



BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NOIDA

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	TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	JAIK	SKS	ARUNA
	TITLE Illumination System for GIS Building, Control Room Building & Switchyard	SIGN	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	
		DATE	25/03/19	25/03/19	27/3/19	
		GROUP	TBEM			
		WO No.	84007			
	CUSTOMER	Tamilnadu Generation and Distribution Corporation (TANGEDCO)				
	CONSULTANT	Desein Private Limited, New Delhi				
	PROJECT	400kV GIS at 2x660MW Ennore SEZ Supercritical Thermal Power Project at Ash Dyke of NCTPS				
	NOA Ref.	CE/P/SE/M/P/EE-10/E/P/F.2X660MW ENNORE SEZ STTP/D60/DT 27.02.2014				
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Section 1: Scope, Technical Requirements and Quantities

1.1 SCOPE

- 1.1.1 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 GIS Building, Control Room Building, Ventilation Room, Switchyard & street lighting complete in line with specification. Performance test is in the scope of bidder.
- 1.1.2 This section covers the specific technical requirements of **Illumination System for GIS Building, Control Room Building, Ventilation Room, Switchyard & street lighting**. This constitutes minimum technical parameters for the above system as specified by the customer/TANGEDCO. 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.
- 1.1.3 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.
- 1.1.4 After placement of order, the bidder has to design the system as per relevant standard/codes to the satisfaction of BHEL/TANGEDCO.
- 1.1.5 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/TANGEDCO, 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.
- 1.1.6 The bidder shall have deemed to have understood completely all the tender drawings and documents and quoted accordingly.

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1.1.7 deleted

1.1.8 The specification comprises of following sections,

- Section-1 :** Scope, Project specific technical requirements
Annexure-BOQ: Bill of Quantities
TB-378-316-013: Design Memorandum of Switchyard Illumination System.
- 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.
- Section-4 :** Annexures

In case of any discrepancies between the requirements mentioned under different Sections, order of precedence shall be Section-1, Section-2 & Section-3.

1.1.9 No deviation from the requirements specified in various clauses of this specification shall be allowed. A certificate to this effect shall have to be furnished along with the offer.

1.1.10 The equipment is required for the following project:

Name of the Customer: Tamilnadu Generation and Distribution Corporation (TANGEDCO)

Name of consultant: Desein Private Limited, New Delhi

Name of the Project: 400kV GIS at 2x660MW Ennore SEZ Supercritical Thermal Power Project at Ash Dyke of NCTPS

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

1.2 SPECIFIC TECHNICAL REQUIREMENTS

1.2.1 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,

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(i) Switchyard control room building, GIS building & Ventilation Room.

(ii) Outdoor switchyard area & street light

The illumination system for transformer yard area is not in the scope of bidder, it is under the scope of power plant package illumination contractor.

1.2.2 Refer **DESIGN MEMORANDUM FOR ILLUMINATION SYSTEM** for details.

1.2.3 Reference drawings:

Sl. No.	BHEL Drawing No.	Drawing Title
1.	TB-0-378-607-620-1 TB-0-378-607-620-2 TB-0-378-607-620-3	Architecture drawing for Control Room Building
2.	TB-1-378-607-640-1 TB-1-378-607-640-2 TB-1-378-607-640-2	Architecture drawing for GIS building (including ventilation Room)
3.	TB-378-316-101-02	Layout plan and section drawing of 400kV Switchyard
4.	TB-378-510-008	Indoor Trench Layout for CRB

1.2.1 The steel structures for the switchyard shall be double dip galvanized with zinc coating not less than 910 gm/Sq.m.

1.2.2 Detailed Illumination Design Calculation shall be submitted by bidder for approval of BHEL/TANGEDCO.

1.2.3 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 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.

1.2.4 All fixtures shall be of a proven design for applications in power plant environment. The lamps for external lighting and internal lighting of not completely closed building shall have protection class of IP 55W minimum. Furthermore, for dust prone areas the lamp shall have protection class IP65.

1.2.5 Lighting panel (LP) for controlling lights with additional provision for manual control

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shall be provided:

- o Indoor lighting panel: With Timer
- o Outdoor lighting panel: With Timer & photocell

1.3 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 as per annexure 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 Substation 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.

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- (viii) All associated items, though not specifically mentioned but required for safe and satisfactory operation of equipment/ system shall also be deemed to be included and the same shall be supplied at NO EXTRA COST to BHEL.
- (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 to be 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) The junction boxes shall be provided with two earthing terminals suitable for 8 SWG GI earthing wires.
- (xii) Junction boxes for outdoor shall be FRP weatherproof IPW-66 type.
- (xiii) 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
- (xiv) Lighting panel shall have following ingress

Indoor Lighting Panel	IP-54
Outdoor Lighting Panel	IPW-55, Weatherproof
- (xv) Street light poles shall be swaged and welded steel pole, complete with fixing brackets, weather-proof junction box and all other accessories.
- (xvi) Bidder shall indicate in his offer, make and catalogue nos. of all equipment offered.
- (xvii) 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, lighting fixtures etc. shall be connected to specified GI wire. Supply of GI ground wire shall be included in bidder's scope.

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- (xviii) Supply of all other items such as wires, steel wire, lugs, cable glands, earthing material etc. required to complete the work is in bidder's scope.
- (xix) Cable gland plate in all the panels shall be minimum 3.0 mm.
- (xx) FRP thickness minimum 3.0 mm
- (xxi) The documents shall be in English language and MKS system of units.
- (xxii) Make of all equipment and components shall be as per attached Sub-Vendor List enclosed as per "Annexure-Vendor List".
- (xxiii) 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.
- (xxiv) Single line diagrams of power distribution upto Lighting Panels. Separate drawing for complete lighting distribution shall also be prepared by vendor.
- (xxv) Preparation of **As-Built drawing** and submission of the same in hard copy 5 set & in CD ROM – 2 numbers.
- (xxvi) Conducting of lux level measurement as per approved designs to the satisfaction of owner / purchaser shall be under bidder's scope.
- (xxvii)) 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.

1.4 SPECIAL TECHNICAL REQUIREMENT FOR POLES & HIGH MAST

- (i) The junction boxes shall be provided with two earthing terminals suitable for 8SWG GI earthing wires.
- (ii) JB-S Provided with four (4) way stud type terminals, each terminal suitable for terminating upto two nos. of 3.5Cx25 mm² /3.5Cx50 mm² /3.5Cx95 mm² stranded aluminium conductors & with one no.6A HRC fuse and link.
- (iii) Junction boxes for outdoor shall be FRP weatherproof IPW-66 & those for hazardous location shall be flame proof type.

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- (iv) Junction boxes shall have following indelible markings :
 - 1. Circuit nos. on top
 - 2. Circuit nos. with ferrules (inside) as per drawing
 - 3. DANGER sign in case of 415V circuit
- (v) Street light poles shall be swaged and welded steel pole, complete with fixing brackets, weather-proof junction box and all other accessories.

1.5 EXCLUSIONS / BHEL ISSUED ITEMS FOR ILLUMINATION:

Following items are supplied by BHEL for illumination system. Remaining all items required for successful completion of illumination system is under scope of bidder. Bidder to however submit **estimate and calculation sheet BHEL supplied item** 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) 75x12 & 50x6mm GI flat for earthing works, however GI flat of size less than 50X6 shall be supplied by bidder.
- (vi) 110/50mm GI/ PVC pipe for cabling works
- (vii) 40mm dia MS rod for earthing works

1.6 BILL OF QUANTITIES

Please refer “**Annexure-BOQ**”.

1.7 SYSTEM PARAMETERS FOR ILLUMINATION DESIGN

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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
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 -15%
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		

1.8 LIGHTING PANEL SPECIFICATIONS

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- (i) Lighting panels (LP) shall be Fibre reinforced plastic (FRP) type suitable for either wall/column mounting on brackets.
- (ii) Indoor Lighting Panels shall be dust and vermin-proof, IP-54. Outdoor panels shall be weather-proof with canopy, IPW-55 or better. The cubicle housing transformer shall be minimum IP-42 (If applicable).
- (iii) 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. Lighting 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.
- (iv) Two ground pads with M10 G.I. bolts and nuts shall be provided on each Lighting Panel for connection to G.I. flat.
- (v) 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.
- (vi) 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.
- (vii) 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 are available on the front.
- (viii) Incoming and outgoing circuits shall be terminated in suitable terminal blocks.
- (ix) In lighting and receptacle panel 3-phase and 1-phase MCB should not be mixed.

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- (x) All indicating lamps will be cluster LED type.

1.9 Lighting Panel Equipment

- (i) Each lighting panel (Without ESS) shall have mains ON, output ON Lamps,
- (ii) Bus bar material - Electrolytic grade hard drawn Aluminium
- (iii) Independent gasket hinged door with operating handle shall be provided for access. Operating handle shall have built-in key locking arrangement.
- (iv) Busbars shall be supported on non-hygroscopic and non-inflammable insulators material.
- (v) Panel access door shall be interlocked with incoming switch unit such that the door can be opened only when the switch is in OFF position. Means shall be provided to defeat this interlock.
- (vi) Time switch should be Digital synchronous type with range 0-24 Hours. Coil voltage rating V 240 AC
- (vii) Contactors shall be air-break electromagnetic type. Push buttons shall be push to actuate type.
- (viii) MCB shall be suitable for manual closing and opening and also automatic trip on overload and short circuit.
- (ix) MCCB to have 2 NO & 2 NC aux. contacts
- (x) Time switch in outdoor 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.

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

(xii) Each lighting panel shall be provided with adequate number of outgoing LCBs/MCBs for controlling fixtures. 5A, 3Pin sockets shall be fed from the lighting panel through separate circuits.

(xiii) Terminals

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

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.

(xiv) FRP LPs shall be of Siemens gray (RAL-7032)

(xv) Test for FRP

Flame spread as per ASTM E84
Low flammability as per ASTM E84
Anti-static, less surface resistivity as per ASTM D257
UV resistance as per ASTM D257
Resistance to heat and fire as per IEC 60695-2-12
Glass content test as per ASTM-D 5630
Oxygen Index Tests as per ASTM-D 2863
Flammability Test as per ASTM-D 635

1.10 LED LUMINARIES WITH FITTING

(Integrated/ retrofitted LED lamp to be provided as a part of Luminaire)

FC02(LED) Indoor 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. Fixtures suitable to meet the Utility Area aesthetic requirement, comparable to FC02.

