approval.

10.4 All manufacturing processes viz. machining, sheet forming, electroplating, wire routing, cleating & crimping, assembly, surface preparation shall conform to good manufacturing practices.

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- 10.5 Inspection for dimensional & visual checks especially of the following, with respect to contract drawings, documents & standards shall be conducted:
- General sturdiness & rigidity of equipment
 - Surface finishing
 - Gasketting
 - Inter-changeability
 - Constructional features viz. location, accessibility & marking of components, segregation, accessibility to live parts (shrouding) etc.
 - Completeness of scope
- 10.6 Equipment shall be liable for rejection if tolerances on the values of dimensions, power consumption, impedances, temperature rise etc. exceed the specified values by purchaser and / or standards.

11.0 SPARES

- 11.1 Mandatory spares (if applicable) are indicated in BOQ-cum-price schedule.
- 11.2 Erection & commissioning spares are included in the bidder's scope of supply. BE&C spares are indicated in BOQ-cum-price schedule.
- 11.3 A list of recommended O&M spares quantities for a duration of 3 years A shall be filled up in the applicable schedule / format and submitted by bidder along with offer. However, the acceptance of the same shall not be binding on purchaser.

12.0 TOOLS AND TACKLE

- 12.1 Tools & tackle which are essential to facilitate assembly, adjustments, erection, maintenance & dismantling of equipment shall be provided as part of equipment supplied.
- 12.2 The above tools shall be supplied along with the initial consignment of equipment so as to be available prior to erection but may not be used for erection purposes.
- 12.3 Vendor shall also submit a list of recommended tools and tackle. Acceptance of these tools and tackle shall not be a binding on the purchaser.
- 12.4 Schedule of tools & tackle shall be filled up by bidder.

13.0 DOCUMENTATION

13.1 Documents to be submitted by the vendor immediately after award of contract

- Bar chart of activities of manufacture, testing, inspection and despatch.

13.2 Documents to be submitted during detailed engineering of contract

- 13.2.1 Engineering documents (refer clause 4.3) to be generated by the vendor, if applicable.
- Lighting calculations for indoor areas.
 - Lighting calculations for outdoor areas.

- c) SLD of power distribution upto LPs.
- d) Power load on each LP & LDB
- e) Layout drawings for indoor areas
- f) Layout drawings for outdoor areas.
- g) Conduit layout drawings.
- h) Wiring and load distribution details for outdoor areas.
- i) Master Bill of Material.
- j) Packing Procedure & drawing.
- k) Calculation for selection of no. & size of container.

13.2.2 Other documents :

- a) Final Quality Plans
- b) Technical data sheet
- c) Polar curves, zonal flux diagram and CoU charts of luminaires.
- d) Complete design calculations for arriving at number of luminaires.
- e) Fixing / mounting details of luminaires and other items.
- f) General arrangement drawings of following:
 - i. Luminaires
 - ii. Receptacles
 - iii. 24 V Supply module
- g) Field Quality Plan as per General Technical Conditions.
- h) Control Scheme for fluorescent, HPMV and HPSV luminaires.
- i) Schematic drawings for LDBs / LPs.
- j) Type test certificates.
- k) Catalogues / leaflets

13.3 Operation and Maintenance (O&M) manual :

The document shall comprise of installation, operating and maintenance instructions for various items / components. The O&M manual shall include the following:

- a) Write ups / instructions / procedures for
 - i. Storage at site.
 - ii. Unpacking.
 - iii. Handling at site.
 - iv. Erection.
 - v. Pre-commissioning / commissioning tests.
 - vi. Operating procedures.
 - vii. Maintenance procedures.

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- viii. Precautions to be taken during operation and maintenance work.
- ix. Trouble shooting charts covering problems, cause and solution.
- b) Approved Technical Data Sheets.
- c) Technical leaflet of various items / components.
- d) Copies of the type, acceptance and routine test certificates in bound volume.
- e) Details of all components liable to be replaced during the life of the equipment.
- f) List of maintenance tools required.
- g) List of testing equipment required.

13.4 AS BUILT DRAWINGS

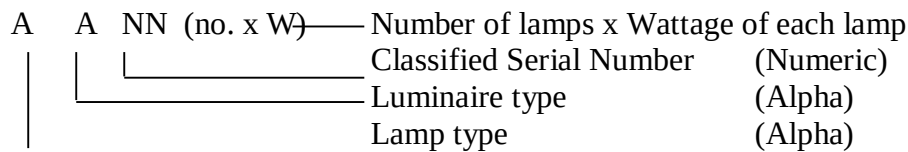
- a) Preparation of as-built drawings shall be in the scope of vendor.
- b) The as-built drawings shall be prepared on the basis of marked up copies received from the erection contractor.
- c) Entire work of as-built drawings shall be to the satisfaction of purchaser.

ANNEXURE-LUMINAIRE

LUMINAIRE DETAILS

LUMINAIRE CODING SCHEME

1.0 Code Structure



2.0 Lamp types

- | | | | |
|----|---|---|----------------|
| a) | F | - | Fluorescent |
| b) | M | - | Mercury Vapour |
| c) | S | - | Sodium Vapour |
| d) | T | - | Tungsten |
| e) | H | - | Halogen |

3.0 Luminaire types

- | | | | |
|----|---|---|-------------------------------|
| a) | C | - | Channel Mounted (Fluorescent) |
| b) | B | - | Bay Mounted |
| c) | W | - | Well Glass |
| d) | S | - | Street Lighting |
| e) | F | - | Flood Lighting |
| f) | H | - | Bulk Head |
| g) | P | - | Post Top Lantern |
| h) | E | - | Emergency Lighting |
| i) | X | - | Others |

4.0 Serial Numbers

- | | | |
|----|---------|------------------------------|
| a) | 01 - 20 | General Purpose (Industrial) |
| b) | 21 - 40 | Decorative |
| c) | 41 - 50 | Vapour Proof |
| d) | 51 - 60 | Dust Proof |
| e) | 61 - 70 | Drip Proof |
| f) | 81 - 90 | Corrosion Proof |
| g) | 91 - 99 | Flame Proof |

NOTES :

- Flood lighting luminaires to have non-integral control gearbox.
- All other luminaires shall have integral control gearbox, unless specifically mentioned otherwise in enclosed sheets.
- For more details of each luminaire, refer specification.

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1.0 Fluorescent Lamp Luminaires

1.1	FC01	1 x 28	Fluorescent, industrial box type base without any cover.
1.2	FC02	2 x 28	Fluorescent, industrial box type base without any cover.
1.3	FC03	1 x 28	Fluorescent, industrial box type base and stove enamelled side reflectors.
1.4	FC04	2 x 28	Fluorescent, industrial box type base and stove enamelled side reflectors.
1.5	FC05	1 x 28	Fluorescent, industrial box type base and vitreous enamelled side reflectors.
1.6	FC06	2 x 28	Fluorescent, industrial box type base and vitreous enamelled/ anodized glossy side reflectors.
1.7	FC07	1 x 18	Fluorescent, industrial box type base and vitreous enamelled side reflectors operating on 220V DC input supply.
1.8	FC21	1 x 28	Fluorescent, decorative with 3 side perspex acrylic diffuser.
1.9	FC22	2 x 28	Fluorescent, decorative with 3 side perspex acrylic diffuser.
1.10	FC23	1 x 28	Fluorescent, decorative, recessed type with perspex acrylic diffuser.
1.11	FC24	2 x 28	Fluorescent, decorative, recessed type with perspex acrylic diffuser.
1.12	FC25	1 x 28	Fluorescent, decorative, recessed type with mirror optic reflector.
1.13	FC26	2 x 28	Fluorescent, decorative, recessed type with mirror optic reflector.
1.14	FC27	2 x 28	Fluorescent, decorative with opal polystyrene louvers.
1.15	FC28	2 x 28	Fluorescent, decorative, recessed type with opal polystyrene louvers.
1.16	FC29	2 x 28	Fluorescent, decorative with vertical metallic louvers.
1.17	FC30	4 x 14	Fluorescent, decorative, recessed type, 600 x 600 size with perspex acrylic diffuser.
1.18	FC31	4 x 20	Fluorescent, decorative, recessed type, 600 x 600 size with opal polystyrene louvers.
1.19	FC32	2 x 20	Fluorescent, decorative, surface mounted with mirror optic reflector.

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- | | | | |
|------|------|--------|---|
| 1.20 | FC33 | 1 x 18 | Fluorescent, decorative, recessed type with mirror optic reflector operating on 220V DC input supply. |
| 1.21 | FC34 | 1 x 18 | Fluorescent, dust proof, totally enclosed type with sheet steel housing operating on 220V DC input supply |
| 1.22 | FC41 | 2 x 28 | Fluorescent, vapour proof with end boxes and controlgear box of cast Al. |
| 1.23 | FC51 | 2 x 28 | Fluorescent, dust proof, totally enclosed type with sheet steel housing. |
| 1.24 | FC61 | 1 x 28 | Fluorescent, street light with sheet aluminium canopy and ribbed acrylic cover. |
| 1.25 | FC62 | 2 x 28 | Fluorescent, street light with sheet aluminium canopy and ribbed acrylic cover. |
| 1.26 | FC81 | 2 x 28 | Fluorescent, corrosion proof, totally enclosed type with sheet aluminium/ polycarbonate housing. |

2.0 High Pressure Sodium Vapour (HPSV) Lamp Luminaire

- | | | | |
|------|------|---------|---|
| 2.1 | SB01 | 1 x 150 | Sodium, high bay, industrial type. |
| 2.2 | SB02 | 1 x 250 | Sodium, high bay, industrial type. |
| 2.3 | SB03 | 1 x 400 | Sodium, high bay, industrial type. |
| 2.4 | SB04 | 1 x 150 | Sodium, high bay, totally enclosed industrial type. |
| 2.5 | SB05 | 1 x 250 | Sodium, high bay, totally enclosed industrial type. |
| 2.6 | SB06 | 1 x 400 | Sodium, high bay, totally enclosed industrial type. |
| 2.7 | SB07 | 1 x 150 | Sodium, high bay with non-integral controlgear box. |
| 2.8 | SB08 | 1 x 250 | Sodium, high bay with non-integral controlgear box. |
| 2.9 | SB09 | 1 x 400 | Sodium, high bay with non-integral controlgear box. |
| 2.10 | SB11 | 1 x 150 | Sodium, medium bay, industrial type. |
| 2.11 | SB12 | 1 x 250 | Sodium, medium bay, industrial type. |
| 2.12 | SB13 | 1 x 150 | Sodium, medium bay, totally enclosed industrial type. |
| 2.13 | SB14 | 1 x 250 | Sodium, medium bay, totally enclosed industrial type. |

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2.14	SB17	1 x 70	Sodium, low bay, industrial type.
2.15	SB18	1 x 150	Sodium, low bay, industrial type.
2.16	SB19	1 x 70	Sodium, low bay, totally enclosed industrial type.
2.17	SB20	1 x 150	Sodium, low bay, totally enclosed industrial type.
2.18	SW41	1 x 70	Sodium, well glass, vapour proof with vitreous enamelled/ powder coated type reflector.
2.19	SW42	1 x 150	Sodium, well glass, vapour proof with vitreous enamelled/ powder coated type reflector.
2.20	SW51	1 x 70	Sodium, well glass, dust proof with vitreous enamelled reflector.
2.21	SW52	1 x 150	Sodium, well glass, dust proof with vitreous enamelled reflector.
2.22	SW91	1 x 70	Sodium, well glass, flame proof with vitreous enamelled reflector and cast aluminium alloy LM6 housing.
2.23	SW92	1 x 150	Sodium, well glass, flame proof with vitreous enamelled reflector and cast aluminium alloy LM6 housing.
2.24	SW93	1 x 70	Sodium, well glass, flame proof with vitreous enamelled reflector and cast aluminium alloy LM6 housing.
2.26	SW95	1 x 70	Sodium, well glass, flame proof increased safety luminaire with vitreous enamelled reflector and cast aluminium alloy LM6 housing for Div. 2 areas.
2.27	SW96	1 x 150	Sodium, well glass, flame proof increased safety luminaire with vitreous enamelled reflector and cast aluminium alloy LM6 housing for Div. 2 areas.
2.28	SS61	1 x 70	Sodium, street light with one piece cast aluminium body.
2.29	SS62	1 x 150	Sodium, street light with one piece cast aluminium body.
2.30	SS63	1 x 250	Sodium, street light with two piece cast aluminium body.
2.31	SS64	1 x 400	Sodium, street light with two piece cast aluminium body.
2.32	SF61	1 x 250	Sodium, flood light, general purpose.
2.33	SF62	1 x 400	Sodium, flood light, general purpose.
2.34	SF63	1 x 250	Sodium, flood light, heavy duty type.

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- | | | | |
|------|------|---------|---------------------------------------|
| 2.35 | SF64 | 1 x 400 | Sodium, flood light, heavy duty type. |
| 2.36 | SF65 | 2 x 250 | Sodium, flood light, heavy duty type. |
| 2.37 | SF66 | 2 x 400 | Sodium, flood light, heavy duty type. |
| 2.38 | SP21 | 1 x 70 | Sodium, post top lantern. |

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SECTION- 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

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, equipment and services covered under other sections of tender documents 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 prevail.