FC06(LED) Indoor 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

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power upto 40W. Fixtures suitable to meet the Switchgear Room aesthetic requirement, comparable to FC06.

FC26(LED)	Flat Panel (1200 mm 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 nominal system output of 3600 $\pm$ 5% lumens with system power upto 40W. Fixtures suitable to meet the Control Room aesthetic requirement, comparable to FC26.
FC30(LED)	Flat Panel 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 nominal system output of 3600 $\pm$ 5% lumens with system power upto 40W. Fixtures suitable to meet the Control Room aesthetic requirement, comparable to FC30.
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. Fixture shall be suitable & comparable to FC81.
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. Fixture shall be suitable & comparable to FC32.
SS62(LED)	Street light with one piece cast aluminium body having an integral driver, protection class IP66. 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 IP66. The luminaire shall have nominal system output of 15000 $\pm$ 5% lumens with system power upto 150W. Fixture shall be suitable & comparable to SS63.
SB03(LED)	Weather proof, dust proof, chain or bracket mounting. Cast Aluminium alloy body, dome type, IP65. system power upto 210W. Fixture shall be suitable & comparable to SB03
SF66(LED)	Flood Light, Weather proof, dust proof, Cast Aluminium alloy body, dome type, protection class IP 66, The luminaire shall

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have nominal system output of 23000 $\pm$ 5% lumens with system power upto 250W. Fixture shall be suitable for flood light requirement & comparable to SF66.

NOTE –

Technical Requirement for LED

1. **Surge Protection for LED Luminaries**
Indoor LED Luminaries - 3kV
Indoor LED Luminaries for GIS Building (High Bay) - 5kV Internal & 10kV external
Outdoor LED Luminaries - 5kV Internal & 10kV external
2. **Ingress Protection Class for LED Luminaries**
Indoor LED Luminaries - IP 20
Indoor LED Luminaries for GIS Building (High Bay) – IP 65
Outdoor LED Luminaries – IP 66
3. **Burning Hours 50,000**
4. **Lumen Maintenance 70% at the End of Burning Hours**
5. **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. All parameters mentioned in Section-II, Clause 5.2.1 are to be complied in totality.

1.11 TECHNICAL QUALIFYING REQUIREMENT

Technical qualifying requirement shall be as per “Annexure-QR” attached.

1.12 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 five (5) years prior to scheduled date of technical bid opening. 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/TANGEDCO 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.

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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.

1.13 QUALITY PLAN

The successful bidder shall submit the QP for BHEL/ TANGEDCO approval. In case bidder has reference QP agreed with TANGEDCO, same can be submitted for specific project after award of contract for BHEL/ TANGEDCO'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.

1.14 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/TANGEDCO 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.

1.15 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.

1.16 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.

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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 _____

2X660 MW ENNORE SEZ				
BILL OF QUANTITY FOR ILLUMINATION SYSTEM			Annexure - BOQ	
Item No.	DESCRIPTION SUPPLY ITEMS	UNIT	QTY.	HSN
				Code
1.0	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 feeding LED / CFL based luminaries			
1.1	AC Normal Lighting Panel (Outdoor Type)	Nos.	3	8537
1.2	AC Normal Lighting Panel (Outdoor Type) - for emergency light	Nos.	1	8537
1.3	AC Normal Lighting Panel (Indoor Type) Decorative	Nos.	4	8537
1.4	Street Lighting Panel (Outdoor Type)	Nos.	2	8537
1.5	Sub Lighting Panel (Outdoor)	Nos.	4	8537
1.6	AC Emergency Lighting Panel (Indoor)	Nos.	2	8537
1.7	DC Emergency Lighting Panel: (Indoor)	Nos.	1	8537
1.8	Welding Distribution Panel (Indoor) without transformer	Nos.	1	8537
2.0	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.			
2.01	Luminaires Type FC02 (LED) with accessories	Nos.	5	9405
2.02	Luminaires Type FC06 (LED) with accessories	Nos.	100	9405
2.03	Luminaires Type FC26 (LED) with accessories	Nos.	20	9405
2.04	Luminaires Type FC30 (LED) with accessories	Nos.	80	9405
2.05	Luminaires Type FC81 (LED) with accessories	Nos.	20	9405
2.06	Luminaires Type FC32 (LED) with accessories	Nos.	20	9405
2.07	Luminaires Type FC07 with 18W CFL with accessories, suitable for 220V DC application	Nos.	30	8539
2.08	Luminaires Type FC33 with 18W CFL with accessories, suitable for 220V DC application	Nos.	15	8539

2X660 MW ENNORE SEZ				
BILL OF QUANTITY FOR ILLUMINATION SYSTEM			Annexure - BOQ	
Item No.	DESCRIPTION SUPPLY ITEMS	UNIT	QTY.	HSN
				Code
2.09	High Bay Luminaires Type SB03 (LED) with accessories	Nos.	34	9405
2.10	Street Light Luminaires Type SS62 (LED) with accessories	Nos.	10	9405
2.11	Street Light Luminaires Type SS63 (LED) with accessories	Nos.	10	9405
2.12	Flood Light Luminaires Type SF66 (LED) with accessories	Nos.	72	9405
2.13	Marine type luminaires 100W lamp with accessories	Nos.	1	8539
3.0	Switchboards consisting of switch boxes, switches, switch plates and fixing accessories on wall			
3.1	Type SWB1 Decorative / Modular	Nos.	5	8536
3.2	Type SWB2 Decorative / Modular	Nos.	10	8536
3.2	Type SWB2a Decorative / Modular	Nos.	10	8536
3.3	Type SWB3 Decorative / Modular	Nos.	20	8536
3.4	Type SWB3a Decorative / Modular	Nos.	20	8536
4.0	Junction boxes - Scope includes supply of anchor fastener / screw as applicable for installation			
4.1	Type JB-F	Nos.	100	8536
4.2	Type JB-FE	Nos.	10	8536
4.3	Telephone junction box suitable for 20 pair. Indoor type	Nos.	1	8536
4.4	Single outlet Telephone socket	Nos.	10	8536
5.0	Receptacles - Scope includes supply of anchor fastener / screw as applicable for installation			
5.1	Type RA	Nos.	75	8536
5.2	Type RA (Flame proof)	Nos.	5	8536
5.3	Type RB	Nos.	65	8536
5.4	Type RC	Nos.	7	8536

2X660 MW ENNORE SEZ				
BILL OF QUANTITY FOR ILLUMINATION SYSTEM			Annexure - BOQ	
Item No.	DESCRIPTION SUPPLY ITEMS	UNIT	QTY.	HSN
				Code
5.6	250A receptacle, 3 Phase, 415V, 4 Pole MCCB, outdoor type. For oil filtration unit	Nos.	1	8536
5.6	32A receptacle set, Single Phase, 32A DP MCB. Indoor type	Nos.	10	8536
6.0	24V supply module & lamp unit complete with all accessories			
6.1	Portable type 24V supply modules with 500VA Transformer	Nos.	1	8537
6.2	Portable 24V halogen lamp unit	Nos.	1	9405
6.3	5A, 24V industrial type sockets	Nos.	1	8536
7.0	INDOOR ITEMS			
7.1	Ceiling fan 1400 mm sweep	Nos.	15	8414
7.2	Wall Fan 400 sweep - industrial type, energy efficient	Nos.	20	8414
7.3	Exhaust fans 300 sweep, industrial type, energy efficient	Nos.	10	8414
7.3	Exhaust fans 600 sweep, industrial type, energy efficient	Nos.	10	8414
7.4	Emergency exit sign board/ lamp - (No. PEL111 E/NM/ equivalent	Nos.	10	8513
7.5	Occupancy Sensor / Motion Detector suitable for LED Lights switching upto 200W.	Nos.	4	9999
8.0	Cu PVC Wires			
8.1	4 Sq mm PVC Wire Red/Yellow/Blue/Black/Grey (ISI marked with valid CML number). Colour coded	m	8,000	8544
8.2	2 Sq mm PVC Wire Red/Yellow/Blue/Black/Grey (ISI marked with valid CML number). Colour coded	m	14,000	8544
8.3	1.5 Sq mm PVC Wire [Green/Red/Yellow/Blue/Black/Grey (ISI marked with valid CML number).	m	6,000	8544
8.4	2 wire telephone cable. (ISI marked).	m	1,000	8544
9.0	CONDUIT ERECTION HARDWARE & ACCESSORIES			
9.1	25mm Conduits, heavy-duty type hot dip galvanized steel conforming to IS-9537.	m	1,000	8307
9.2	20mm Conduits, heavy-duty type hot dip galvanized steel conforming to IS-9537.	m	5,000	8307
9.3	20mm Flexible conduits made with bright, cold rolled annealed and electro galvanized mild steel strips and coated with PVC	m	300	8307
9.4	20mm Conduits, heavy-duty type hot dip galvanized steel conforming to IS-9537 with additional epoxy coating (for use in battery room/ corrosion area). all accessories/ hardware required for epoxy coated conduiting work is deemed included in the scope.	m	200	8307

2X660 MW ENNORE SEZ				
BILL OF QUANTITY FOR ILLUMINATION SYSTEM			Annexure - BOQ	
Item No.	DESCRIPTION SUPPLY ITEMS	UNIT	QTY.	HSN
				Code
9.5	GI Hardware / Accessories for Illumination System - Hot dip galvanized. all the accessories required for successful installation of work i.e. 3 / 4 way JB, 90 degree GI normal / inspection bend, Solid bend, Spacer, Circular boxes (with gasket as applicable), closer, socket, saddle, saddle base, Fan box, mounting hardwares, nut, lock nut, bolt, washer, screw, reducer, U clamp, earth clip/clamp, anchor fastener, etc complete material required for complete installation of Illumination system. Bidder to submit detailed BOM with weight conversion during detailed engineering.	Kg	500	8307
9.6	Hardware / Accessories for Illumination System work, as above but without Hot dip galvanization. (As applicable)	Kg	150	8307
10	CABLE GLANDS (Double compression type) - Supply of Tin/ Nickel, Nickel/chromium - Plated (coating thickness not less than 10 microns) Sunil & Co. / Arup/ Comet / QPIE / or equivalent BHEL approved make brass cable glands as per BS:6121, double compression heavy-duty type complete with necessary armor clamp & tapered washer etc for the following cables. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene and of tested quality. Cable glands shall match with the sizes of different Power / control cables (Armored). Bidder to submit quantity estimation for cable lug along with cable schedule / wiring diagram.			
10.1	Cable Glad suitable for 3CX2.5 sqmm Cu	Nos.	50	8536
10.2	Cable Glad suitable for 5Cx2.5 sqmm Cu	Nos.	50	8536
10.3	Cable Glad suitable for 3Cx16 sqmm Al	Nos.	50	8536
10.4	Cable Glad suitable for 4Cx16 sqmm Al	Nos.	50	8536
10.5	Cable Glad suitable for 3Cx10 sqmm Al	Nos.	50	8536
10.6	Cable Glad suitable for 3.5Cx35 sqmm Al	Nos.	20	8536
10.7	Cable Glad suitable for 3.5Cx70 sqmm Al	Nos.	20	8536
11	CABLE LUG - Cable lugs shall be tinned copper solderless crimping type conforming to IS-8309 & 8394. Aluminum Bimetallic lugs for power cables as shall be supplied depending upon type of cables and terminations. The cable lugs shall suit the type of terminals provided. Bidder to submit quantity estimation for cable lug along with cable schedule / wiring diagram.			
11.1	Cable Lug suitable for 1.5 Sqmm Cu	Nos.	1,000	8536
11.2	Cable Lug suitable for 2.5 Sqmm Cu	Nos.	2,000	8536
11.3	Cable Lug suitable for 4.0 Sqmm Cu	Nos.	1,000	8536
11.4	Cable Lug suitable for 10 sqmm Al	Nos.	200	8536
11.5	Cable Lug suitable for 16 sqmm Al	Nos.	200	8536
11.6	Cable Lug suitable for 35 sqmm Al	Nos.	200	8536
11.7	Cable Lug suitable for 70 sqmm Al	Nos.	100	8536

2X660 MW ENNORE SEZ				
BILL OF QUANTITY FOR ILLUMINATION SYSTEM			Annexure - BOQ	
Item No.	DESCRIPTION SUPPLY ITEMS	UNIT	QTY.	HSN
				Code
12.0	Portable emergency lighting unit-(Prolite cat. No. PEL 210 PNM)/ equivalent. 4 Hour backup. 2X11W CFL/ equivalent LED	Nos.	2	8513
13	POLE & MAST			
13.1	Lighting Pole (Hot dip galvanised) - Type PS1 (11m,410 SP51 as per IS-2713) including street light junction box.	Nos.	10	7308
13.2	LIGHTING MAST (Hot dip galvanised) - 30m high mast with lantern carriage (double drum winch type) including junction box. Suitable mounting of luminaries upto 12 nos. Including Junction Box.	Nos.	3	7308
13.3	LIGHTING MAST (Hot dip galvanised) - 20m high mast with lantern carriage (double drum winch type) including junction box. Suitable mounting of luminaries upto 12 nos. Including Junction Box.	Nos.	3	
14.0	Ladder			
14.1	Free-standing Ladder, height adjustable (from 5m to10m height) aluminum ladder	Nos.	2	7616
14.2	Portable aluminum ladder 3 meter	Nos.	2	7616
15	EARTHING MATERIAL			
15.1	GI Earthing Flat sizes from sizes 25X3 mm to 50X6mm as per technical requirement.	Kg	2,000	8535
15.2	GI wire for Earthing of size 8 SWG to 16 SWG as per technical requirement.	Kg	200	8535
15.3	Copper braided wire for Earthing (if required, size to be derived during engineering)	Kg	50	8535
15.4	Aluminium Flat - Aluminum flat of sizes 20X1.5mm and above as per technical requirement.	Kg	50	8535
16	Any other hardware / accessories if not covered in BOQ but required for sucessful completion of the system.	Lot	1	7308
17.0	O&M Spare -			
17.01	Driver for Luminaire Type FC02 (LED)	Nos.	1	9405
17.02	Driver for Luminaire Type FC06 (LED)	Nos.	4	9405

2X660 MW ENnore SEZ				
BILL OF QUANTITY FOR ILLUMINATION SYSTEM			Annexure - BOQ	
Item No.	DESCRIPTION SUPPLY ITEMS	UNIT	QTY.	HSN
				Code
17.03	Driver for Luminaire Type FC26 (LED)	Nos.	1	9405
17.04	Driver for Luminaire Type FC30 (LED)	Nos.	4	9405
17.05	Driver for Luminaire Type FC81 (LED)	Nos.	1	9405
17.06	Driver for Luminaire Type FC32 (LED)	Nos.	1	9405
17.07	Driver for High Bay Luminaire Type SB03 (LED)	Nos.	2	9405
17.08	Driver for Street Light Luminaire Type SS62 (LED)	Nos.	1	9405
17.09	Driver for Street Light Luminaire Type SS63 (LED)	Nos.	1	9405
17.10	Driver for Flood Light Luminaire Type SF66 (LED)	Nos.	4	9405
18.0	System design of complete lighting system for indoor and outdoor areas of the switchyard. Any other design / drawing / document required for successful completion of the illumination system is in bidder's scope.			
18.1	Lux Level Calculation for indoor & Outdoor area	Lot	1	9954
18.2	Lighting Layout for indoor & Outdoor area	Lot	1	9954
18.3	Conduit Layout for indoor areas	Lot	1	9954
18.4	Cable Schedule, Power Distribution scheme, Control Schemes, any other drawing, document, design required for complete illumination system	Lot	1	9954
18.5	Bill of Quantity (separate for outdoor area & indoor area in room wise) lighting fixtures, lamps, DBs, Panels, conduits, wires, Switches, Socket, Receptacles, cables, Earthing material, JB, Pole, Fan hardwares etc. complete in all respect.	Lot	1	9954
18.6	Supervision of Erection Testing & Commissioning for illumination system on per day basis for the days present at site on certification by BHEL site incharge. Price shall be inclusive of charges for lodging, boarding, medical, insurances etc but excluding the followings (1) To & Fro travel charges shall be reimbursed as actual limited to 2nd AC charges for all visits as per site requirement. (2.) local transportation between Hotel and site shall be arranged by BHEL.	man-day	40	9954
18.7	Lux Level Measurement and demonstration to customer at site including arrangement of necessary test equipment on returnable basis	Lot	1	9954
	NOTES			

2X660 MW ENNORE SEZ				
BILL OF QUANTITY FOR ILLUMINATION SYSTEM			Annexure - BOQ	
Item No.	DESCRIPTION SUPPLY ITEMS	UNIT	QTY.	HSN
				Code
1	Energy saving system is not considered for panels feeding LED / CFL based luminaries			
2	Prices for supply of all applicable illumination erection hardware material shall be included along with above BOQ offer. Any hardware / accessories required for sucessful completion of the system is to be supplied by vendor. Complete list of hardware to be provided by vendor on contract stage.			
3	The above quantities (BOQ) are as per preliminary design only. The detailed design shall be submitted by bidder and subject to approval by Customer. The BOQ quantities which are finalized after approval has to be supplied. BHEL reserves the right for quantity variation due to any reason upto $\pm 30\%$ of total value at same unit rate and terms & conditions during execution of contract . The quantity of individual items may however vary upto any extent.			



1.0 SCOPE:

The purpose of this design philosophy document is to cover basic approach for designing Illumination system for switchyard, control room building, GIS building and outdoor switchyard area under BHEL TBG scope.

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

- (i) Switchyard control room building & GIS building
- (ii) Outdoor switchyard area

The illumination system for transformer and reactor yard area shall be under the scope of power plant package.

2.0 LIGHTING SYSTEM DESIGN:

- 2.1 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 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.

- 2.2 All fixtures shall be of a proven design for applications in power plant environment. All outdoor fixtures shall be weatherproof type.

LED based lighting fixture should have ingress protection class IP-65

All fluorescent fixtures, lamp & ballast shall be of following type:

Fixture [Energy efficient]:	T5 type
Lamp:	28 W
Ballast [main control room]:	Electronic ballast
Ballast [all other area]:	Electronic ballast

- 2.3 **All highbay fixtures will have vibration damper.**

- 2.4 In general, the type of fixtures, type of luminaries and illumination levels to be achieved will be as per enclosed Annexure-I.

- 2.5 The lighting fixtures in the GIS & switchyard area will be group controlled from lighting panel. The lighting fixtures in office areas, control rooms etc. will be controlled by switches.

- 2.6 Lighting panel (LP) for controlling lights with additional provision for manual control shall be provided:

Indoor lighting panel: **With Timer**



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Outdoor lighting panel: **With Timer & photo cell**

2.7 Outdoor area shall have flood light fixtures mounted on flood light poles & lighting mast.

2.8 In all the air filtration units and air handling units, one marine type lamp (of 100W approx.) shall be supplied.

2.9 Lighting transformers shall be dry type, indoor type dust and vermin proof having single phase, 415 V/415 V, off load tap-changer with $\pm 2 \times 2.5\%$ 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.) The casing of the transformer shall be grounded at least at two (2) points. Rating of each transformer shall be decided to limit the fault level within 9kA.

Insulation class of the lighting transformer shall be class F and limited upto class B insulation.

Lighting Transformer shall be 2 x 100% for switchyard

Lighting Transformer shall be provided with winding temperature indicator(having contacts for alarm & trip).Further the enclosure door of the transformer shall have safety switches with 1NO+1NC auxiliary contacts.

2.10 The portable emergency lighting unit shall be complete with storage battery (rechargeable), inverter, automatic charger, twin 9W CFL lamp and test switch. The battery shall have two hours back-up.