3.1 PROJECT DETAILS

	Particular	Details
a)	Customer	Uttar Pradesh Rajya Vidyut Utpadan Nigam Ltd.
b)	Engineer Consultant	DCPL
c)	Engineer Review Consultant/ Inspector	NTPC Ltd.
d)	Project Title	Panki Thermal Power Project (3x660 MW): 400kV Switchyard
e)	Project Location	Place: Panki District: Kanpur State: Uttar Pradesh
f)	Latitude & Longitude	North N26028'20" East E 80014'32"
g)	Nearest Railway Station	Panki
h)	Distance of project location from the Railway station	5 Km
i)	Nearest Major Town	Kanpur
j)	Distance of the town from the project site	16 Km.
k)	Nearest Highway from the project site	National Highway - 25
l)	Nearest airport	Kanpur – 25 Km Lucknow – 80 Km
m)	Nearest commercial airport	440 Km
n)		
	<u>SITE CONDITIONS</u> (for design purposes)	
a)	Design ambient temperature	50°C
b)	Maximum Relative humidity	85 %
c)	Height above mean sea level	Less than 1000 meters
d)	Pollution Severity	Heavily polluted (With Coal dust & Fly ash) and Highly Corrosive environment.
e)	Criteria for Wind Resistant design of structures and equipment	Standard Applicable - IS 875 (Part 3) 1987
f)	Basic Wind speed “Vb” at ten meters above the mean ground level.	47 m/ sec
g)	Siesmic data	Zone-III as per IS: 1893

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3.1.1 SYSTEM PARAMETERS:

Sl.No.	Parameters	400 kV
1	Highest system voltage	420 kV rms
2	Lightning Impulse voltage	±1425kVp
3	Switching impulse voltage	±1050kVp
4	Power frequency withstand for 1 min (rms)	630 kV(rms)
5	Max. fault level (1 sec.)	50 kA
6	Minimum creepage distance	13020 mm

3.1.2 AUXILIARY POWER:

Sl.No.	Nominal Connection Voltage	Variations in Voltage	Frequency	Phase	Neutral
1	415V	±10%	50 (+5% -5%)	3Phase , 4 Wire	Solidly Earthed
2	240V	±10%	50 (+5% -5%)	1 phase	Solidly Earthed

Combined variation of voltage and frequency shall be + 10%. Design fault level of 415V system shall be restricted to 50kA rms for 1 second & for 25kA for 1 sec. for 220V DC system.

The operational limits for variation of DC voltage are (+) 10% to (-) 15%.

3.1.3 The various minimum heights of the switchyard shall be as given below from plinth level:

Voltage	Equipment /1st Level	Main Bus Level	Jack Bus Level	Peak
400kV	8000mm	15000mm	23000mm	7500mm

The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or support insulators to the bottom of the equipment structure, where it rests on the foundation pad shall be 2550mm.

3.1.4 The minimum clearances for 400kV switchyard shall be as given below:

Phase to earth clearance	3500 mm
Phase to phase clearance	4200 mm
Section clearance	6500 mm

3.2 INSTRUCTION TO BIDDERS

The bidders shall submit the technical requirements, data and information as per the technical data sheets, provided in Section-4.

The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc fully in conformity with the technical specification.

It is recognized that the bidders may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective

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schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.

Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes, though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment under supply shall be inter-changeable with one another.

‘Make’ of brought-out items are subject to Owner/Purchaser’s approval.

The bidder shall furnish relevant details to the Owner/Purchaser for his concurrence before procurement. Makes approved by owner shall only be acceptable.

The bidder shall supply type tested (including special tests as per tech. specification) equipment and materials. The test reports shall be furnished by the bidder along with equipment/ material drawings. In the event of any discrepancy in the test reports, (i.e., if any test report is not acceptable due to any design/ manufacturing changes or due to non-compliance with the Technical Specification and/ or applicable standard), the tests shall be carried out without any additional cost implication to the BHEL. BHEL reserves the right to get any or all type/tests conducted/repeated.

3.3 CODES AND STANDARDS

The Design, manufacture, erection, testing and performance of items and services provided under this specification shall comply with the latest edition including all applicable official amendments and revisions as on date of award of the following standards. In case of conflict between this specification and code (IS Code, standards, etc.) referred herein, the more stringent of both shall prevail. All work shall be carried out as per the codes and standards listed out in the description of each equipment/item.

Indian Electricity Act and Indian Electricity Rules can be obtained from bureau of Indian Standards.

Equipment complying with other internationally accepted standards such as IEC, BS, USA, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision amendments and revision in force on date of opening of bid and shall clearly bring out the salient features for comparison.

The supplier is required to follow local statutory regulations stipulated in the latest amended Electricity Supply Act 1948 and Indian Electricity Rules 1956 (latest), and other local rules and regulations.

3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

The 400 kV system is being designed to limit the power frequency over voltage of 1.5 p.u. and the switching surge over voltage to 2.5 p.u. In 400 kV system the initial value of temporary over voltage could be 2.0 p.u. for 1-2 cycles. All the equipment/materials covered in this specification shall perform all its function satisfactorily without undue strain, restrike etc. under such over voltage conditions. All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like

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wind load, temperature variation, ice & snow, (not applicable for this project) short circuit etc for the equipment .

The equipment shall also comply with the following:

- a) All equipments shall be suitable for hot line washing.
- b) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".
- c) Piping, if any, between equipment control cabinet or operating mechanism to marshalling box of the equipment shall bear proper identification to facilitate the connection at site.
- d) All equipment shall be supplied with necessary inter-pole cabling, and its cost shall be included in the cost of equipment.

3.5 ENGINEERING DATA

3.5.1 Drawings

All drawings submitted by the supplier 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 equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. 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.

After the approval of the drawings, 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 Purchaser, if so required.

The review of these data by the purchaser will cover only general conformance of the data to the specification and documents, interfaces with the equipment provided under specification, external connections and of the dimensions which might affect plan layout. This review by the purchaser may not indicate a thorough review of the dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the purchaser shall not be considered by the contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings 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 Purchaser. Approval of Contractor's drawing or work by the Purchaser shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

All engineering data submitted by the contractor after final process including review and approval by the purchaser shall form part of the contract document and the entire work performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the purchaser in writing.

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3.5.2 Approval Procedure

The following procedure for submission and review/approval of the drawings, data, reports, information, etc. shall be followed by Contractor:

- a. All data/information furnished by Vendor in the form of drawings, documents, Catalogues or in any other form for NTPC's information/interface and/or review and approval are referred by the general term "drawings".
- b. The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering.
- c. All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor's compliance.
- d. Contractor shall submit all the drawings in five (5) copies for review of Employer. Employer shall forward their comments within four (4) weeks of receipt of drawings.
- e. Upon review of each drawings, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

CATEGORY I	Approved
CATEGORY II	Approved subject to incorporation of comments/modification as noted. Resubmit revised drawing incorporating the comments
CATEGORY III	Not approved. Resubmit revised drawings for Approval after incorporating comments/modifications as noted
CATEGORY IV	For information and records

- f. Contractor shall resubmit the drawings approved under Category II, III within one (1) week of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.).
- g. In case Contractor does not agree with any specific comment, he shall furnish the explanation for the same to Employer consideration. In all such cases Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.
- h. It is the responsibility of the Contractor to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.
- i. Contractor shall not make any changes in the portion of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawings identifying the changes (along with reasons for changes) for Employer's review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.**
- j. Approval of drawings will not in any way relieve the Contractor of his obligations of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if such equipment is later found to be defective.

3.5.3 Erection Drawings.

- a. Contractor shall furnish erection drawings for the guidance or commencement of erection or the first shipment, whichever is earlier. These shall generally comprise of fabrication/assembly drawings, various component/part details drawing, assembly, clearance data requirements, etc.

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The drawings shall contain details of components/ equipment with identification number, match marks, bill of materials, assembly procedures etc.

- b. For all major equipment apart from above details, assembly sequence and instructions with check-lists shall be furnished in the form of erection manuals.

3.5.4 Instruction Manual

- a. The Contractor shall submit to the Employer preliminary instruction manuals for all the equipments for review. The final instructions manuals incorporating Employer's comments and complete in all respect shall be submitted at least sixty (60) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipments, the transportation, storage, installation, testing, operation and maintenance procedures, etc. separately for each component/equipment along with log record format. These instruction manuals shall be submitted in five (5) copies for approval.
- b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall being corporate and the updated final instruction manuals shall be submitted.
- c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Employer to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment, including erection, testing, commissioning, operation, maintenance dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be considered completed for purpose of taking over until such instructions and drawings have been supplied to the Employer.
- d. A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together will all relevant pamphlets.
- e. The manuals shall include the following
 - a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.
 - b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.
- f. A collection of the manufacturer's standard leaflets will not accepted to be taken as a compliance of this clause. The manual shall be specifically compiled for the concerned project.

3.5.5 Operation & Maintenance Manuals

The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.

3.5.6 As Built Drawings

After final acceptance of individual equipment/system by the Owner, the Bidder will update all original drawings and documents for the equipment/ system to "as built" conditions in requisite number.

Drawings must be checked by the Bidder in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Owner. In case drawings are found to be submitted without proper endorsement for checking by the Bidder, the same shall not be reviewed and returned to the Bidder for re-submission. The Bidder shall make a visit to site to see the existing

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facilities and understand the layout completely and collect all necessary data/drawings at site which are needed as an input to the engineering. The Bidder shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Owner's scope and submit all necessary drawings/ documents for the same.

3.5.7 Final Submission of drawings and documents:

The Contractor shall furnish the following after approval of all drawings /documents and test reports:

- a. List of drawings bearing the Employer's and Contractor's drawing number.
- b. Two (2) bound sets alongwith 4 CD-ROMs of all drawing.
- c. All documents/designs in two (2) copies as noted above.
- d. Contractor shall also furnish six (6) bound sets of all as-built drawings including the list of all as-built drawings bearing drawing numbers. The Contractor shall also furnish two (2) sets of CD-ROMs/ DVD/Portable hard disk of all as-built drawings as decided by the Employer.
- e. The Contractor shall also furnish four (4) copies of instruction/ operations & maintenance manuals (after approval) for all the equipments.

3.5.8 TEST REPORTS

Four (4) copies of preliminary test results shall be supplied for approval prior to despatch of the equipment. Bound copies of complete test results shall be furnished later, in number of copies as per attached Distribution Schedule. These shall incorporate all tests carried out on the equipment and its auxiliaries as well as characteristic curves of current transformers including reports on the official test waves, failure detection data and copies of final test oscillograms of both voltage and current with calibration.

3.6 MATERIAL /WORKMANSHIP

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential 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 and shall ensure satisfactory performance throughout the service life.

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard the purchaser shall decide upon the question of similarity. When required by the specification or when required by the purchaser the contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

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. 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 the 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 also be interchangeable 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

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equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

The equipment offered in the bid only shall be accepted for supply, with the minimum modifications as agreed/accepted.

3.7 TROPICAL PROTECTION

All electrical equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

Fine mesh screen of corrosion resistant material shall be furnished on all ventilating openings to prevent entry of insects.

3.8 SPACE HEATERS

The heaters shall be suitable for continuous operation at 230 V as supply voltage. On –off switch and fuse shall be provided.

One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the compartment and electrical connections shall be made sufficiently away from below the heaters 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 the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous 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.

3.9 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistance varnish shall be applied on 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 interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

3.10 VENTILATION OPENING

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

3.11 DEGREE OF PROTECTION

Degree of protection for various enclosures as per IS: 13947 shall be as follows:

1. LT Switchgear/MCC/DBs/Fuse Boards

- | | | |
|--|---|------|
| i. Compartments and busbar chambers upto 1600A | : | IP52 |
| ii. Compartments and busbar chambers above 1600A | : | IP42 |
| iii. Switchgear located outdoor | : | IP55 |

2. Motors

- | | | |
|--------------------|---|------------------|
| i. Indoor motors | : | IP55 |
| ii. Outdoor motors | : | IP55 with canopy |

3. Transformers

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- | | | |
|---|---|------|
| i. Indoor Transformer | : | IP22 |
| ii. Cable box-indoor area | : | IP52 |
| iii. Cable box-outdoor area | : | IP54 |
| iv. Indoor kiosks and marshalling boxes | : | IP54 |
| v. Outdoor kiosks and marshalling boxes | : | IP55 |
- 4. Push Button Stations and any other kiosk/box/panel/ enclosure**
- | | | |
|---|---|------|
| i. Indoor | : | IP54 |
| ii. Outdoor | : | IP55 |
| iii. In dusty areas, e.g. conveyor galleries, transfer points, crusher house, bunker floor etc. | : | IP65 |
- 5. Junction boxes for cables/wires** : **IP55**
- 6. Outdoor lighting fixtures** : **IP55**

The degree of protection shall be in accordance with IS: 13947 (Part –I) / IEC-947 (Part-I) / IS 12063/IEC 529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

3.12 PRESERVATIVE SHOP COATING

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer.

Transformers and other electrical equipment if included shall be shop finished with one or more coats of primer and two coats of high grade epoxy. The finished colours shall be as per manufacturer's standards, to be selected and specified by the Owner at a later date.

Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.

All other steel surfaces which are not to be painted shall be coated with suitable rust preventive compound subject to the approval of the Owner.

3.13 RATING PLATES, NAME PLATES AND LABELS

- 3.13.1 Each equipment shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.
- 3.13.2 Such nameplates or labels shall be of white non hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.
- 3.13.3 The rated current, extended current rating and rated thermal current shall be clearly indicated in the name plate in case of current transformer.
- 3.13.4 Rated voltage, voltage factor and intermediate voltage shall be clearly indicated on the nameplate in case of capacitor voltage transformer.
- 3.13.5 Each switch shall have a clear inscription identifying its function. Switches shall also have a clear inscription of each position indication.

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- 3.13.6 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.
- 3.13.7 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

3.14 GALVANISING

- 3.14.1 The galvanised surface shall consist of a continuous film adhering to the steel. The finished surface shall be clean and smooth, and shall be free from defects like dissolved patches, base, spot, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surfaces, flaking or peeling off, etc. The presence of any of these defects shall render the material liable to rejection.
- 3.14.2 All exposed ferrous parts shall be hot dip galvanised as per IS:2629 & IS:2633, Galvanising shall be uniform, smooth continuous and free from acid spots. Should the galvanising of the sample be found defective, the entire batch of steel shall have to be re-galvanised at Contractor's cost. The amount of zinc deposit shall be not less than 610 gms. per sq.m. of surface area and in addition, the thickness of zinc at any spot shall not be less than 85 microns. The Employer reserves the right to measure the thickness of zinc deposit by Elkometer or any other instrument acceptable to Employer and reject any component which shows thickness of zinc at any location less than 85 microns. The testing on the galvanised materials shall be carried out as per IS:2633.
- 3.14.3 The amount of zinc deposit over threaded portion of the bolts, nuts and screws shall not be less than 300 gms. per sq. meter of surface area. The amount of zinc deposit on washers shall not be less than 340 gms. per sq. meter of surface area. The threads having extra deposit of zinc shall be removed by die cutting after the completion of galvanising. The removal of extra zinc shall be carefully done so that threads shall have minimum deposits of zinc on them as specified.