3.0 ILLUMINATION DESIGN CALCULATION:

3.1 Lighting design for indoor areas will be done by LUMEN method only .

For a given indoor area, number of luminaires is calculated as follows:

$$\text{Number of luminaires} = \frac{L \times W \times \text{LUX LEVEL (Average)}}{\text{LUMEN} \times \text{COU} \times \text{MF}}$$

where,

L= Length of room (Restricted to Max. 5 times of width)

W= Width of room

LUMEN= Lumen output of each lamp

COU= Coefficient of Utilization

MF= Maintenance Factor



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Coefficient of Utilization (COU) is determined from the COU chart for a particular luminaire of the manufacturer, corresponding to selected reflection factors and calculated Room Index.

The working plane from the floor level considered at : 0.85 meter

The Room Index is calculated by the following formula:

$$\text{Room Index} = \frac{L \times W}{(L + W) \times MH}$$

where, MH = Mounting height of luminaire. Mounting height of the fixture shall not exceed one meter.

Utilization will be considered as given below:

1. Dusty area = 50% ceiling, 30% wall, 10% floor
2. Clear areas such as switchgear room / control room etc. = 70% ceiling, 50% wall, 10% floor.
3. Working plain = a) Ground Level . B) At building floor level.

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

Boiler area	0.55	
Switchgear Room	0.65	
Indoor area non-AC (except fluorescent fixture)	0.6	
Indoor area non-AC (fluorescent fixture)	0.57	\$
\$: (0.65 x 0.87 = 0.57)		

Ambient temperature considered for above correction factor 50 deg C

Correction factor at above ambient temp. in motionless air: 0.87

- 3.2 Lighting design for outdoor area, open area shall be done by computer programme as per standard norms for lighting design to meet the specified lux level.

Average maintenance factor for outdoor and road lighting : 0.6

For outdoor lighting and road lighting ratio of minimum to average illumination will not be less than 0.3 and for minimum to maximum will not be less than 0.05.

4.0 LIGHTING SYSTEM DESCRIPTION

Lighting system will be provided with AC normal, AC emergency and DC emergency as listed against various areas as per Annexure-II enclosed.

The sources of power lighting are as below :

- (i) 415V AC Normal (ACN) Supply from LT AC Board
- (ii) 415V AC Emergency (ACE) Supply from Emergency Board
- (iii) 220V DC Emergency (DCE) Supply from DC Distribution Board
- (iv) 24V AC Supply for maintenance

For switchyard area normally all AC luminaires will be in service on normal AC supply .

Approximately distribution of AC Luminaries on AC normal and AC emergency shall as below:

AC Normal (ACN) supply: 80 %



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AC Emergency (ACE) supply: 20 %

Emergency DC lighting will be provided by emergency DC lighting fixtures located strategically in critical operating area & emergency exits. The number of emergency DC fixture shall be 10% of the number of Normal AC fixture in respective area.

DC fixtures shall be standalone type and normally remain in off position. In the event of failure of normal & emergency AC Lighting supply, emergency DC will be powered on by auto.

For other auxiliary areas AC Normal lighting will provide 100% illumination level and normally all AC lighting fixture shall remain "ON" as long as normal AC supply is available. **In DG room, in addition to DC emergency lighting, 100% AC emergency lighting will be provided.**

4.1 AC Normal Lighting Systems:

AC Normal lighting fixtures are fed through a number of conveniently located AC Lighting panel (ACLP) which are fed from Lighting Distribution Board (LDB).

LDBs consisting of dry type isolation transformer housed in LDB with proper separation from distribution panels as per details indicated below is envisaged:

Transformer rating:	100 kVA
Transformer voltage ratio:	415 / 415 Volt, taps of +5% to -5% in steps of 2.5%.
Transformer type:	Encapsulated
Distribution Panel type:	Single front fixed type
LDB Configuration:	Two incomer & bus coupler
Incomer & Bus coupler type:	4 Pole MCCB
Incomer & Bus coupler rating:	As per lighting transformer rating
Outgoing feeder type:	4 Pole MCCB
Outgoing feeder rating:	63A

AC Normal Lighting Panel (Outdoor Type) as per details given below is envisaged:

Incomer type:	4 Pole MCCB
Incomer rating:	63A
Outgoing feeder type/Rating:	16A, Single pole MCB with neutral link (Minimum 6 numbers) 32A, 4 Pole MCB (Minimum 4 numbers)
Short circuit rating:	10kA
ELCB in Incomer:	Yes
ON/ OFF control	With Timer & photo cell

AC Normal Lighting Panel (Indoor Type) as per details given below is envisaged:

Incomer type:	4 Pole MCCB
Incomer rating:	63A
Outgoing feeder type/Rating:	16A, Single pole MCB with neutral link (Minimum 18 numbers)



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Short circuit rating:	10kA
ELCB in Incomer:	Yes
ON/ OFF control	With Timer
Mount	Wall mount / Free stand (as required) Wall mount panel shall be of slim depth suitable for embedding in the wall and will be flush mounted

Street Lighting Panel (Outdoor Type) as per details given below is envisaged:

Incomer type:	4 Pole MCCB
Incomer rating:	100A
Outgoing feeder type/Rating:	32A, 4 Pole MCB (Minimum 4 numbers)
Short circuit rating:	10kA
ELCB in Incomer:	Yes
ON/ OFF control	With Timer & Photo cell

Sub Lighting Panel (Outdoor) as per details given below is envisaged:

SLP-1 (Outdoor Sublighting panel)	Incomers: 4 pole 32A TPN MCB suitable for 415V AC supply Outgoings: 9 nos. 1 phase feeders. Terminal blocks suitable for cable upto 16 sq. mm cable. Mounting: Suitable for Outdoor applications with Loop in and Loop out facility.
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AC LDB shall be 3Ph, 4Wire, 50Hz effectively grounded System.

AC LDB shall have 20% spare feeders. (O/G feeder mentioned above includes of spare)

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

AC Normal Lighting Panel shall have 20% spare feeders. (O/G feeder mentioned above includes of spare)

Circuit loading of each Lighting panel shall be done in such a way that almost balance loading in all the phases will be achieved.

Minimum two phases will be used for Illumination of a particular area.

4.2 AC Emergency Lighting Systems:

AC Emergency lighting fixtures are fed through AC Emergency Lighting Panel (ACELP) which is fed from AC Emergency Lighting Distribution Board (ELDB).

ELDBs consisting of encapsulated, dry type isolation transformer housed in ELDB with proper separation from distribution panels as per details indicated below is envisaged:

Transformer rating:	50 kVA
Transformer voltage ratio:	415 / 415 Volt, taps of +5% to -5% in steps of 2.5%.

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Transformer type:	Encapsulated
Distribution Panel type:	Single front fixed type
LDB Configuration:	one incomer (Fed from DG backup section of LT AC Board)
Incomer & Bus coupler type:	4 Pole MCCB, 100A
Outgoing feeder type:	4 Pole MCCB, 63A, 5 Numbers
Outgoing feeder rating:	63A

AC Emergency Lighting Panel (Indoor) as per details given below is envisaged:

Incomer type:	4 Pole MCCB
Incomer rating:	63A
Outgoing feeder type:	Single pole MCB (15 Nos) with neutral link
Outgoing feeder rating:	16A
Short circuit rating:	10kA
ELCB in Incomer:	Yes
ON/ OFF control	With Timer
Mount	Wall mount / Free stand (as required)
	Wall mount panel shall be of slim depth suitable for embedding in the wall and will be flush mounted

AC ELDB shall be 3Ph, 4Wire, 50Hz effectively grounded System.

AC ELDB shall have 20% spare feeders (O/G feeder mentioned above includes of spare)

4.3 DC Emergency Lighting Systems: (220V DC)

DC Emergency lighting fixtures fed through suitable numbers of conveniently located DC Emergency Lighting panel (DCELP)

220V DC Emergency Lighting Panel (DCELP) as per details given below is envisaged:

The DC Emergency Lighting Panel will be fed from 220V DC distribution boards. The emergency DC lights will be normally OFF condition when Normal / Emergency AC supply remain healthy. On the occasion of failure of both Normal & Emergency AC supply, Emergency DC supply will be switched on through automatic switching.

Incomer type:	32A DP Contactor backed up by 32A double pole MCCB.
Incomer rating:	32A
Outgoing feeder type:	DP MCB (12 Numbers)
Outgoing feeder rating:	6A
Mounting	The indoor DCP shall be of slim depth suitable for embedding in the wall and will be flush mounted



- 4.4 The LDBs will be provided with voltmeter and ammeter along with selector switch, supply ON indicating lamps etc. All indicating lamps will be cluster LED type. The DOP for LDB will be IP-54 and for transformer cubicle IP-42. Where as the DOP for LP will be IP-54 for indoor and IP-55 with canopy for outdoor. **Indoor lighting distribution boards shall be made of 2mm CRCA sheet steel with epoxy coating. Outdoor Lighting distribution boards shall be made of 2mm galvanized sheet steel. Lighting panels shall be made of FRP.**

4.5 24V AC Supply system:

Each 24V AC supply module will have one no. dry type two winding, 1 phase transformer and necessary terminals for incoming and outgoing connections. The 240V terminals of 24V AC supply module will be fed from AC emergency lighting panels (ACELP). Details of 24V supply modules shall be as given below:

Module type:	Portable type / Fixed type with receptacle distribution panel
Transformer rating:	500 VA
Transformer voltage ratio:	240 / 26.5 Volt
Primary side isolation:	DP MCB with HRC fuse
Isolator rating:	16A
HRC fuse rating:	6A
Secondary side isolation:	DP MCB with HRC fuse
Isolator rating:	16A
HRC fuse rating:	6A

Four number 5A, 24V AC sockets identified with colour coding in order to distinguish them from the normal 240V sockets shall be provided.

Suitable numbers of 24V portable LED hand held lamp unit along with flexible copper cable shall also be supplied as per details below:

Lamp wattage:	30 W
Cable size:	2 Core 2.5 sq. mm PVC
Cable length:	20 meter

4.6 Emergency EXIT lamps:

Emergency exit lamps backed up by battery shall be provided at strategic locations of the building for safe exit of personnel. These exit lamps will remain ON all the time and normally received power supply from ACELP.

Exit lamp unit shall contain maintenance free Ni-Cd battery with 0.5 hours backup capacity.

5.0 STREET LIGHTING / OUTDOOR LIGHTING

- 5.1 The roads within BHEL scope as per contract will be considered for lighting.

- 5.2 Street lights / outdoor lighting will be fed from separate panel located at suitable places. Automatic switching ON/OFF of these circuits shall be done from street light panel.



- 5.3 For street lighting, street light pole will be used. For outdoor area lighting if required flood light pole will be used. Pole type shall be as below:

Pole height: 11 meter

Pole construction type: Fabricated, swaged, steel tubular poles with swan neck arrangement. complete with fixing brackets, weather-proof junction box and all other accessories.

Pole type: hot dip galvanized

The technical details of poles will be as per IS-2713. The poles shall be equipped with junction boxes and all other required accessories.

The poles will be located 1.5 M away from the road edge. The buried cable will run in hume pipe (100 mm dia) wherever it is crossing the roads.

- 5.4 High mast tower will be 30 meter high, hot dip galvanized and polygonal shaped. The location of high mast will be decided during detailed engineering.

6.0 LOW VOLTAGE POWER SERVICES

- 6.1 Different type of receptacles as per details below will be provided:

(i) Decorative receptacle:

At least 02 number 6/16A, 5-Pin, 240V AC decorative type receptacle shall be provided in control, relay and SCADA Room, control and EWS Room, conference room, maintenance cum office room & maintenance communication room, pantry & toilet, passage/ corridor, staircase, landing and exit area

(ii) Industrial receptacle:

At least 02 number 20A, 3-Pin, 240V AC industrial type receptacles will be provided at suitable location in ACDB/ DCDB room & AHU room, Cable vault room & LT transformer room and GIS building. The receptacles shall be provided at interval of 20m or part thereof. All receptacles shall be controlled with a switch.

(iii) Welding receptacle:

63A, 3-phase, 415V AC welding receptacles with isolating switch will be provided at specific points (location will be decided during detailed engineering). Maximum 03 nos. receptacles will be fed through one feeder. receptacle to have LILO provision.

Welding receptacles shall be fed from Welding Distribution Board which in turn fed from main Lighting distribution board (MLDB)

Welding Distribution Panel as per details given below is envisaged:

Incomer type: 4 Pole MCCB

Incomer rating: 100A

Outgoing feeder rating: 63A, 4 Pole MCCB, 5 Nos

32A, DP MCCB, 5 Nos

Short circuit rating: 25kA



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ELCB in Incomer: Yes

Based on room size, suitable nos. of ceiling fans (1200mm sweep) with stepped electronic regulator shall be provided in locations which are not air-conditioned and ventilation system. In the office premises, one fan per 10 sq.metres shall be provided.

For the maintenance of lighting fixtures within GIS Building and outdoor switchyard Area, 1nos. free standing adjustable aluminium ladder adjustable from 5mtr to 10mtr shall be provided.

7.0 WIRING / CONDUITS

7.1 Wiring of lighting system will be done as follows:

- (i) Wiring installation will be done by multi-stranded, PVC insulated, colour coded wires laid in GI conduits of 20 mm dia size (minimum) conforming to IS-9537. The thickness of conduits upto & including 25 mm dia will be 1.6 mm and conduits above 25 mm will be 2.0 mm.
- (ii) Conduits will be heavy-duty type hot dip galvanized steel conforming to IS-9537. Conduit accessories will be hot dip galvanized. In corrosive area, conduits will have suitable epoxy coating additionally.
- (iii) Flexible conduits made with bright, cold rolled annealed and electro galvanized mild steel strips and coated with PVC will be used where required.
- (iv) Conduits in control room, service building, laboratory building and other air-conditioned areas will be surface mounted on the roof above false ceiling, however vertical drops of conduits will be concealed along walls and finally plastered for better aesthetics.
- (v) Filling area of wires in conduit shall not exceed 40% of the conduit area.
- (vi) Wiring for AC Normal, AC Emergency, and DC Emergency services will run in separate conduits.
- (vii) Lighting and receptacles will be fed from separate circuits. No two different phase circuits will be run in the same conduit. However, different circuits of same phase may be laid in the same conduit.
- (viii) Maximum 03 numbers of 1-phase receptacles will be loop in & loop out in a circuit.

7.2 Following sizes of 1100 V grade, PVC insulated, single core, stranded copper conductor wires will be used:

Lighting Panel to Fixtures:	2.5 sq. mm (Cu)
Lighting Panel to JBs/ Switches:	2.5 sq. mm (Cu)
JBs/ switches to Fixtures:	2.5 sq. mm (Cu)
Panel to First receptacles:	4.0 sq. mm (Cu)
First receptacles to looping other receptacles:	4.0 sq. mm (Cu)
In case of only one receptacles in ckt., Panel to receptacles:	4.0 sq. mm (Cu)



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- 7.3 Panel/ JBs to flood light fixtures: 2 x 2.5 sq. mm (Cu)
Wiring in hazardous area, transformer yard will be done using 3C-2.5 sq. mm (Cu), PVC insulated, FRLS PVC sheathed armored cable.

8.0 EARTHING

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

Lighting Distribution Board: GI Flat 50x6 mm

Lighting Panels: GI Flat 35x6 mm

Lighting fixtures, receptacles, conduits,
junction boxes & switch boxes: 8 SWG GI wire

Welding receptacles: GI Flat 50x6 mm

Street light pole/ flood light pole and High
mast: GI Flat 50x6 mm

Electrode for Pole/ High mast Earthing: 2 nos, 40 mm dia MS rod, 3 mtr long

- 9.0 Shop tests on Lighting Distribution Boards / Lighting Panels shall include:

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

10 STATUTORY & REGULATORY REQUIREMENT

Statutory and regulatory regulation shall be applicable as per Indian Electricity Rule, 1956 with amendment-3 Rule no. 35, 48, 49, 50, 61 & 64 for illumination & low voltage power services.



ANNEXURE-I: AVERAGE LUX LEVEL & TYPE OF FIXTURES

Sl. No.	Location/ Area/ Structure	Average Illumination	Type of Luminaire	Type of Luminaries
A.	AC Light Fittings			
1	GIS building	250	Industrial integral high bay	LED lamp fixtures
2	Control, Relay and SCADA room (with false ceiling)	400	Decorative recessed mounted with mirror optic (Dark lighter)	LED lamp fixtures
3	Control and EWS room (with false ceiling)	400	Decorative recessed mounted with mirror optic (Dark lighter)	LED lamp fixtures
4	Conference room, maintenance cum office room & maintenance communication room (with false ceiling)	300	Decorative mirror optics type	LED lamp fixtures
5	ACDB/ DCDB Room & AHU room (Without false ceiling)	200	Industrial type fluorescent lamp with vitreous enamel reflectors	LED lamp fixtures
6	Cable vault room & LT transformer room (without false ceiling)	100	Industrial type fluorescent lamp with vitreous enamel reflectors	LED lamp fixtures
7	Battery room (without false ceiling)	200	Industrial Corrosion Proof	LED lamp fixtures
8	Cable Galleries			
8.1	Cable galleries	100	Industrial tough Type fluorescent	LED lamp fixtures
9	Administration Building			
9.1	Main office areas (air conditioned)	300	Decorative recessed type with mirror optic reflector	LED lamp fixtures

Sl. No.	Location/ Area/ Structure	Average Illumination	Type of Luminaire	Type of Luminaries	
9.2	Main office areas (non A/c)	300	Decorative with wide mirror optic reflector	LED lamp fixtures	
10	General				
10.1	Offices, conference rooms, etc.	300	Decorative mirror optics type	LED lamp fixtures	
10.2	Corridors, Walkways, Staircase, Lockers etc	70	Industrial Type CFL with vitreous enamel reflectors	LED lamp fixtures	
10.3	Toilet Wash room etc	70	Industrial Type CFL with vitreous enamel reflectors	LED lamp fixtures	
10.4	Garage/Car Parking	50	Industrial trough type fluorescent	LED lamp fixtures	
10.5	Facility building, canteen	150	Industrial trough type fluorescent	LED lamp fixtures	
6	Road & Yard Lighting				
6.1	Outdoor Switchyard Yard Lighting	20	Flood light	LED lamp fixtures	
6.2	Switchyard Roads	20	Integral type street lighting luminaire with aluminium reflector	LED lamp fixtures	
B.	DC Light Fittings				
1	Control, relay & SCADA Room (With false ceiling)	50	Recess mounted down lighter	CFL Lamp	
2	Other areas (Without false ceiling)	20	Industrial bulk head	CFL Lamp	
Notes: - Decorative type fixtures shall be provided for false ceiling areas. - The lux levels in the above areas shall be measured (measured at the working plane) using suitable devices/ meters as per relevant standards to prove the specified values. - DC light fitting shall be provided in the following areas. - Control, relay & SCADA room-02nos - Conference room-01nos - Control & EWS room-02nos - Maintenance cum office room-01nos - Maintenance communication room-01nos - ACDB/ DCDB room-01nos - AHU room-01nos - Cable vault room-01nos. - Battery room-01nos - Toilet-01nos - Passage/corridor & landing/exit area-04nos					

	400kV GIS at 2x660MW Ennore SEZ Supercritical Thermal Power Project at Ash Dyke of NCTPS					Document Number: TB-378-316-013	
	Design philosophy of Switchyard Illumination System					Revision:	1
						Date:	19.03.19
ANNEXURE-II: LIGHTING & LOW VOLTAGE POWER SERVICE							
Sl. No.	Location/ Area/ Structure	AC.N	ACE	DCE	5/15A Receptacle	20A Receptacle	63/125A Receptacle
1	Control, relay and SCADA room	Y	Y	Y	Y	-	Y
2	Control & EWS room	Y	Y	Y	Y	-	-
3	Conference room	Y	Y	Y	Y	-	-
4	Maintenance cum office room	Y	Y	Y	Y	-	-
5	Maintenance communication room	Y	Y	Y	Y	-	-
6	ACDB/ DCDB room	Y	Y	Y	-	Y	-
7	AHU room & Ventillation Room	Y	Y	Y	-	Y	-
8	Cable vault room & LT transformer room	Y	Y	Y	-	Y	Y
9	Battery room	Y	Y	Y	-	-	-
10	Pantry	Y	Y	-	Y	-	-
11	Toilet	Y	Y	Y	Y	-	-
12	Passage/ corridor	Y	Y	Y	Y	-	-
13	Staircase	Y	Y	Y	Y	-	-
14	Landing area & exit area	Y	Y	Y	Y	-	-
15	GIS Building	Y	Y	Y	-	Y	Y
16	Outdoor Switchyard Area	Y	Y	Y	-	-	Y
Legends:							
ACN: AC Normal Lighting							
ACE: AC Emergency Lighting							
DCE: DC Emergency Lighting							