3.15 PAINTING

- 3.15.1 All surfaces to be painted including interior and exteriors of enclosures and other metal parts shall be shot or sand blasted or chemically treated to remove all rust, scale, grease and other adhering foreign matters. If not specified or approved otherwise later, colour of finishing paint shall be RAL 7032 with glossy finish except for panels which shall have matt finish. The paints used shall be epoxy-based or of suitable type to withstand the salty atmosphere prevalent in the coastal areas.
- 3.15.2 All metal parts not accessible for painting shall be made of corrosion resistant materials. All machine finished or bright surfaces shall be coated with a suitable rust preventive compound and wrapped or otherwise protected.
- 3.15.3 Paints shall be carefully selected to withstand tropical heat and extremes of weather specified herein. It shall not scale-off or crinkle or be removed by abrasion due to normal handling.
- 3.15.4 Should finished paint chip-off or crinkle during transit or installation, the Contractor shall arrange for re-painting the equipment at site at his own cost.

3.16 QUALITY ASSURANCE

The Contractor shall follow his standard procedures for quality assurance and control. This shall be in standard format indicating test witness and customer hold point shall be submitted for approval by the successful bidder. A copy of the said standard procedures shall be submitted to the Owner/Purchaser for his reference. However, Owner/Purchaser reserves the right to review the same and give his observations, if any, for compliance.

The procedures shall be in such a form as to clearly delineate the manufacturing sequence, inspection points, tests and test procedures, acceptable ranges/values, reference drawings etc.

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Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.

Manufacturing and quality control procedures shall be available for audit to the Owner/Purchaser and/or its representative at the place of manufacture.

The Owner/Purchaser reserves the right to inspect the equipment at the point of manufacture and witness factory and other such tests as may be necessary to ensure conformance to the specification.

The Owner/Purchaser may inspect the Contractor's facilities prior to award of contract.

The Owner/Purchaser may witness any or all of the tests stipulated in the relevant standards and this specification.

The Owner/Purchaser may conduct surveillance of the Contractor's facilities for compliance to his standard procedures of Quality Assurance and Quality Control while work on the specified equipment is in progress.

3.17 QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance program to control such activities at all points, as necessary. Such programs shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA program shall be generally in line with ISO-9001/IS-14001. A quality assurance program of the contractor shall generally cover the following:

- i. His organisation structure for the management and implementation of the proposed quality assurance programme
- ii. Quality System Manual
- iii. Design Control System
- iv. Documentation Data Control System
- v. Qualification data for Bidder's key Personnel.
- vi. The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- vii. System for shop manufacturing and site erection controls including process, fabrication and assembly.
- viii. Control of non-conforming items and system for corrective actions and resolution of deviations.
- ix. Inspection and test procedure both for manufacture and field activities.
- x. Control of calibration and testing of measuring testing equipments.
- xi. System for Quality Audits.
- xii. System for identification and appraisal of inspection status.
- xiii. System for authorising release of manufactured product to the Employer.
- xiv. System for handling storage and delivery.
- xv. System for maintenance of records, and
- xvi. Furnishing quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed as Annexure-I.

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3.18 GENERAL REQUIREMENTS - QUALITY ASSURANCE

- 13.18.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award.
- 13.18.2 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. floppy or E-mail in addition to hard copy, for review. Once the same is finalised, hard copies shall be submitted for approval. After approval the same shall be submitted in compiled form on CD ROM.
- 13.18.3 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control Organisation, during various stages of site activities starting from receipt of materials/equipment at site.
- 13.18.4 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed.
- 13.18.5 These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.
- 13.18.6 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of MDCC.
- 13.18.7 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.
- 13.18.8 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.
- 13.18.9 All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.
- 13.18.10 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.
- 13.18.11 Test results or qualification tests and specimen testing shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.

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- 13.18.12 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipments/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.
- 13.18.13 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 13.18.14 No welding shall be carried out on cast iron components for repair.
- 13.18.15 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
- 13.18.16 All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.
- 13.18.17 In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 50mm shall be ultrasonically tested.
- 13.18.18 The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the subcontractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified subcontractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.
- 13.18.19 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the subcontractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc.
- 13.18.20 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub vendor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
- 13.18.21 The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractors and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.
- 13.18.22 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.
- 13.18.23 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

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- 13.18.24 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

3.19 Environmental Stress Screening

All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the contractor / sub – contractor should meet the following.

1. The Contractor / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization.
Or
2. In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.

Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C.

In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.

Burn In Test Cycle

The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test.

The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature.

The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not

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been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.

3.20 QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit two hard copies and two sets on CDROM of the following Quality Assurance Documents as identified in respective quality plan with tick (√) mark.

Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before dispatch. However CD-Rom may be issued not later than three weeks.

3.20.1 Typical contents of Quality Assurance Document are as below:-

- i) Quality Plan,
- ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
- iii) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
- iv) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- v) Heat Treatment Certificate/Record (Time- temperature Chart)
- vi) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).
- vii) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.
- viii) Certificate of Conformance (COC) whoever applicable.
- ix) MDCC

3.20.2 Similarly, the contractor shall be required to submit two hard copies and two sets on CD ROM of Quality Assurance Documents (in line with above) pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

3.20.3 Before dispatch/ commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

- i) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory. The Inspector shall stamp the quality document (or applicable section) for release.
- ii) If the quality document is unsatisfactory, the Supplier shall endeavour to correct the incompleteness, thus allowing finalizing the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.
- i) If a decision is made for dispatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier

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Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the dispatch of equipment.

3.21 TRANSMISSION OF QUALITY DOCUMENTS

As a general rule, two hard copies of the quality document and Two CD ROMs shall be issued to the Employer after the delivery date for the corresponding equipment. One set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Site.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 1 month after the date of the last delivery similarly as stated above.

3.22 INSPECTION, TESTING & INSPECTION CERTIFICATE

- 3.22.1 The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.
- 3.22.2 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.
- 3.22.3 The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.
- 3.22.4 The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
- 3.22.5 When the factory tests have been completed at the Contractor's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 3.22.6 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

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- 3.22.7 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.
- 3.22.8 To facilitate advance planning of inspection in addition to giving inspection notice, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
- 3.22.9 All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by customer/consultant. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.

3.23 PACKAGING & TRANSPORTATION

3.24.1 Packing, Marking and shipping

The packing and shipping shall be carried out in accordance with the standard practice of Contractor and with the following additional requirements:

- a) The equipment shall be prepared in such a manner as to protect the equipment from damage or deterioration during shipping or storage. The shipments can be exposed to heavy rains, hot sun, high humidity and sudden extreme changes of temperature. The equipment shall be packed and shipped so as to protect it from all such conditions and any other abnormal conditions, generally expected during shipping & storage. **Packing shall be done by high quality material suitable for at least 1 yr. storage at site.**
- b) The metallic containers, if any, shall be considered as the property of the Contractor and he will be allowed to remove them from site once the contents are unpacked, inspected, documented and placed in temporary storage or in final position.
- c) The equipment shall be shipped in such a manner as to facilitate unloading, handling and storage enroute and at the site. The Contractor shall provide lifting lugs and special lifting devices for proper handling and erection.
- d) The Contractor shall be liable for any damage or loss resulting due to careless, improper, poor or insufficient packing and handling.
- e) Spare parts and spare equipment shall be packed separately in containers adequate for long term storage, plainly marked "Spare Parts Only". They shall be crated individually or in kits to be used in one single renewal or overhaul operation. Other spare part kits shall not be disturbed when using one set or kit.
- f) The Contractor shall at all times protect and preserve from damage, loss, corrosion and all other forms of damage, all parts of the works.

3.24.2 Transportation

- a) The Contractor shall make a careful examination of access rail/roadways to the site in order to confirm the practical maximum transport weight and dimensions as well as a careful examination of the ports of disembarkation particularly with respect to the capacity of the cranes installed and access roads.
- b) All instruments and computer/microprocessor based equipment imported into India from overseas for the purpose of this contract shall be air freighted to the nearest possible point and further by rail/road taking due precautions as per manufacturer's recommendations.

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Employer shall have the right to decide the items that should be air freighted and Employer's decision shall be binding on Contractor.

3.24.3 Insurance

- a) The Contractor shall insure all shipments and works at his own expense for not less than the full replacement cost plus any additional cost for accelerated manufacturing of the replacement parts.
- b) Loss or the damage to equipment during shipping or transportation to the site(s) or otherwise shall not constitute groups for claims for extension in time or for extra payment.

3.24 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

- 3.24.1 The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS: 617 for connecting to equipment terminals and conductors of aluminium. In case the terminals are of copper, the same clamps/connectors shall be used with 2mm thick bimetallic liner.
- 3.24.2 The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.
- 3.24.3 Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.
- 3.24.4 All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.
- 3.24.5 They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.
- 3.24.6 Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.
- 3.24.7 Current rating and size of terminal/conductor for which connector is suitable shall be put on a suitable sticker on each component which should last atleast till erection time.

3.24.1 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS, AND DISC INSULATORS

- 3.25.1 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC: 137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS 5284. The support insulators shall be manufactured and tested as per IS: / IEC 168/IEC 273. The insulators shall also conform to IEC 815 as applicable.
- 3.25.2 Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.
- 3.25.3 Porcelain used shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture. Hollow porcelain should be in one integral piece in green & fired stage.
- 3.25.4 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burns and other similar defects.
- 3.25.5 When operating at normal rated voltage there shall be no electric discharge between conductor and insulators which would cause corrosion or injury to conductors or when operating at normal rated voltage.
- 3.25.6 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall be lead to deterioration. All ferrous parts shall be hot dip galvanised.
- 3.25.7 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps, the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All

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- portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.
- 3.25.8 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued, porcelain parts by grinding and metal parts by machining. Insulator/ bushing design shall be such as to ensure a uniform compressive pressure on the joints.
- 3.25.9 Insulator shall also meet requirement of IEC - 815 as applicable, having alternate long & short sheds.
- 3.25 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT.**
- 3.26.1 All types of control cabinets, junction boxes, marshaling boxes, lighting panels, terminal boxes, operating mechanism boxes, Kiosks etc. shall generally conform to IS:5039, IS:8623 and IEC:439 as applicable.
- 3.26.2 Mechanism Box/ Control Cabinet/ Kiosks: A sheet steel (atleast 2.5 mm thick), dust and vermin proof M.Box/CCC/CMB shall be provided with proper lighting and thermostatically controlled space heaters. The degree of protection shall be IP 55. One dummy terminal block in between each trip wire terminal shall be provided. At least 20% spare terminals shall be provided on each panel. The gasket used shall be of neoprene rubber.
- 3.26.3 Junction Boxes: The junction boxes shall be made of minimum 2 mm thick sheet steel. Gland plates shall be removable type and made of 3 mm thick sheet steel. The boxes shall be provided with detachable cover or hinged door with captive screws. Top of the box shall be arranged to slope towards the rear of the box. The box shall be hot dip galvanised and shall be provided with suitable neoprene gaskets to achieve requisite degree of protection. Adequate spacing shall be provided to terminate the external cables. The boxes shall be suitable for mounting on various types of steel structures. The terminal blocks provided shall be of 650 V grade, rated for 10 A for control cables. Suitable numbering for terminal blocks shall be done. In case of junction box for power cable, the box shall be rated for maximum current carrying capacity. Terminal blocks shall be of one piece, Klippon RSF-1 or ELMEX CSLT-1 type with insulating barriers.
- 3.26.4 The cabinets/boxes/kiosks/panels shall be free standing or wall mounting or pedestal mounting type. They shall have hinged doors with padlocking arrangement. All doors, removable covers and plates shall be gasketed all around with neoprene gaskets.
- 3.26.5 The degree of protection of all the outdoor boxes shall not be less than IP 55 as per IS 2147.
- 3.26.6 The cable entry shall be from bottom, for which removable gasketed cable gland plates shall be provided.
- 3.26.7 Suitable 240V, single phase, 50Hz ac heaters with thermostats controlled by switch and fuse shall be provided to maintain inside temperature 10deg. above the ambient.
- 3.26.8 The size of enclosure and the layout of equipment inside shall provide generous clearances. Each cabinet/box/kiosk/panel shall be provided with a 15A, 240V ac, 2 pole, 3 pin industrial grade receptacle with switch. For incoming supply, MCB of suitable rating shall be provided. Illumination of each compartment shall be with door operated incandescent lamp. All control switches shall be of rotary switch type.
- 3.26.9 Each cabinet/box/kiosk/panel shall be provided with two earthing pads to receive 75mmx12mm GS flat. The connection shall be bolted type with two bolts per pad. The hinged door shall be connected to body using flexible wire. The cabinets/boxes/kiosks/panels shall also be provided with danger plate, and internal wiring diagram pasted on inside of the door. The front label shall be on a 3mm thick plastic plate with white letters engraved on black background
- 3.26 TERMINAL BLOCKS**

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- 3.27.1 They shall be non-disconnecting stud type of extensible design equivalent to Elmex type CAT-M4.
- 3.27.2 The terminal blocks shall be of 650 V grade, and rated to continuously carry maximum expected current. The conducting part shall be tinned or silver plated.
- 3.27.3 They shall be of moulded, non-inflammable thermosetting plastic. The material shall not deteriorate with varied conditions of temperature and humidity. The terminal blocks shall be fully enclosed with removable covers of transparent, non deteriorating plastic material. Insulating barriers shall be provided between the terminal blocks so that the barriers do not hinder the wiring operation without removing the barriers.
- 3.27.4 The terminals shall be provided with marking tags for wiring identification.
- 3.27.5 Unless otherwise required (expected current rating) or specified, terminal blocks shall be suitable for connecting the following conductors on each side:
 - All CT & VT circuits - Min. four 2.5 sq.mm. copper flexible conductor
 - AC & DC power supply -Two 16 sq.mm. Aluminium conductor
 - Other control circuits - Min. two 2.5 sq.mm. copper flexible conductor.
- 3.27.6 The terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall also be provided with short circuiting and earthing facilities.