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SUB-VENDOR LIST

S. NO.	ITEM	VENDOR
1	24V SUPPLY MODULE WITH COMPLETE ACCESSORIES	POWER PACK ENTERPRISES
	24V SUPPLY MODULE WITH COMPLETE ACCESSORIES	INDCOIL
	24V SUPPLY MODULE WITH COMPLETE ACCESSORIES	Ames Impex Electricals Pvt. Ltd
2	AC CONTACTORS	SIEMENS
	AC CONTACTORS	GE-POWER
	AC CONTACTORS	TELEMECHANIQUE/ SCHNEIDER ELECTRIC INDIA PVT. LTD.
	AC CONTACTORS	L&T
	AC CONTACTORS	BCH
3	AC MCCB	C&S ELECTRIC LTD.
	AC MCCB	SCHNEIDER ELECTRIC INDIA PVT. LTD.
	AC MCCB	SIEMENS
	AC MCCB	GE-POWER
	AC MCCB	L&T
	AC MCCB	CROMPTON GREAVES
4	AMMETER	AUTOMATIC ELECTRIC LTD.
	AMMETER	RISHABH INST.PVT LTD
5	AUXILIARY RELAYS	ABB
	AUXILIARY RELAYS	ALSTOM LTD
	AUXILIARY RELAYS	JYOTI LTD.
	AUXILIARY RELAYS	OEN INDIA LTD
	AUXILIARY RELAYS	SIEMENS
6	CABLE GLANDS	ALLIED TRADERS & EXPORTERS
	CABLE GLANDS	ARUP ENGG & FOUNDRY WORKS
	CABLE GLANDS	BALIGA LIGHTING EQPT PVT LTD
	CABLE GLANDS	COMMET BRASS PRODUCTS
	CABLE GLANDS	DOWELLS
	CABLE GLANDS	ELECTROMAC INDUSTRIES
	CABLE GLANDS	INCAB
7	CABLE LUGS	DOWELLS
	CABLE LUGS	UNIVERSAL MACHINES LTD.
8	CONTROL SWITCHES/ SELECTOR SWITCH	KAYCEE
	CONTROL SWITCHES/ SELECTOR SWITCH	GE-POWER
	CONTROL SWITCHES/ SELECTOR SWITCH	ALSTOM LTD



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	CONTROL SWITCHES/ SELECTOR SWITCH	SCHNEIDER ELECTRIC INDIA PVT. LTD.
	CONTROL SWITCHES/ SELECTOR SWITCH	Shrenik & Co.
	CONTROL SWITCHES/ SELECTOR SWITCH	RECOM PVT. LTD.
9	D.C. MCCB	CROMPTON GREAVES
	D.C. MCCB	L&T
	D.C. MCCB	GE-POWER
	D.C. MCCB	SIEMENS
10	DC CONTACTORS	SCHNEIDER ELECTRIC INDIA PVT. LTD.
	DC CONTACTORS	BHEL (BHOPAL)
	DC CONTACTORS	ELECTROMAC INDUSTRIES
	DC CONTACTORS	L&T
	DC CONTACTORS	SIEMENS
	DC CONTACTORS	TELEMECHANIQUE/ SCHNEIDER ELECTRIC INDIA PVT. LTD.
	DC CONTACTORS	GE-POWER
11	DC SWITCH	GE-POWER
	DC SWITCH	KAYCEE
	DC SWITCH	SIEMENS
12	DICHORIC SPOT LIGHTING FIXTURE	REPUTED MAKE
13	EARTH LEAKAGE CB	L&T
	EARTH LEAKAGE CB	SIEMENS
	EARTH LEAKAGE CB	GE-POWER
	EARTH LEAKAGE CB	SCHNEIDER ELECTRIC INDIA PVT. LTD.
	EARTH LEAKAGE CB	C&S ELECTRIC LTD.
	EARTH LEAKAGE CB	ABB
	EARTH LEAKAGE CB	INDO ASIAN
	EARTH LEAKAGE CB	MDS SWITCHGEAR LTD
14	EMER. PORTABLE LTG. SET	BAJAJ ELECTRICALS
	EMER. PORTABLE LTG. SET	BAJAJ ELECTRICALS
15	EMERGENCY LIGHTING UNIT (FIXED & PORTABLE TYPE)- FLAME PROOF	
	EMERGENCY LIGHTING UNIT (FIXED & PORTABLE TYPE)- NON FLAME PROOF	BAJAJ ELECTRICALS
	EMERGENCY LIGHTING UNIT (FIXED & PORTABLE TYPE)- NON FLAME PROOF	PROLITE AUTOGLO LIMITED,
16	EXIT SIGN (FLAME PROOF)	REPUTED MAKE
	EXIT SIGN (NON FLAME PROOF)	REPUTED MAKE
17	FLEXIBLE CONDUITS (LEAD COATED)	PLICA INDIA PVT. LTD.
	FLEXIBLE CONDUIT (PVC COATED)	REPUTED MAKE



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18	FUSE BASE	INDO ASIAN
	FUSE BASE	GE-POWER
	FUSE BASE	L&T
	FUSE BASE	C&S ELECTRIC LTD.
	FUSE BASE	SIEMENS
	FUSE BASE	ABB
	FUSE BASE	SPACEAGE SWITCHGEARS LTD.
	FUSE BASE	SCHNEIDER ELECTRIC INDIA PVT. LTD.
	FUSE BASE	ALSTOM LTD
	FUSE BASE	ESSEN DEINKI
19	GI CONDUIT (EPOXY PAINTED)	BIS APPROVED MAKE
20	GI CONDUITS	BIS APPROVED MAKE
21	GI WIRE & FLAT	Brahampuri Steels Limited
	GI WIRE & FLAT	INDIA ELECTRICALS SYNDICATE
	GI WIRE & FLAT	INDMARK FORMTECH PVT. LTD.
	GI WIRE & FLAT	PREMIER POWER PRODUCTS (CAL) PVT. LTD.
	GI WIRE & FLAT	Patny Systems (P) Ltd.
	GI WIRE & FLAT	PASSIVE INFRA PROJECTS PVT. LTD.
	GI WIRE & FLAT	RUKMANI ELECTRICAL & COMPONENTS PVT LTD
	GI WIRE & FLAT	RATAN PROJECTS & ENGINEERING CO. PVT.LTD.
	GI WIRE & FLAT	RABI ENGINEERING WORKS PVT. LTD.
	GI WIRE & FLAT	RAJASTHAN METAL SMELTING CO.
	GI WIRE & FLAT	SARAL INDUSTRIES
	GI WIRE & FLAT	PARCO Engineers Pvt. Ltd.
	GI WIRE & FLAT	UNITECH FABRICATORS and ENGINEERS PVT LTD
22	HAND LAMP UNIT	REPUTED MAKE
23	HRC FUSES	INDO ASIAN
	HRC FUSES	GE-POWER
	HRC FUSES	L&T
	HRC FUSES	C&S ELECTRIC LTD.
	HRC FUSES	SIEMENS
	HRC FUSES	ABB
	HRC FUSES	SPACEAGE SWITCHGEARS LTD.
	HRC FUSES	SCHNEIDER ELECTRIC INDIA PVT. LTD.
	HRC FUSES	ALSTOM LTD
	HRC FUSES	ESSEN DEINKI
24	HUME PIPE	REPUTED MAKE
25	IND.POWER & WLDG SOCKETS	CROMPTON GREAVES
	IND.POWER & WLDG SOCKETS	CYCLO ELECTRIC DEVICE & SERV.CO.
	IND.POWER & WLDG SOCKETS	BCH
	IND.POWER & WLDG SOCKETS	BEST & CROMPTON
	IND.POWER & WLDG SOCKETS	AJMERA INDUSTRIES & ENGG. WORKS



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26	INDICATING LAMPS	BCH
	INDICATING LAMPS	C&S ELECTRIC LTD.
	INDICATING LAMPS	ESSEN DEINKI
	INDICATING LAMPS	VAISHNO(HOTLINE SWGR.& CONTROL)
	INDICATING LAMPS	GE-POWER
	INDICATING LAMPS	SIEMENS
	INDICATING LAMPS	SCHNEIDER ELECTRIC INDIA PVT. LTD.
27	JUNCTION BOXES (FLAME PROOF)	SUDHIR SWITCHGEAR
28	JUNCTION BOXES (NON FLAME PROOF)	JASPER ENGNIREES PVT. LTD.
	JUNCTION BOXES (NON FLAME PROOF)	Electro Controls & Devices
	JUNCTION BOXES (NON FLAME PROOF)	Shrenik & Co.
	JUNCTION BOXES (NON FLAME PROOF)	PHOENIX MECANO LTD.,
	JUNCTION BOXES (NON FLAME PROOF)	Adroit Control Engineers Pvt.Ltd.
	JUNCTION BOXES (NON FLAME PROOF)	PHOENIX MECANO LTD.,
	JUNCTION BOXES (NON FLAME PROOF)	MIKA ENGINEERS
	JUNCTION BOXES (NON FLAME PROOF)	PHOENIX MECANO LTD.,
	JUNCTION BOXES (NON FLAME PROOF)	BAJAJ ELECTRICALS
	JUNCTION BOXES (NON FLAME PROOF)	AJMERA INDUSTRIES & ENGG. WORKS
	JUNCTION BOXES (NON FLAME PROOF)	S.B. ELECTRICAL ENGINEERING CORPORATION
29	LADDER	REPUTED MAKE
30	LIGHTING FIXTURES (LED)	HAVELLS INDIA LIMITED
	LIGHTING FIXTURES (LED)	BAJAJ ELECTRICALS
	LIGHTING FIXTURES (LED)	SURYA ROSHNI LIMITED
	LIGHTING FIXTURES (LED)	PHILIPS
	LIGHTING FIXTURES (LED)	HPL ELECTRIC & POWER PVT. LTD
	LIGHTING FIXTURES (LED)	INSTA POWER
31	LIGHTING FIXTURES (NON LED)	BALIGA LIGHTING EQPT PVT LTD
	LIGHTING FIXTURES (NON LED)	ELEXPLO ELECTRICALS PVT/ LTD.
	LIGHTING FIXTURES (NON LED)	BAJAJ ELECTRICALS
	LIGHTING FIXTURES (NON LED)	CROMPTON GREAVES
	LIGHTING FIXTURES (NON LED)	EVERGREEN ENGG. CO.
	LIGHTING FIXTURES (NON LED)	PHILIPS
	LIGHTING FIXTURES (NON LED)	WIPRO LTD.