3.27 Wiring

- 3.28.1 All wiring shall be carried out with 1100 V grade stranded copper wires. The minimum size of the stranded conductor used for internal wiring shall be as follows:
 - a) All circuits except CT circuits 2.5 sq.mm
 - b) CT circuits 4 sq. mm (minimum number of strands shall be 3 per conductor).
- 3.28.2 All internal wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals and terminal blocks.
- 3.28.3 Wire terminations shall be made with solderless crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires shall not fall off when the wires and shall not fall off when the wire is disconnected from terminal blocks.
- 3.28.4 All wires directly connected to trip circuit breaker shall be distinguished by the addition of a red coloured unlettered ferrule. Number 6 & 9 shall not be included for ferrules purposes.
- 3.28.5 All terminals including spare terminals of auxiliary equipment shall be wired upto terminal blocks. Each equipment shall have its own central control cabinet in which all contacts including spare contacts from all poles shall be wired out. Interpole cabling for all equipment's shall be carried out by the Contractor.

3.28 CABLE GLANDS AND LUGS

- 3.29.1 Cable glands shall be Double compression type, tinned/Nicked plated (coating thickness not less than 20 microns in case of tin and 10 to 15 microns in case of nickel) brass cable glands for all power and control cables. They shall provide dust and weather proof terminations. They shall comprise of heavy duty brass casting, machine finished and tinned to avoid corrosion and oxidation. Rubber components used in cable glands shall be neoprene and off tested quality. Required number of packing glands to close unused openings in gland plates shall also be provided.
- 3.29.2 The cable glands shall be tested as per BS: 6121. The cable glands shall also be duly tested for dust proof and weather proof termination.
- 3.29.3 Cables lugs for power cables shall be tinned copper solder less crimping type conforming to IS:8309 and 8394 suitable for aluminum or copper conductor (as applicable). Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall

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be provided with insulating sleeve and shall suit the type of terminals provided on the equipment. The cable lugs shall suit the type of terminals provided. The cable lugs shall be of Dowell make or equivalent.

3.29 CONDUITS, PIPES AND ACCESSORIES

- 3.30.1 The bidder shall supply and install all rigid conduits, mild steel pipes, flexible conduits, hume pipes, etc. including all necessary sundry materials, such as tees, elbows, check nuts, bushing reduces, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes, etc.
- 3.30.2 Rigid conduits shall be flow-coat metal conduits of Nagarjuna Coated Tubes or equivalent make. The outer surface of the conduits shall be coated with hot-dip zinc and chromate conversion coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanised. All rigid conduits/ pipes shall be of a reputed make.
- 3.30.3 Flexible conduits shall be heat-resistant lead coated steel, water-leak, fire and rust proof, and be of PLICA make or equivalent.

3.30 AUXILIARY SWITCH

The auxiliary switch shall conform of following type tests:

- Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/ visual defects/ temperature rise test.
- Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination
- Heat run test on contacts
- IR/HV test, etc.

3.31 LAMPS AND SOCKETS

3.32.1 Lamps:

All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

3.32.2 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

3.32.3 Hand Lamp:

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

3.32 SWITCHES & FUSES:

Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switch-fuse units. Selection of the main and sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

All fuses shall be of HRC cartridge type conforming to IS 9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal Protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

PROJECT: 400kV Switchyard for Panki Thermal Power Station (1x660MW) CUSTOMER: UPRVUNL REVIEW CONSULTANT: NTPC LTD. CONSULTANT: DCPL	
Technical Specification Section-3: Project Details and General Specification	TB-316-401-XXX

All control switches shall be of rotary type. Toggle/piano switches shall not be accepted.

3.33 TESTS

General

During manufacture, the Owner/Purchaser's representative(s) shall have the right to expedite and/or inspect design, materials, workmanship and progress of manufacture of the Contractor's and their Sub-Contractor's equipment and may reject defective materials considered unsuitable for the intended purpose or which do not comply with the intent of the tender specification. The Contractor, upon any such rejection by the Purchaser or his representative(s), shall replace the defective or unsuitable materials. The Contractor shall provide every reasonable inspection facility to the Purchaser's Inspector(s) or representative(s) at his own and his Sub-Contractor's works.

The Contractor shall give thirty (30) day notice of readiness for inspection of component parts and/or before final assembly and test, so that the Purchaser's representative(s) may inspect the materials and witness such tests before shipment. The Purchaser's representative(s) may, at any time, inspect and request copies of any or all test data of raw materials and finished components which shall be immediately furnished.

Material being furnished against this order shall only be shipped when factory inspection, satisfactory to the Purchaser and/or their representative(s) has been conducted. Such inspection and acceptance for shipment shall not, however, relieve the Contractor from his entire responsibility for furnishing equipment conforming to the requirement of the tender specification nor shall prejudice any claim, right or privilege which the Purchaser may have because of the use or supply of defective or unsatisfactory materials or equipment. Should the inspection be waived by the purchaser, such waiver shall not also relieve the Contractor, in any way, from his entire obligations under the Contract.

The equipment shall, at the factory or after installation, be demonstrated capable of performing satisfactorily upto the Contractor's guaranteed performance. All tests required by the tender specification including retests and inspection that may be necessary owing the failure to meet any tests specified, shall be made at the Contractor's expenses. Additional tests, as necessary, shall be made to locate such failure(s) and after determining the causes of failure(s) and rectifying it, specified tests shall be repeated to establish that the rebuilt equipment meets the tender specification requirements in every respect.

Should the equipment ultimately fail to pass the specified tests, the Purchaser will have the option to reject the unit.

Tests during Manufacture

During the manufacture of equipment, tests specified in Standard Specification(s) shall be performed on each unit in addition to any of manufacturer's standard tests and requisite number of copies of tests certificates as per Distribution Schedule shall be furnished.

Routine Tests

After completion of manufacture routine tests as specified in relevant Standards and in Standard Specification(s) shall be performed on equipment and requisite number of copies of test certificates as per Distribution Schedule shall be furnished.

All tests shall be conducted in accordance with Indian Standards in effect at the time of testing and in presence of representative(s) of the Purchaser/ Consulting Engineer.

PROJECT: 400kV Switchyard for Panki Thermal Power Station (1x660MW) CUSTOMER: UPRVUNL REVIEW CONSULTANT: NTPC LTD. CONSULTANT: DCPL	
Technical Specification Section-3: Project Details and General Specification	TB-316-401-XXX

Tests on Associated Components

Cast epoxy resin insulators, surge absorbers, current transformers, voltage transformers, control devices and other associated components as applicable, shall be tested in accordance with the relevant Indian standards and/or Manufacturer's Standards.

Type Tests

Contractor will have to submit Type test reports for all equipment for review. The test reports shall be of same or higher rating. In case the test reports are **older than 5 years from the date of techno commercial bid opening i.e. 02.11.15** or related to equipment of lower rating then fresh type tests have to be conducted without any implication.

Site Tests

The Bidder shall indicate tests recommended to be carried out at site during installation and commissioning to ensure satisfactory performance of all the equipment supplied.

Testing Facility

The Bidder shall state in the Proposal the testing facilities available at his works. Should full capacity testing equipment be not available, the Bidder shall state the method proposed to be adopted with detailed computations and justification for adopting such a method to reliably ascertain the equipment characteristics corresponding to full capacity testing.

3.4 Enclosures:

1. ANNEXURE- I – MQP (Customer format)
2. ANNEXURE- II – QUALITY ASSURANCE FOR SWITCHYARD

ANNEXURE-I

MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER :								
			ITEM :		QP NO.: REV.NO: DATE: PAGE: OF....										
SL. NO	COMPONENT & OPERATIONS	CHARACTERI STICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS	
					M	C/N					M	C	N		
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	** 10.			11.	
				LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: SUPPLIER/NOMINATED INSPECTION AGENCY, N: THE OWNER P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: THE OWNER SHALL IDENTIFIED IN COLUM "N"						DOC. NO.: REV..... CAT.....					
MANUFACTURER / SUB-SUPPLIER		MAIN- SUPPLIER						FOR THE OWNER USE		REVIEWED BY		APPROVED BY		APPRO VAL SEAL	
SIGNATURE															

E2 : SWITCHYARD

ATTRIBUTES, CHARACTERISTICS  	Make, model, Type & Rating, Test Certificate	Routine & Acceptance Test as per IS / IEC	Functional requirements as per Owner Specification
ITEM, COMPONENTS, SUB SYSTEM ASSEMBLY			
Circuit Breaker (IEC: 56)	Y	Y	Y
Interruptor & hollow insulator (IEC: 233/ IS: 5284)	Y	Y	Y
Isolator (IEC: 129 / IEC: 694)	Y	Y	Y
Current Transformer (IEC: 185)	Y	Y	Y
Capacitor Voltage Trams former (IEC: 186 / 358)	Y	Y	Y
Bus Post Insualtor (IEC: 168 / 273 / IS:2544)	Y	Y	Y
Disc,Pin & String Insualtor (IEC: 383 / IS: 731)	Y	Y	Y
Long Rod Insualtor (IEC: 433)	Y	Y	Y
Surge Arrestor (IEC: 99-4)	Y	Y	Y
Hardware fittings for Insulator (IS: 2486 / BS: 3288)	Y	Y	Y
Spacer Clamps & Connector (IS: 10162 / 5561)	Y	Y	Y
Aluminum Tube (IS: 5082 / 2673 / 2678)	Y	Y	Y
Wave Trap (IEC: 353 / IS: 8792 / 8793)	Y	Y	Y
Conductor (IS: 398-P-II)(V)	Y	Y	Y
Galvanised Steel Structures (IS: 2062/2629/4759/6745)	Y	Y	Y
Vibration Damper (IS: 9708)	Y	Y	Y
Sag Compensating Spring DIN: 2089/2096 IS: 3195 / 7906	Y	Y	Y
Control & Relay Panel	Y	Y	Y
SF6 Gas filling & evacuating plant	Y	Y	Y
SF6 Gas Leak Detector	Y	Y	Y
Leakage Current Analyser	Y	Y	Y
Nitrogen Gas Filling Device	Y	Y	Y

Protection Relays	Y	Y	Y
Event Logger	Y	Y	Y
Operation Analyser	Y	Y	Y
Disturbance Recorder	Y	Y	Y
Tariff Metering System	Y	Y	Y
Synchronising Trolley	Y	Y	Y
Relay Test Kit	Y	Y	Y
LT Switchgear /LT Panels (IEC:947 / IS:13947)	Y	Y	Y
Battery IS:1652	Y	Y	Y
Lighting Panels	Y	Y	Y
Surge Monitor	Y	Y	Y

Notes:

- 1) This is an indicative list of test/checks. The manufacture is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents during QP finalisation for all items.
- 2) All major Bought Out Items will be subject to Owner/ Owner Engineer approval.

PROJECT: 400kV Switchyard for Panki Thermal Power Station (1x660MW) CUSTOMER: UPRVUNL REVIEW CONSULTANT: NTPC LTD. CONSULTANT: DCPL	
Technical Specification of Illumination System Section-4: Guaranteed and Technical Particulars	TB-316-401-009 REV.00

SECTION 4

GUARANTEED AND TECHNICAL PARTICULARS

- Datasheet for Illumination System (3 pages)

CLAUSE NO.	Bidder's Name
1.00.00	Lighting Panel a) Make b) Applicable standard c) Enclosure d) Degree of protection i) Indoor ii) Outdoor
2.00.00	Miniature circuit Breaker a) Make b) Type designation c) Applicable standard d) Rated current/ voltage e) Breaking capacity at 0.6 p.f. f) Catalogue attached as annexure no.
3.00.00	Lighting fixtures & Accessories a) Make of lighting fixture & accessories b) Catalogue for each type of fixture attached as annexure no c) Applicable Standard
4.00.00	Receptacles/Sockets a) Make b) Type c) Applicable standard

CLAUSE NO.	Bidder's Name	
5.00.00	Junction Boxes a) Make b) Type c) Material d) Applicable standard	
6.00.00	Rigid steel Conduits/Fittings & Accessories a) Make b) Material c) Applicable standard	
7.00.00	Flexible steel standard a) Make b) Applicable standard	
8.00.00	Lighting poles a) Make b) Applicable standard c) Type d) Pole height	
9.00.00	Lighting masts a) Make b) Type c) Overall height d) Applicable standard e) Catalogue attached as annexure no.	

CLAUSE NO.	Bidder's Name
10.00.00	Emergency Lighting Transformers a) Make b) Voltage Ratio c) KVA Rating

PROJECT: 400kV Switchyard for Panki Thermal Power Station (1x660MW)
CUSTOMER: UPRVUNL
REVIEW CONSULTANT: NTPC LTD.
CONSULTANT: DCPL

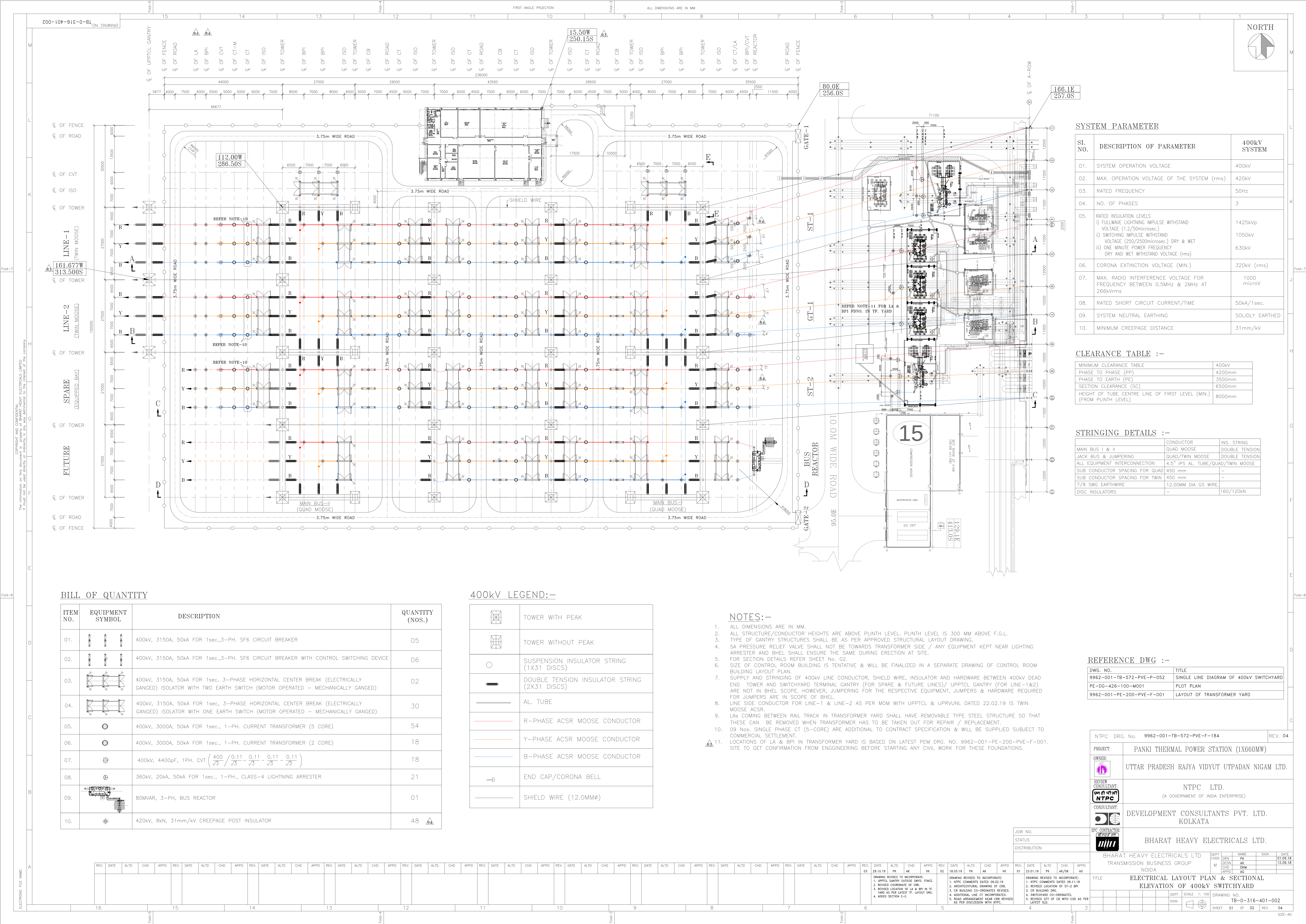
Technical Specification of Illumination System
Section-5: List of Enclosures

TB-316-401-009
REV.00

SECTION-5

ENCLOSURES TO THE SPECIFICATION

SN.	NTPC Drawing No.	Drawing Title
1	9962-001-TB-572-PVE-F-184	ELECTRICAL LAYOUT PLAN & SECTIONAL ELEVATION OF 400kV SWITCHYARD
2	9962-001-TB-572-PVC-C-121	SWITCHYARD CONTROL ROOM BUILDING - ARCHITECTURAL PLAN & ELEVATION
3	9962-001-TB-572-PVE-F-190	CABLE TRENCH LAYOUT OF 400kV SWITCHYARD (ELECTRICAL)
4	9962-001-TB-572-PVE-F-191	INDOOR CABLE TRENCH LAYOUT OF SWITCHYARD CRB (ELECTRICAL)



SYSTEM PARAMETER

Sl. NO.	DESCRIPTION OF PARAMETER	400kV SYSTEM
01.	SYSTEM OPERATION VOLTAGE	400kV
02.	MAX. OPERATION VOLTAGE OF THE SYSTEM (rms)	420kV
03.	RATED FREQUENCY	50Hz
04.	NO. OF PHASES	3
05.	RATED INSULATION LEVELS i) FULLWAVE LIGHTNING IMPULSE WITHSTAND VOLTAGE (1.2/50microsec.) ii) SWITCHING IMPULSE WITHSTAND VOLTAGE (250/2500microsec.) DRY & WET iii) ONE MINUTE POWER FREQUENCY DRY AND WET WITHSTAND VOLTAGE (rms)	1425kVp 1050kV 630kV
06.	CORONA EXTINCTION VOLTAGE (MIN.)	320kV (rms)
07.	MAX. RADIO INTERFERENCE VOLTAGE FOR FREQUENCY BETWEEN 0.5MHz & 2MHz AT 266kVrms	1000 microV
08.	RATED SHORT CIRCUIT CURRENT/TIME	50kA/1sec.
09.	SYSTEM NEUTRAL EARTHING	SOLIDLY EARTHED
10.	MINIMUM CREEPAGE DISTANCE	31mm/kV

CLEARANCE TABLE :-

MINIMUM CLEARANCE TABLE	400kV
PHASE TO PHASE (PP)	4200mm
PHASE TO EARTH (PE)	3500mm
SECTION CLEARANCE (SC)	6500mm
HEIGHT OF TUBE CENTRE LINE OF FIRST LEVEL (MIN.) (FROM PLINTH LEVEL)	8000mm

STRINGING DETAILS :-

	CONDUCTOR	INS. STRING
MAIN BUS I & II	QUAD MOOSE	DOUBLE TENSION
JACK BUS & JUMPING	QUAD/TWIN MOOSE	DOUBLE TENSION
ALL EQUIPMENT INTERCONNECTION	4.5" IPS AL. TUBE/QUAD/TWIN MOOSE	
SUB CONDUCTOR SPACING FOR QUAD	450 mm	-
SUB CONDUCTOR SPACING FOR TWIN	450 mm	-
7/8 SWG EARTHWIRE	12.00MM DIA GS WIRE	
DISC INSULATORS	-	160/120kN

BILL OF QUANTITY

ITEM NO.	EQUIPMENT SYMBOL	DESCRIPTION	QUANTITY (NOS.)
01.		400kV, 3150A, 50kA FOR 1sec.,3-PH. SF6 CIRCUIT BREAKER	05
02.		400kV, 3150A, 50kA FOR 1sec.,3-PH. SF6 CIRCUIT BREAKER WITH CONTROL SWITCHING DEVICE	06
03.		400kV, 3150A, 50kA FOR 1sec, 3-PHASE HORIZONTAL CENTER BREAK (ELECTRICALLY GANGED) ISOLATOR WITH TWO EARTH SWITCH (MOTOR OPERATED - MECHANICALLY GANGED)	02
04.		400kV, 3150A, 50kA FOR 1sec, 3-PHASE HORIZONTAL CENTER BREAK (ELECTRICALLY GANGED) ISOLATOR WITH ONE EARTH SWITCH (MOTOR OPERATED - MECHANICALLY GANGED)	30
05.		400kV, 3000A, 50kA FOR 1sec., 1-PH. CURRENT TRANSFORMER (5 CORE)	54
06.		400kV, 3000A, 50kA FOR 1sec., 1-PH. CURRENT TRANSFORMER (2 CORE)	18
07.		400kV, 4400pF, 1PH. CVT $\left(\frac{400}{\sqrt{3}} / \frac{0.11}{\sqrt{3}} - \frac{0.11}{\sqrt{3}} - \frac{0.11}{\sqrt{3}} - \frac{0.11}{\sqrt{3}} \right)$	18
08.		360kV, 20kA, 50kA FOR 1sec., 1-PH., CLASS-4 LIGHTNING ARRESTER	21
09.		80MVAR, 3-PH, BUS REACTOR	01
10.		420kV, 8kN, 31mm/kV CREEPAGE POST INSULATOR	48

400kV LEGEND:-

	TOWER WITH PEAK
	TOWER WITHOUT PEAK
	SUSPENSION INSULATOR STRING (1X31 DISCS)
	DOUBLE TENSION INSULATOR STRING (2X31 DISCS)
	AL. TUBE
	R-PHASE ACSR MOOSE CONDUCTOR
	Y-PHASE ACSR MOOSE CONDUCTOR
	B-PHASE ACSR MOOSE CONDUCTOR
	END CAP/CORONA BELL
	SHIELD WIRE (12.0MMø)

NOTES:-

- ALL DIMENSIONS ARE IN MM.
- ALL STRUCTURE/CONDUCTOR HEIGHTS ARE ABOVE PLINTH LEVEL. PLINTH LEVEL IS 300 MM ABOVE F.G.L.
- TYPE OF GANTRY STRUCTURES SHALL BE AS PER APPROVED STRUCTURAL LAYOUT DRAWING.
- SA PRESSURE RELIEF VALVE SHALL NOT BE TOWARDS TRANSFORMER SIDE / ANY EQUIPMENT KEPT NEAR LIGHTING ARRESTER AND BHEL SHALL ENSURE THE SAME DURING ERECTION AT SITE.
- FOR SECTION DETAILS REFER SHEET No. 02.
- SIZE OF CONTROL ROOM BUILDING IS TENTATIVE & WILL BE FINALIZED IN A SEPARATE DRAWING OF CONTROL ROOM BUILDING LAYOUT PLAN.
- SUPPLY AND STRINGING OF 400kV LINE CONDUCTOR, SHIELD WIRE, INSULATOR AND HARDWARE BETWEEN 400kV DEAD END TOWER AND SWITCHYARD TERMINAL GANTRY (FOR SPARE & FUTURE LINES)/ UPPTCL GANTRY (FOR LINE-1&2) ARE NOT IN BHEL SCOPE. HOWEVER, JUMPING FOR THE RESPECTIVE EQUIPMENT, JUMPERS & HARDWARE REQUIRED FOR JUMPERS ARE IN SCOPE OF BHEL.
- LINE SIDE CONDUCTOR FOR LINE-1 & LINE-2 AS PER MOM WITH UPPTCL & UPRVUNL DATED 22.02.19 IS TWIN MOOSE ACSR.
- LAs COMING BETWEEN RAIL TRACK IN TRANSFORMER YARD SHALL HAVE REMOVABLE TYPE STEEL STRUCTURE SO THAT THESE CAN BE REMOVED WHEN TRANSFORMER HAS TO BE TAKEN OUT FOR REPAIR / REPLACEMENT.
- 09 Nos. SINGLE PHASE CT (5-CORE) ARE ADDITIONAL TO CONTRACT SPECIFICATION & WILL BE SUPPLIED SUBJECT TO COMMERCIAL SETTLEMENT.
- LOCATIONS OF LA & BPI IN TRANSFORMER YARD IS BASED ON LATEST PEM DRG. NO. 9962-001-PE-200-PVE-F-001. SITE TO GET CONFIRMATION FROM ENGINEERING BEFORE STARTING ANY CIVIL WORK FOR THESE FOUNDATIONS.

REFERENCE DWG :-

DWG. NO.	TITLE
9962-001-TB-572-PVE-P-052	SINGLE LINE DIAGRAM OF 400kV SWITCHYARD
PE-DG-426-100-M001	PLOT PLAN
9962-001-PE-200-PVE-F-001	LAYOUT OF TRANSFORMER YARD

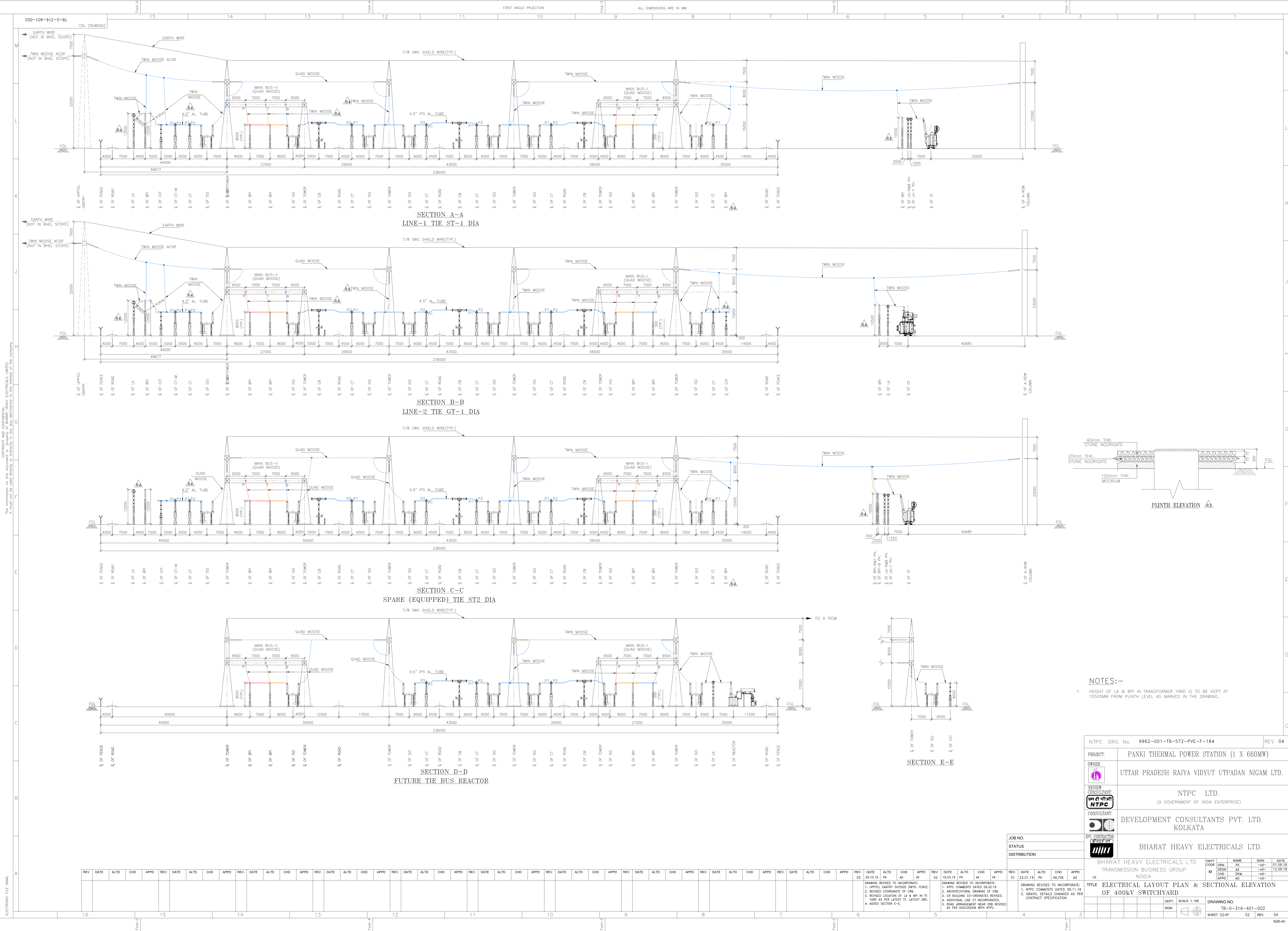
NTPC DRG. No.	9962-001-TB-572-PVE-F-184	REV. 04
PROJECT:	PANKI THERMAL POWER STATION (1X660MW)	
OWNER:	UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.	
REVIEW CONSULTANT:	NTPC LTD.	
CONSULTANT:	DEVELOPMENT CONSULTANTS PVT. LTD.	
EXECUTIVE CONTRACTOR:	BHARAT HEAVY ELECTRICALS LTD.	