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	LIGHTING FIXTURES (NON LED)	HPL ELECTRIC & POWER PVT. LTD
	LIGHTING FIXTURES (NON LED)	SURYA ROSHNI LIMITED
	LIGHTING FIXTURES (NON LED)	HAVELLS INDIA LIMITED
32	LIGHTING FIXTURES (FLAME PROOF)	HAVELLS INDIA LIMITED
	LIGHTING FIXTURES (FLAME PROOF)	BAJAJ ELECTRICALS
	LIGHTING FIXTURES (FLAME PROOF)	BALIGA LIGHTING EQPT PVT LTD
33	LIGHTING LAMP (LED)	HAVELLS INDIA LIMITED
	LIGHTING LAMP (LED)	SURYA ROSHNI LIMITED
	LIGHTING LAMP (LED)	BAJAJ ELECTRICALS
	LIGHTING LAMP (LED)	PHILIPS
	LIGHTING LAMP (LED)	HPL ELECTRIC & POWER PVT. LTD
	LIGHTING LAMP (LED)	INSTA POWER
34	LIGHTING LAMP (NON LED)	WIPRO LTD.
	LIGHTING LAMP (NON LED)	ESSEN DEINKI
	LIGHTING LAMP (NON LED)	BAJAJ ELECTRICALS
	LIGHTING LAMP (NON LED)	INSTA POWER
	LIGHTING LAMP (NON LED)	PHILIPS
	LIGHTING LAMP (NON LED)	HAVELLS INDIA LIMITED
	LIGHTING LAMP (NON LED)	HPL
35	LIGHTING SWITCH , SOCKET & S/F UNIT	ELEXPLO ELECTRICALS PVT/ LTD.
	LIGHTING SWITCH , SOCKET & S/F UNIT	ANCHOR
	LIGHTING SWITCH , SOCKET & S/F UNIT	KAYCEE
	LIGHTING SWITCH , SOCKET & S/F UNIT	L&T
	LIGHTING SWITCH , SOCKET & S/F UNIT	SIEMENS
	LIGHTING SWITCH , SOCKET & S/F UNIT	INDO ASIAN
36	LT- CURRENT TRANSFORMER	SIEMENS
	LT- CURRENT TRANSFORMER	AUTOMATIC ELECTRIC LTD.
	LT- CURRENT TRANSFORMER	INDCOIL
	LT- CURRENT TRANSFORMER	KAPPA ELECTRICALS
	LT- CURRENT TRANSFORMER	PRAGATI ELECTRICALS
	LT- CURRENT TRANSFORMER	PRECISE ELECTRICALS
	LT- CURRENT TRANSFORMER	SILKAANS ELECT.MFG.CO.PVT.LTD
	LT- CURRENT TRANSFORMER	PRAYOG ELECTRICALS PVT. LTD.
37	LT- POTENTIAL TRANSFORMER	C&S ELECTRIC LTD.
	LT- POTENTIAL TRANSFORMER	SIEMENS
	LT- POTENTIAL TRANSFORMER	AUTOMATIC ELECTRIC LTD.
	LT- POTENTIAL TRANSFORMER	INDCOIL

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	LT- POTENTIAL TRANSFORMER	KAPPA ELECTRICALS
	LT- POTENTIAL TRANSFORMER	PRAGATI ELECTRICALS
	LT- POTENTIAL TRANSFORMER	PRECISE ELECTRICALS
	LT- POTENTIAL TRANSFORMER	SILKAANS ELECT.MFG.CO.PVT.LTD
	LT- POTENTIAL TRANSFORMER	PRAYOG ELECTRICALS PVT. LTD.
38	MCB	MDS SWITCHGEAR LTD
	MCB	INDO ASIAN
	MCB	SCHNEIDER ELECTRIC INDIA PVT. LTD.
	MCB	S&S POWER SWITCHGEAR LTD,
39	MODULAR SWITCH BOARD	ANCHOR
	MODULAR SWITCH BOARD	ELEXPLO ELECTRICALS PVT/ LTD.
	MODULAR SWITCH BOARD	HAVELLS INDIA LIMITED
	MODULAR SWITCH BOARD	ANCHOR
	MODULAR SWITCH BOARD	ELEXPLO ELECTRICALS PVT/ LTD.
	MODULAR SWITCH BOARD	HAVELLS INDIA LIMITED
40	PEDESTAL FAN & CEILING FAN	REPUTED MAKE
41	PHOTOELECTRIC SWITCH	REPUTED MAKE
42	PVC WIRES	BIS APPROVED MAKE
43	RECEPTACLE (FLAME PROOF)	BALIGA LIGHTING EQPT PVT LTD
	RECEPTACLE (FLAME PROOF)	SUDHIR SWITCHGEAR
	RECEPTACLE (FLAME PROOF)	FCG FLAME PROOF CONTROL GEAR
44	RECEPTACLE (NON FLAME PROOF)	AJMERA INDUSTRIES & ENGG. WORKS
	RECEPTACLE (NON FLAME PROOF)	CROMPTON GREAVES
	RECEPTACLE (NON FLAME PROOF)	CYCLO ELECTRIC DEVICE & SERV.CO.
	RECEPTACLE (NON FLAME PROOF)	BCH
	RECEPTACLE (NON FLAME PROOF)	BEST & CROMPTON
45	RECEPTACLES - DECORATIVE	ANCHOR
	RECEPTACLES - DECORATIVE	ELEXPLO ELECTRICALS PVT/ LTD.
	RECEPTACLES - DECORATIVE	BAJAJ ELECTRICALS
	RECEPTACLES - DECORATIVE	AJMERA INDUSTRIES & ENGG. WORKS
46	SWITCH BOX	ANCHOR
	SWITCH BOX	ELEXPLO ELECTRICALS PVT/ LTD.
	SWITCH BOX	BAJAJ ELECTRICALS
	SWITCH BOX	AJMERA INDUSTRIES & ENGG. WORKS
	SWITCH BOX	S.B. ELECTRICAL ENGINEERING CORPORATION
47	TERMINAL BLOCKS	WAGO-CONTROLS
	TERMINAL BLOCKS	CONNECT WELL
	TERMINAL BLOCKS	ELMEX CONTROLS PVT. LTD.
	TERMINAL BLOCKS	ESSEN DEINKI
	TERMINAL BLOCKS	TECHNOPLAST
	TERMINAL BLOCKS	PHOENIX MECANO LTD.,
48	TIMERS - ELECTRONIC	ESSEN DEINKI

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	TIMERS - PNEUMATIC	BCH
	TIMERS - PNEUMATIC	ALSTOM LTD
	TIMERS - PNEUMATIC	L&T
	TIMERS - PNEUMATIC	TELEMECHANIQUE/ SCHNEIDER ELECTRIC INDIA PVT. LTD.
	TIMERS - PNEUMATIC	SCHNEIDER ELECTRIC INDIA PVT. LTD.
	TIMERS - PNEUMATIC	ELECTRONIC AUTOMATION PVT. LTD.
49	VOLTMETER	AUTOMATIC ELECTRIC LTD.
	VOLTMETER	RISHABH INST.PVT LTD

50	GALVANISING	JENCO INDUSTRIAL CORPORATION
	GALVANISING	NATIONAL GALVANISING COMPANY
	GALVANISING	SIGMA GALVANISING PVT.LTD
	GALVANISING	B.P. PROJECTS PVT LTD
	GALVANISING	STANDARD GALVANISERS
	GALVANISING	STEEL PRODUCTS
	GALVANISING	UNITECH FABRICATORS & ENGINEERS PVT. LTD.
	GALVANISING	M/s Shivam Engineers & Fabricators
	GALVANISING	M/s B.G. Shirke Construction Technology Pvt. Ltd.
	GALVANISING	M/s Galbro Ispat Galvanizers Pvt. Ltd.
	GALVANISING	EROS METELS
34	FRP	REPUTED

NOTE: This list is tentative. Addition/deletion of sub-vendor shall be as per customer approval without price implication.

CHAPTER-19

ILLUMINATION SYSTEM

1.00.00 SCOPE OF WORK

The scope of work shall include complete supply, installation, testing, commissioning and putting into successful commercial operation of the lighting system for the entire plant covering all indoor & outdoor areas including street, area, periphery and yard lighting and of site buildings like ICHS Stage I, Sea water intake plant at NCTPP Stage II etc.

The equipment and materials within the scope of supply shall include but not limited to:

- a) Lighting transformer.
- b) Lighting fixtures with lamps and accessories/LED type fixtures.
- c) 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.
- d) Street lighting poles, flood lighting towers and high masts.
- e) Receptacles, switches, switchboards, portable emergency lighting unit, maintenance equipment etc.
- f) Cables, wires, splicing/termination kits/connection accessories.
- g) Conduit and accessories, junction and pull boxes, terminal blocks.
- h) Grounding materials and connections.
- i) All fittings, supports, brackets, anchors, clamps and connections.
- j) Steel for field fabrication of supports and brackets

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.

Furnishing of all labour, skilled and unskilled, supervisory personnel, erection tools and tackles, testing equipments, implements, supplies, consumables & hardware, and transportation for timely and efficient execution of the contract work.