BHARAT HEAVY ELECTRICALS LTD	DEPT. CODE	NAME	SIGN	DATE
TRANSMISSION BUSINESS GROUP	M	DESIGN	AK	01.05.14
Noida		CHECK	AK	12.09.18

TITLE				ELECTRICAL LAYOUT PLAN & SECTIONAL ELEVATION OF 400kV SWITCHYARD			
DEPT. SCALE				1: 100			
DRAWING NO.				TB-0-316-401-002			
SHEET				01 OF 02			
REV.				04			

Consent and Confidentiality: The information on this document is property of BHARAT HEAVY ELECTRICALS LIMITED. It shall not be used directly or indirectly in any way detrimental to the interest of the company.

ELECTRONIC FILE NAME:



NOTES:-
1. HEIGHT OF LA & BP1 IN TRANSFORMER YARD IS TO BE KEPT AT 10500MM FROM PLINTH LEVEL AS MARKED IN THE DRAWING.

NTPC DRG. No. 9962-001-TB-572-PVE-F-184		REV. 04
PROJECT:	PANKI THERMAL POWER STATION (1 X 660MW)	
OWNER:	UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.	
REVIEW CONSULTANT:	NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE)	
CONSULTANT:	DEVELOPMENT CONSULTANTS PVT. LTD. KOLKATA	
EXECUTIVE CONTRACTOR:	BHARAT HEAVY ELECTRICALS LTD.	
BHARAT HEAVY ELECTRICALS LTD TRANSMISSION BUSINESS GROUP NOIDA		DEPT. NAME SIGN DATE CODE DRN PK -sd- 01.03.13 M DESN AK -sd- 12.09.18 CHD SKM -sd- APPO AS -sd-
TITLE ELECTRICAL LAYOUT PLAN & SECTIONAL ELEVATION OF 400KV SWITCHYARD		DEPT. SCALE 1:100 DRAWING NO. TB-0-316-401-002
SIGN		SHEET 02 OF 02 02 REV. 04
JOB NO. STATUS DISTRIBUTION		SIZE-A0

TB-3-316-401-061

ON 'DRD

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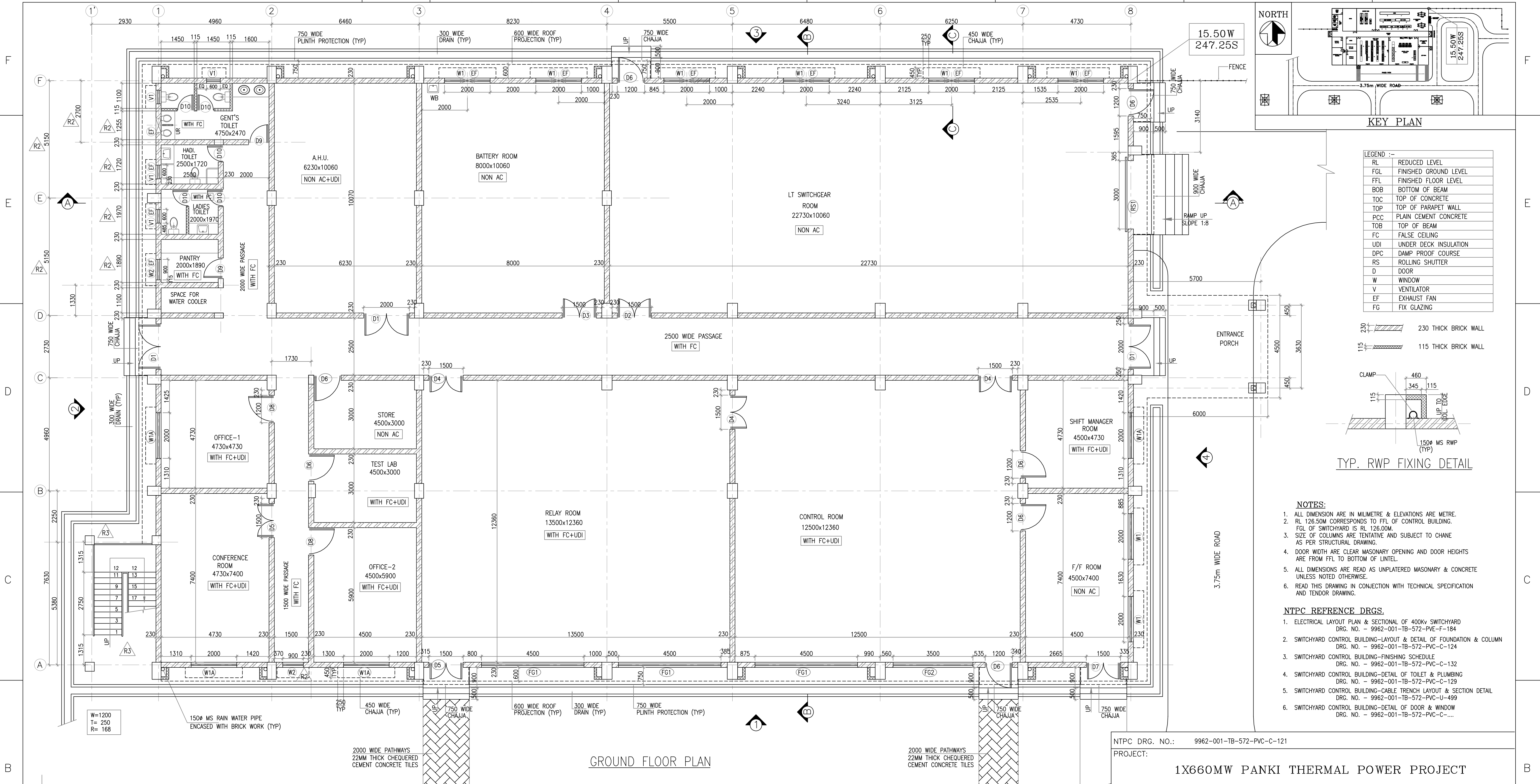
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3

2

1



GROUND FLOOR PLAN

NTPC DRG. NO.: 9962-001-TB-572-PVC-C-121

PROJECT:

1X660MW PANKI THERMAL POWER PROJECT

CUSTOMER:

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

CONSULTANT:

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI



BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP
NOIDA

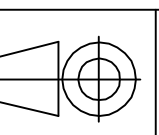
STRUCTURAL CONSULTANTS:-

RDA CIVIL ENGINEERING SYSTEM PVT. LTD.
N-43, SRINIWASपुरI NEW DELHI -65
PH. 011 26845128, FAX 011 26313478

NAME	SIGN.	DATE	NO.OF VAR.
DRN. TKR	—sd—	06.03.19	
CHD. AK	—sd—		N.A.
APPD. DKM	—sd—		

DEPT. TBG
CODE

UNTOL. DIMS. GR. 9/M/9



SCALE N.T.S

WEIGHT (KG) N.A.

REF. TO ASSY. DRG. N.A.

ITEM NO. N.A.

NO.OF ITEMS N.A.

TITLE
CONTROL ROOM BUILDING LAYOUT FOR 400KV
ARCHITECTURAL GROUND FLOOR PLAN

CARD CODE NA

DRG.NO.
TB-3-316-401-061

REV.
03

SHT. No 01 NO. OF SHT. 04

TB-3-316-401-061

ON 'D'RD

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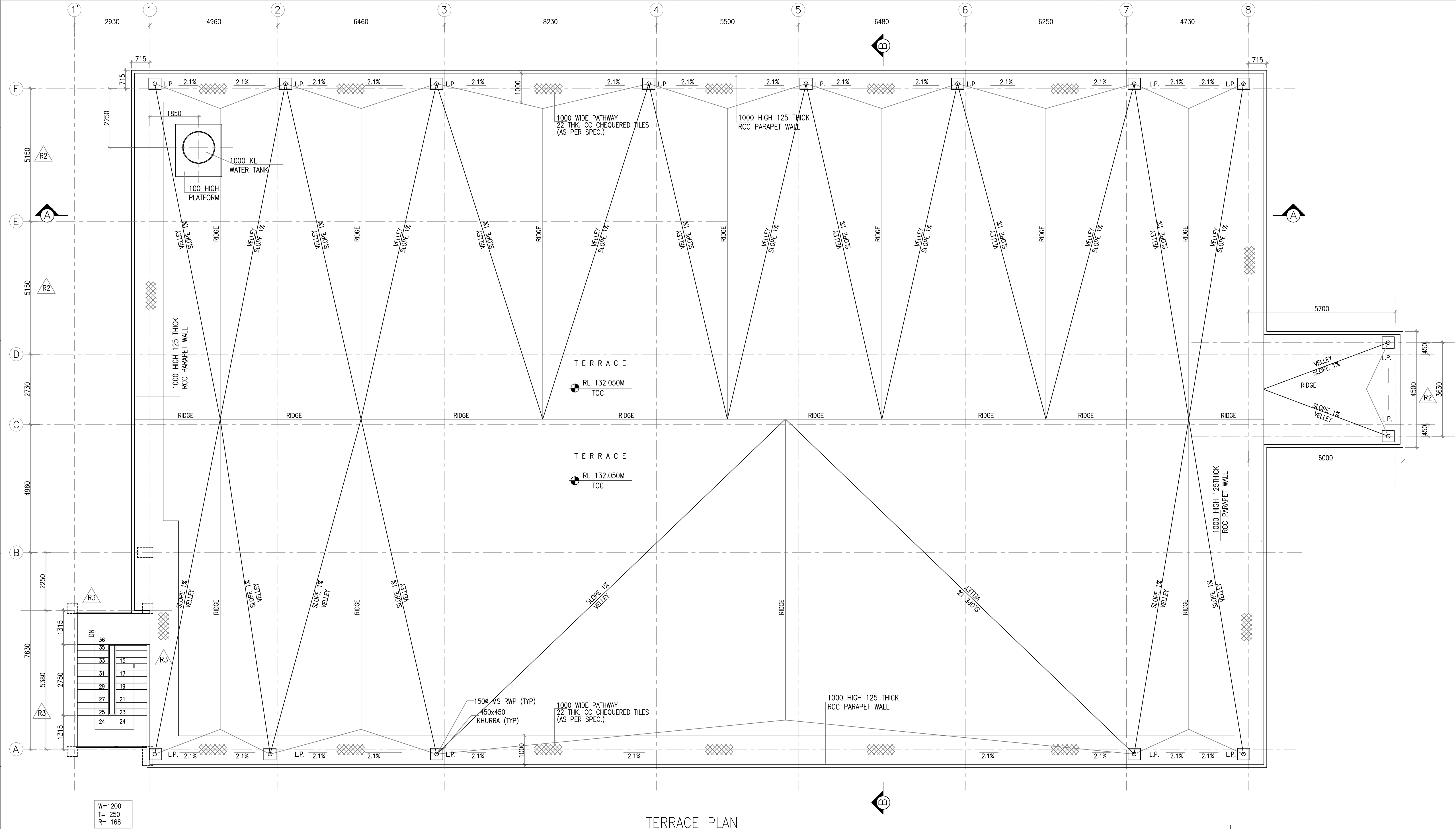
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4

3

2

1



WATER PROOFING ON ROOF:

HIGH SOLID CONTENT LIQUID APPLIED ELASTOMERIC WATER PROOFING MEMBRANE WITH SEPARATE WEARING COURSE AS PER ASTM C-898. THICKNESS OF THE MEMBRANE SHALL BE 1.5 MM. THIS TREATMENT SHALL INCLUDE APPLICATION OF POLYMERISED MASTIC OVER THE ROOF TO ACHIEVE SMOOTH SURFACE AND PRIMER COAT. WEARING COURSE ON THE TOP OF MEMBRANE SHALL CONSIST OF 40MM. THICK RCC (1:2:4) CAST IN PANELS OF MAX. 1200x1200 SIZE AND REINFORCED WITH 0.56 MM. DIA. GALVANIZED CHICKEN WIRE MESH AND SEALING OF JOINTS USING SEALING COMPOUND/ ELASTOMERIC WATER PROOFING MEMBRANE.

NTPC REFERENCE DRGS.

- ELECTRICAL LAYOUT PLAN & SECTIONAL OF 400kv SWITCHYARD
DRG. NO. - 9962-001-TB-572-PVE-F-184
- SWITCHYARD CONTROL BUILDING-LAYOUT & DETAIL OF FOUNDATION & COLUMN
DRG. NO. - 9962-001-TB-572-PVC-C-124
- SWITCHYARD CONTROL BUILDING-FINISHING SCHEDULE
DRG. NO. - 9962-001-TB-572-PVC-C-132
- SWITCHYARD CONTROL BUILDING-DETAIL OF TOILET & PLUMBING
DRG. NO. - 9962-001-TB-572-PVC-C-129
- SWITCHYARD CONTROL BUILDING-CABLE TRENCH LAYOUT & SECTION DETAIL
DRG. NO. - 9962-001-TB-572-PVC-U-499
- SWITCHYARD CONTROL BUILDING-DETAIL OF DOOR & WINDOW
DRG. NO. - 9962-001-TB-572-PVC-C-....

NOTES:

- ALL DIMENSION ARE IN MILLIMETRE & ELEVATIONS ARE METRE.
- RL 126.50M CORRESPONDS TO FFL OF CONTROL BUILDING.
- SIZE OF SWITCHYARD IS RL 126.00M.
- SIZE OF COLUMNS ARE TENTATIVE AND SUBJECT TO CHANE AS PER STRUCTURAL DRAWING.
- DOOR WIDTH ARE CLEAR MASONARY OPENING AND DOOR HEIGHTS ARE FROM FFL TO BOTTOM OF LINTEL.
- ALL DIMENSIONS ARE READ AS UNPLATERED MASONARY & CONCRETE UNLESS NOTED OTHERWISE.
- READ THIS DRAWING IN CONJECTION WITH TECHNICAL SPECIFICATION AND TENDOR DRAWING.

NTPC DRG. NO.: 9962-001-TB-572-PVC-C-121

PROJECT:

1X660MW PANKI THERMAL POWER PROJECT

CUSTOMER:

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

CONSULTANT:



DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI



BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP
NOIDA

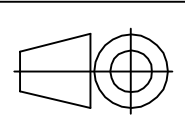
STRUCTURAL CONSULTANTS:-

RDA CIVIL ENGINEERING SYSTEM PVT. LTD.
N-43, SRINIWASPURI NEW DELHI -65
PH. 011 26845128, FAX 011 26313478

NAME	SIGN.	DATE	NO.OF VAR.
TKR	-sd-	06.03.19	
AK	-sd-		N.A.
DKM	-sd-		

DEPT. TBG CODE

UNTOL. GR. DIMS. 9/M/f



SCALE N.T.S

WEIGHT (KG) N.A.

REF. TO ASSY. DRG. N.A.

ITEM NO. N.A.

NO.OF ITEMS N.A.

TITLE
CONTROL ROOM BUILDING LAYOUT FOR 400kv
ARCHITECTURAL TERRACE PLAN

CARD CODE NA

DRG.NO.
TB-3-316-401-061
SHT. No 02

REV.
03

NO. OF SHT. 04

SIZE-A1

TB-3-316-401-061

ON 'DRD

6

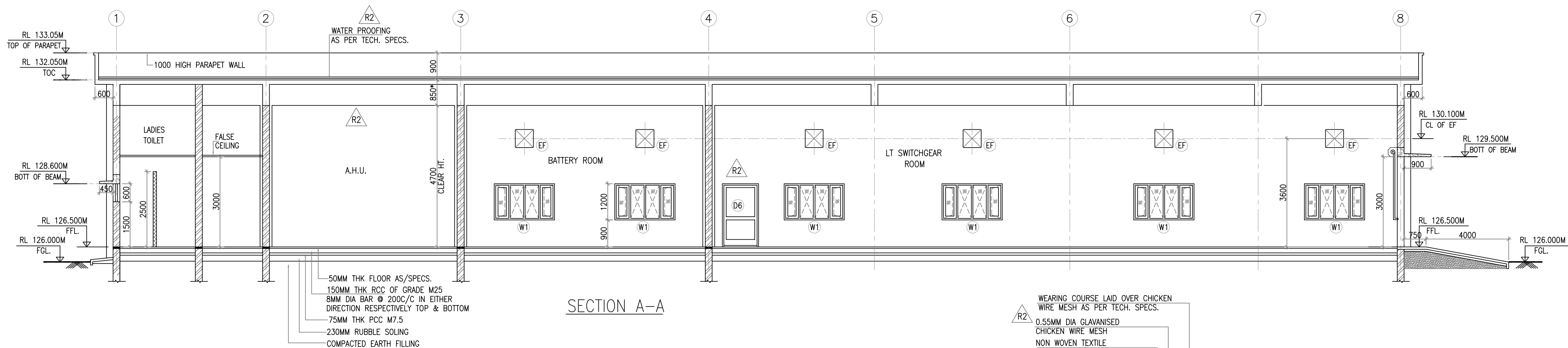
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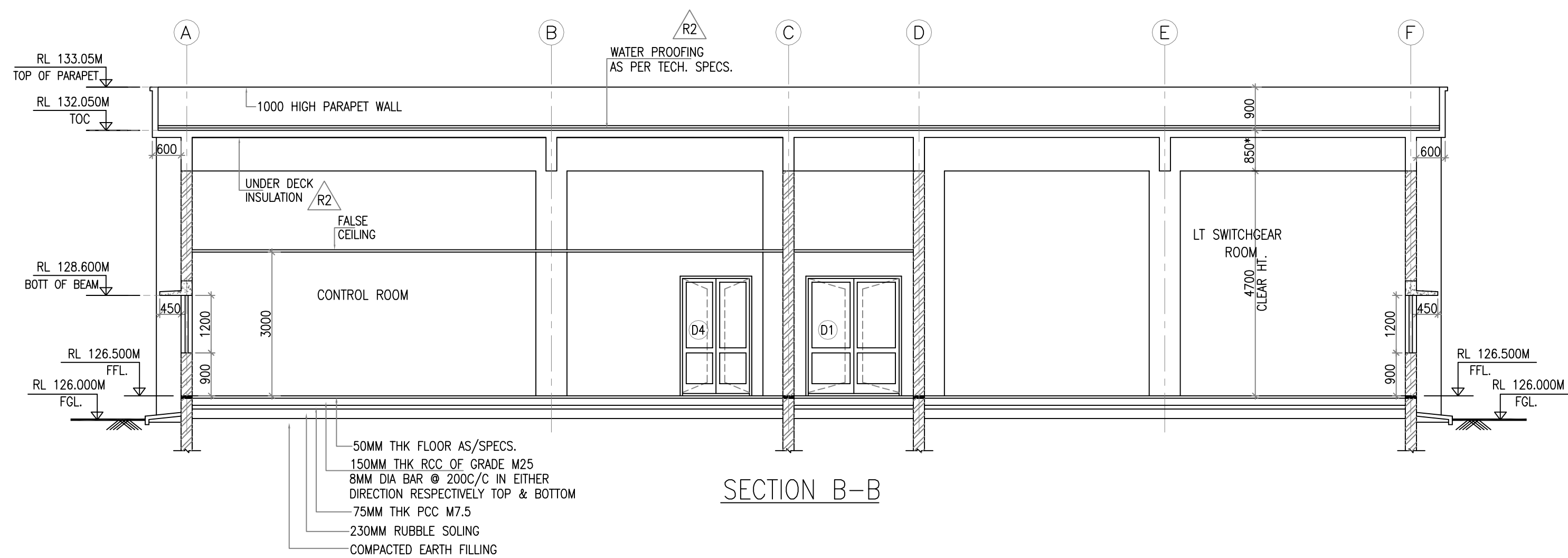
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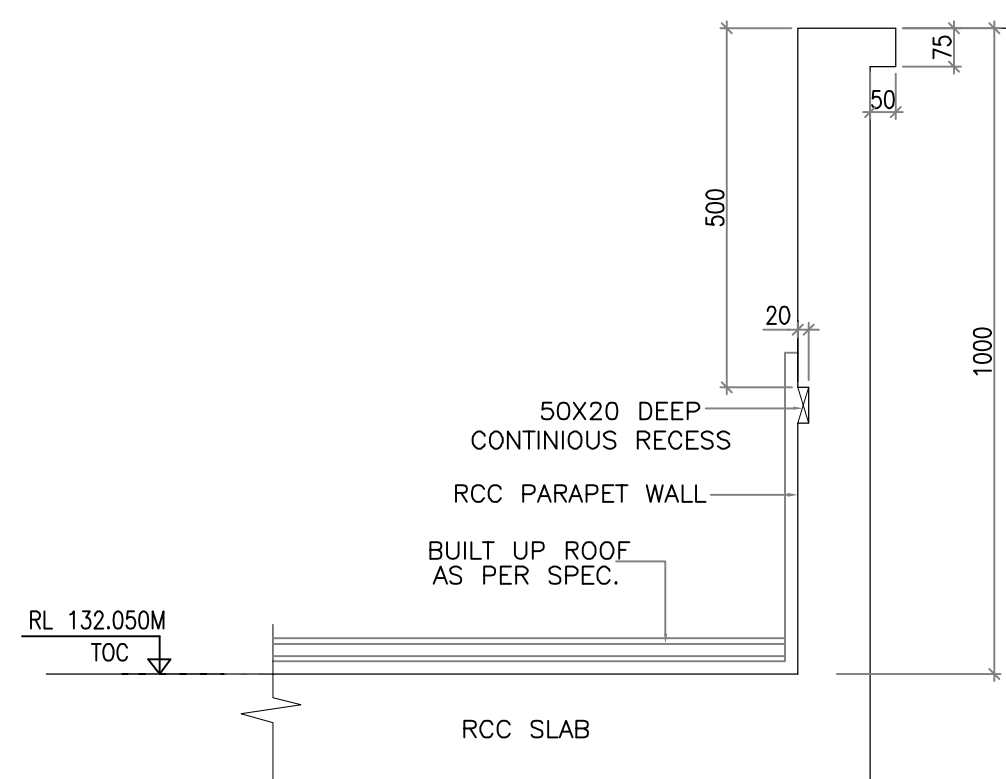
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SECTION A-A



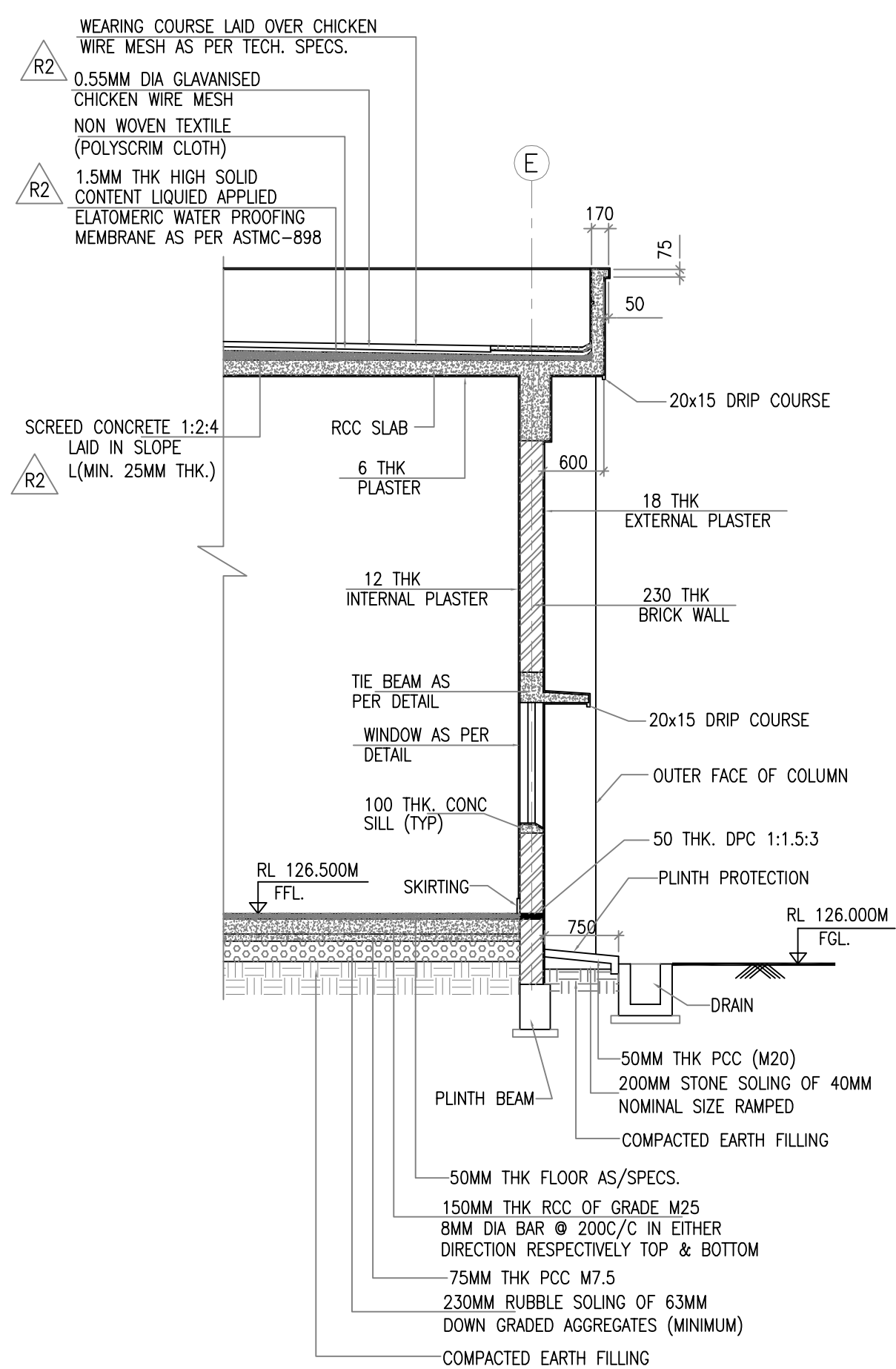
SECTION B-B



TYP. RCC DETAIL OF PARAPET WALL

SCHEDULE OF DOORS & WINDOWS

TYPE	OPENING SIZE	CHL. LEVEL	CHL. LEVEL	NOS.	DESCRIPTION	REMARKS
RS1	3000x3000	-	3000	1	STEEL ROLLING SHUTTER	LT SWITCHGEAR RM
D1	2000x2500	-	2500	3	DOUBLE SHUTTER ALUMINIUM GLAZED DOOR AS PER SPECS.	MAIN ENTRANCE
D2	1500x2500	-	2500	1	DOUBLE SHUTTER FIRE PROOF STEEL FRAME DOOR AS PER SPECS.	LT SWITCHGEAR RM/AHU RM
D3	1500x2500	-	2500	1	DOUBLE SHUTTER STEEL FRAME DOOR AS PER SPECS.	BATTERY RM
D4	1500x2500	-	2500	3	DOUBLE SHUTTER ALUMINIUM GLAZED DOOR AS PER SPECS.	RELAY RM/CONTROL RM
D5	1500x2100	-	2100	2	DOUBLE SHUTTER ALUMINIUM GLAZED DOOR AS PER SPECS.	RELAY RM/CONFERENCE RM
D6	1200x2100	-	2100	7	SINGLE SHUTTER ALUMINIUM GLAZED DOOR AS PER SPECS.	CONTROL RM/FF RM
D7	1500x2100	-	2100	1	DOUBLE SHUTTER STEEL FRAME DOOR AS PER SPECS.	SHIFT RM/STORE/LAB
D8	1200x2100	-	2100	2	SINGLE SHUTTER STEEL FRAME WITH WOODEN FLUSH DOOR AS PER SPECS.	OFFICE-1/OFFICE-2
D9	900x2100	-	2100	3	SINGLE SHUTTER PVC DOOR FRAME AS PER SPECS.	TOILET/PANTRY
D10	750x2100	-	2100	4	SINGLE SHUTTER PVC DOOR FRAME AS PER SPECS.	TOILET/PANTRY
W1	2000x1200	900	2100	8	PARTLY FIXED & PARTLY OPENABLE ALUMINIUM FRAME GLAZED SHUTTER WINDOW AS PER SPECS.	
W1A	2000x1200	900	2100	4	ALUMINIUM FRAME GLAZED SHUTTER FIXED WINDOW (HERMETICALLY SEALED DOUBLE GLAZING)	
W2	900x1200	900	2100	2	PARTLY FIXED & PARTLY OPENABLE ALUMINIUM FRAME GLAZED SHUTTER WINDOW AS PER SPECS.	
V1	600x600	1500	2100	4	PARTLY FIXED & PARTLY OPENABLE ALUMINIUM FRAME GLAZED SHUTTER VENTILATOR AS PER SPECS.	
FG1	4500x1200	900	2100	3	ALUMINIUM FRAME GLAZED SHUTTER FIXED WINDOW (HERMETICALLY SEALED DOUBLE GLAZING)	
FG2	3500x1200	900	2100	1	ALUMINIUM FRAME GLAZED SHUTTER FIXED WINDOW (HERMETICALLY SEALED DOUBLE GLAZING)	
EF	SIZE AS PER VENTL. DWG.	-	-	10	EXHAUST FAN	



SECTION C-C

NOTES:

- ALL DIMENSION ARE IN MILLIMETRE & ELEVATIONS ARE METRE.
- RL 126.50M CORRESPONDS TO FFL OF CONTROL BUILDING. FGL OF SWITCHYARD IS RL 126.00M.
- SIZE OF COLUMNS ARE TENTATIVE AND SUBJECT TO CHANE AS PER STRUCTURAL DRAWING.
- DOOR WIDTH ARE CLEAR MASONARY OPENING AND DOOR HEIGHTS ARE FROM FFL TO BOTTOM OF LINTEL.
- ALL DIMENSIONS ARE READ AS UNPLATERED MASONARY & CONCRETE UNLESS NOTED OTHERWISE.
- READ THIS DRAWING IN CONJECTION WITH TECHNICAL SPECIFICATION AND TENDOR DRAWING.

NTPC REFERENCE DRGS.

- ELECTRICAL LAYOUT PLAN & SECTIONAL OF 400KV SWITCHYARD DRG. NO. - 9962-001-TB-572-PVE-F-184
- SWITCHYARD CONTROL BUILDING-LAYOUT & DETAIL OF FOUNDATION & COLUMN DRG. NO. - 9962-001-TB-572-PVC-C-124
- SWITCHYARD CONTROL BUILDING-FINISHING SCHEDULE DRG. NO. - 9962-001-TB-572-PVC-C-132
- SWITCHYARD CONTROL BUILDING-DETAIL OF TOILET & PLUMBING DRG. NO. - 9962-001-TB-572-PVC-C-129
- SWITCHYARD CONTROL BUILDING-CABLE TRENCH LAYOUT & SECTION DETAIL DRG. NO. - 9962-001-TB-572-PVC-U-499
- SWITCHYARD CONTROL BUILDING-DETAIL OF DOOR & WINDOW DRG. NO. - 9962-001-TB-572-PVC-C-....

NTPC DRG. NO.: 9962-001-TB-572-PVC-C-121

PROJECT:

1X660MW PANKI THERMAL POWER PROJECT

CUSTOMER:

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

CONSULTANT:

DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI



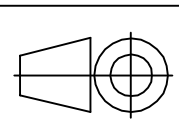
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP
NOIDA

STRUCTURAL CONSULTANTS:-

RDA CIVIL ENGINEERING SYSTEM PVT. LTD.
N-43, SRINIWASPURI NEW DELHI -65
☎PH. 011 26845128, FAX 011 26313478

DEPT.
TBG
CODE

UNTO.
GR.
9/M/9



SCALE
N.T.S

WEIGHT (KG)
N.A.

REF. TO ASSY. DRG.
N.A.

ITEM NO.
N.A.

NO.OF
ITEMS
N.A.

TITLE

CONTROL ROOM BUILDING LAYOUT FOR 400KV
ARCHITECTURAL SECTIONS

DRG.NO.

TB-3-316-401-061

REV.
03

SHT. No 03

NO. OF SHT. 04

SIZE-A1

TB-3-316-401-061

ON 'D'RD

6

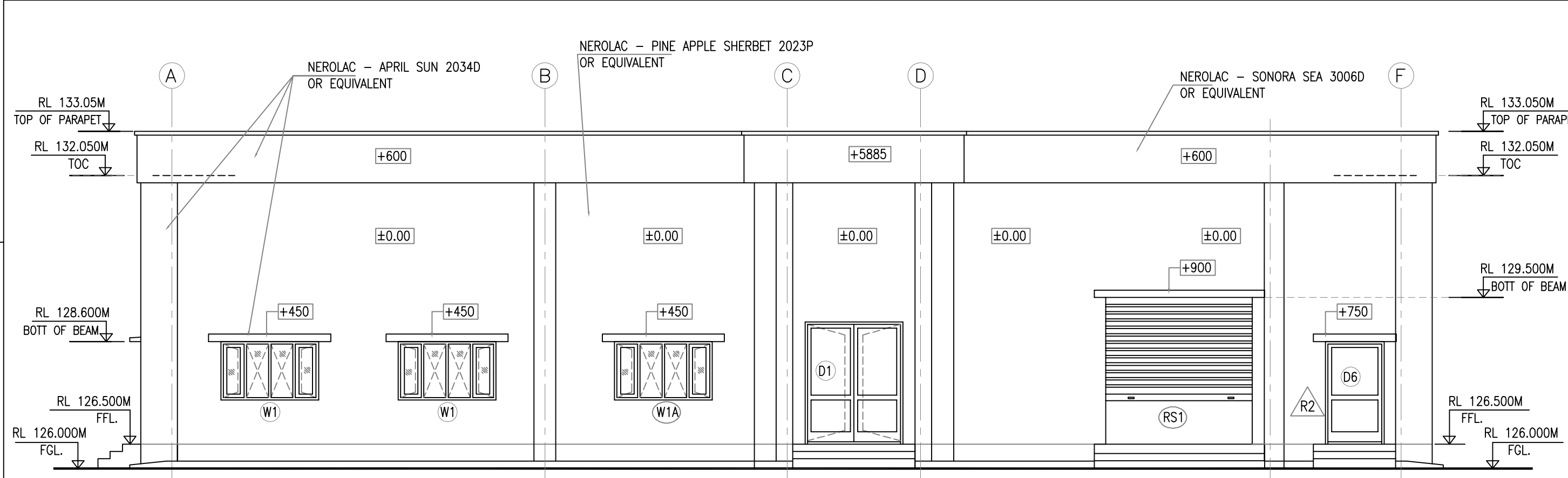
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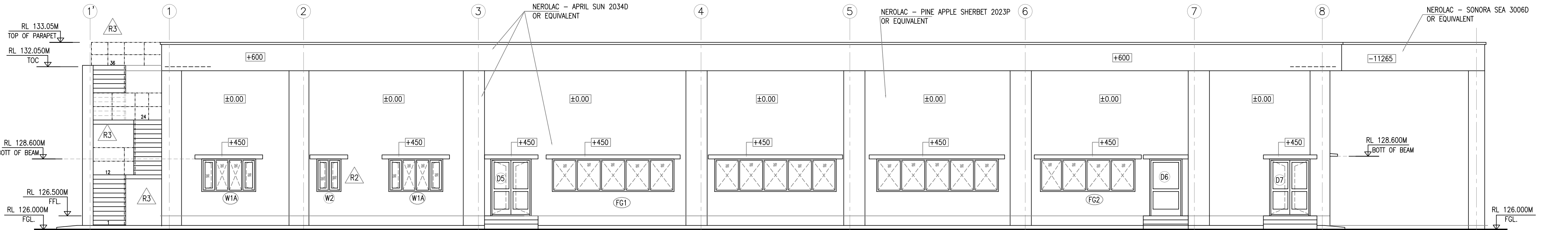
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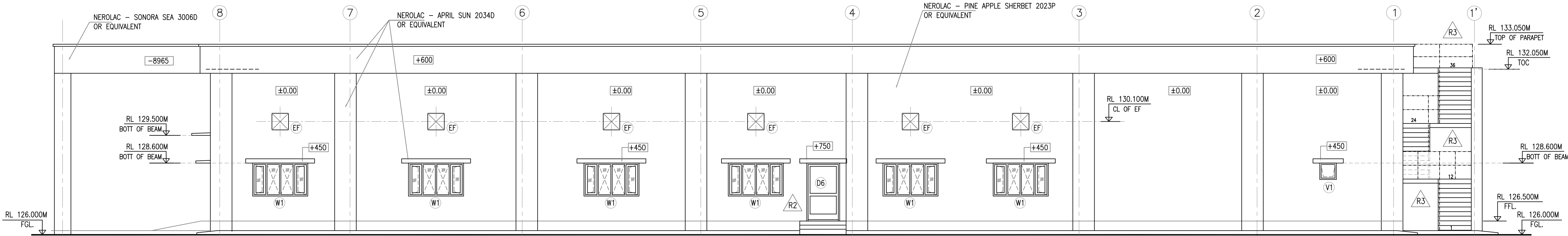
ELEVATION - 4



ELEVATION - 2



ELEVATION - 1



ELEVATION - 3

EXTERNAL FINISH COLOUR SCHEME	
AREA	SHADE
PROJECTED AREA	NEROLAC - APRIL SUN 2034D OR EQUIVALENT
WALL	NEROLAC - PINE APPLE SHERBET 2023P OR EQUIVALENT
PORCH	NEROLAC - SONORA SEA 3006D OR EQUIVALENT

NTPC REFERENCE DRGS.

- ELECTRICAL LAYOUT PLAN & SECTIONAL OF 400kV SWITCHYARD
DRG. NO. - 9962-001-TB-572-PVC-F-184
- SWITCHYARD CONTROL BUILDING-LAYOUT & DETAIL OF FOUNDATION & COLUMN
DRG. NO. - 9962-001-TB-572-PVC-C-124
- SWITCHYARD CONTROL BUILDING-FINISHING SCHEDULE
DRG. NO. - 9962-001-TB-572-PVC-C-132
- SWITCHYARD CONTROL BUILDING-DETAIL OF TOILET & PLUMBING
DRG. NO. - 9962-001-TB-572-PVC-C-129
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DRG. NO. - 9962-001-TB-572-PVC-U-499
- SWITCHYARD CONTROL BUILDING-DETAIL OF DOOR & WINDOW
DRG. NO. - 9962-001-TB-572-PVC-C-....

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NTPC DRG. NO.: 9962-001-TB-572-PVC-C-121

PROJECT:

1X660MW PANKI THERMAL POWER PROJECT

CUSTOMER:

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

CONSULTANT:



DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI



BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP
NOIDA

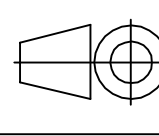
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PH. 011 26845128, FAX 011 26313478

NAME	SIGN.	DATE	NO.OF VAR.
TKR	-sd-	06.03.19	
AK	-sd-		N.A.
DKM	-sd-		

DEPT. TBG CODE

UNTOL. GR. DIMS. 9/M/9



SCALE N.T.S

WEIGHT (KG) N.A.

REF. TO ASSY. DRG. N.A.

ITEM NO. N.A.

TITLE
CONTROL ROOM BUILDING LAYOUT FOR 400kV
ARCHITECTURAL ELEVATIONS

CARD CODE NA

DRG.NO.
TB-3-316-401-061

REV.
03

SHT. No 04 NO. OF SHT. 04

REV.	DATE	ALTERED
		CHD/APPD

ZONE

REV.	DATE	ALTERED	TKR
R3	02-08-19	CHD/APPD	AK

ZONE
REVISED AS PER COMMENTS IN DESIGN DOC.

REV.	DATE	ALTERED	TKR
R2	22-05-19	CHD/APPD	AK

ZONE
REVISED AS PER COMMENTS

REV.	DATE	ALTERED	TKR
R1	30-04-19	CHD/APPD	AK

ZONE
REVISED AS PER COMMENTS