Preparation of **AS-BUILT** drawings showing field modifications (if any).

2.00.00 CODES AND STANDARDS

2.01.00 The design, manufacture and testing of equipments shall be carried out as per the latest Indian/International Standards, Indian Electricity Rules, Relevant Code of Practices and requirements of Govt. of Tamil Nadu.

2.02.00 Equipment/components conforming to the latest editions of Standards of the International Standard Institutions, Institution of Electrical & Electronic Engineers, USA (IEEE), National Elect. Manufacturers Association, USA (NEMA) or International Electro-Technical Commission (IEC) will also be acceptable provided these are either equivalent or more stringent.

IS-1913	IS-1977	IS-10322	IS-8623	IS-6064
IS-8828	IEC-598	IS-9224	IS-2959	IS-1248
IS-2705	IS-4160	IS-2713	IS-800	IS-2026
IS-2099	IS-694	IS-1554	IS-9537	IS-5133

3.00.00 DESIGN CRITERIA

3.01.00 The Lighting Layout shall be designed to provide uniform illumination with minimum glare. The layout design shall meet all the statutory requirements, etc.

3.02.00 The system provides lighting and electric power supply to all plant areas covering both BTG, BOP, Outdoor areas (also including lighting of all main streets, approach roads to various buildings) and Offsite buildings and areas. In addition, it also provides lighting to selected areas during plant emergency conditions.

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

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

3.05.00 All A.C. Normal and Emergency A.C. lighting shall be provided with Energy Saving System



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

i) Normal A.C. Lighting

- a) 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.
- b) 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 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.

ii) Emergency A.C. Lighting

- a) On failure of normal A.C. Supply, emergency A.C. lighting will be provided in service building, areas of the powerhouse, boiler area, boiler galleries etc for general visibility, safe movements and operation of important auxiliaries.
- b) 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.
- c) At least 20% of the fixtures shall be fed from AC emergency source.

iii) Emergency D.C. Lighting

- a) This will be provided by emergency A.C. /D.C. lighting fixtures located strategically in critical operating areas and emergency exits. About 10% of the fixtures that are fed from normal AC supply and upon its failure, be fed from 220 V DC supply. Emergency DC lighting will be catered by DC emergency lighting distribution (DCELDB) boards. These DCELDBs will feed the DC emergency lighting fixtures directly and through a number of DC emergency lighting panels (DCELP) located suitably in respective areas.



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

1. Emergency Main Lighting Distribution Board (EMLDB)
2. 220V DC distribution boards (DCDB)

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

iv) Remote Emergency Lighting

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

v) 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 coal yard.

vi) Receptacles

To cater to welding and other low voltage power requirement of the plant 63A TPN welding socket fed from MCC/A.C. distribution board of respective areas shall be provided. For other services 15A, 3pin socket shall be provided.

4.00.00 SYSTEM PARTICULARS

System particulars are as follows:

		415V AC System Incoming	415V AC System Outgoing	240V AC System	220VDC System
4.01.00	Nominal Voltage	415V	415 V	240V	220V



4.02.00	Highest system Voltage	457V	457 V	264V	242 V
4.03.00	Number of phases	Three (3)	Three (3)	Single	NA
4.04.00	Frequency	50 Hertz	50 Hertz	50 Hertz	NA
4.05.00	Voltage variation	±10%	±10%	±10%	-15% to +10%
4.06.00	Frequency variation	±5%	±5%	±5%	NA
4.07.00	Combined voltage & frequency variation	10%	10%	10%	NA
4.08.00	Neutral earthing	Effectively	Solidly grounded	Solidly grounded	Un grounded grounded
4.09.00	Fault level	50 kA	9 kA	9 kA	25 kA

5.00.00 METHOD OF CALCULATION

- a) 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.
- b) The coefficient of utilization shall be considered to take care of Lumen loss due to:
1. Effect of room dimensions
 2. Absorption of light in luminaries
 3. Absorption of light at various room surfaces in ceiling, wall etc.
 4. Floor cavity, ceiling cavity
 5. Mounting height
- c) 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 :



<u>Area</u>	<u>Maintenance factor</u>
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

d) Utilization Factor

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

e) Lux levels and types of fittings to be considered for various areas are given in Annexure-1.

f) Voltage drop at the fixture from the LDB bus shall not exceed 3%.

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

h) At least two phases shall be used for illumination of a particular area. All control rooms & power house area like operating floor, Switchgear room, boiler area etc.

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

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

k) The suspension height for suspended fixtures shall not exceed 1 m.



6.00.00 GENERAL REQUIREMENTS

- 6.00.01 Equipment and material shall comply with description, rating, type and size as detailed in this Specification. All equipment and accessories shall be designed for continuous operation under site conditions without exceeding permissible temperature rise as stipulated in relevant standards.
- 6.00.02 Equipment and materials furnished shall be complete and operative in all details.
- 6.00.03 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.
- 6.00.04 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.
- 6.00.05 All equipment and accessories shall have proper enclosure to suit the site conditions. Hazardous areas shall have flame-proof enclosure

6.01.00 Lighting Transformers

- a) Lighting transformers shall be dry type, indoor type dust and vermin proof having single phase, 415 V/433 V, off load tap-changer with $\pm 2 \times 2.5\%$ 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 and receptacle load on that transformer. The casing of the transformer shall be grounded at least at two (2) points. Rating of each transformer shall be decided to limit the fault level within 9kA.
- b) Lighting Transformer shall be 2 x 100% for TG Building , Service building , Water treatment plant, ESP and Fuel oil pump house
- c) If necessary, apart from the main lighting transformers, separate small additional lighting transformers may be used at distance lighting points.

6.02.00 Lighting Fixtures

- a) Lighting fixtures shall be designed for minimum glare. The surface finish shall be smooth, unobtrusive and scratch resistant.
- b) Reflector shall be of sheet steel or aluminium, minimum 20 SWG thick, securely fixed by fastening device of captive type.
- c) Fixture shall be suitable for 20 mm conduit entry and 16 S WG G.I. earth-wire connections. Fixture shall also be suitable for case coupling entry wherever required.
- d) High bay fixtures shall have provision for vibration damper to ensure rated lamp life.
- e) 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.
- f) Fixtures shall be fully wired up to respective terminal blocks, suitable for loop in and loop one connection of PVC wires of following sizes:-
 - 1. Lighting fixture : 2.5 Sq.mm Copper
 - 2. Flood Light fixture : 2x2.5 Sq.mm Copper
- g) The distribution of lighting fixtures/receptacles shall be such that the loading on each phase of the LDB is approx. equal.
- h) In indoor areas fixtures with suitable mounting accessories shall be used and shall not be directly mounted on walls.
- i) Search lights having adequate coverage shall be provided in watch towers

6.03.00**Lamps**

- a) General lighting service (GLS) lamps shall be with clear glass and screwed caps.
- b) All fluorescent lamp shall be bi-pin rotary type and cool daylight.
- c) 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.
- d) CFL and T5 fluorescent tube with electronic ballast or tri phosphorous tube.



- e) Latest energy saving LED type lighting fixture/ lamps
- f) Light Emitting Plasma (LEP)

6.04.00 Ballast

- a) Ballasts shall be heavy duty, low loss, and polyester-filled type with copper winding.
- b) Ballasts shall be free from hum. Ballasts which produce humming sound shall be replaced without any implication.
- c) In multi-lamp fixture, each lamp shall be provided with individual ballast.
- d) Ballast windings shall have maximum operating temperature of 120 Deg.C without rated temperature rise marking.
- e) 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.

6.05.00 Lighting Panel/Distribution Boards

- a) Lighting Distribution Boards/panels shall be Fibre reinforced plastic (FRP) type, suitable for either wall/column mounting on brackets or floor mounting on channel sills.
- b) Indoor Lighting Distribution Boards & Lighting Panels shall be dust and vermin-proof, IP-54. Outdoor panels shall be weather-proof with canopy, IPW-55 or better. The cubicle housing transformer shall be minimum IP-42.
- c) 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.



- d) 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.
- e) Two ground pads with M10 G.I. bolts and nuts shall be provided on each Lighting Distribution Board and Lighting Panel for connection to 25 x 3 mm G.I. flat.
- f) 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.
- g) 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.
- h) 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 are available on the front.
- i) Incoming and outgoing circuits shall be terminated in suitable terminal blocks.
- j) In lighting and receptacle panel 3-phase and 1-phase MCB should not be mixed.

6.06.00**Receptacles**

- a) Receptacles shall be heavy duty, complete with individual plug and switch.
- b) 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.

- c) Shrouded type plug shall be provided with corresponding matching arrangement at sockets to prevent accidental contact with finger during plug insertion.
- d) Receptacles shall be of following types:
 1. Type RA-5A, 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.

In service building and administration building all the occupants shall be provided with 4 nos. of 5A, switches and telephone point in the modular furniture.

2. Type RB-15A, 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 rooms 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, Sub-station, Control Room, Pump House, Transformer Room, various levels of service building, RO plant, 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 4 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 (2 nos. on each floor of crusher house), wagon tippler, stacker



reclaimer machines, pump houses, substation buildings & Cable spreader room, transformer room, boiler platform, switchgear/ MCC rooms, Transformer yard, cooling tower, etc. Separate distribution boards with isolating transformers shall be used to feed these welding receptacles. At least one (1) nos 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.

4. 400A, 415 V, 3 phase, 4 wire receptacles for Transformer filtration unit shall also be provided with MCCB and earthing arrangement.

6.07.00 Fans & Regulators

- a) Ceiling fans shall be provided in non-air conditioned cabins and in various areas inside the administration building canteen, security building etc. The number of such fans shall be decided based on room size.
- b) 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.
- c) Fan motor shall be totally enclosed type with copper winding & class E insulation.
- d) Regulator shall have minimum five steps. Electronic regulator with smooth control is preferred.
- e) Fans and accessories shall be provided for the Local control rooms in addition to the Air Conditioning

6.08.00 Switch & Switch Board

- a) Modular Switches, miniature circuit breakers (MCB), 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.
- b) All switch boards/boxes shall be of bent steel construction, fabricated of 14 SWG M.S. sheet with 6 mm thick Bakelite cover.
- c) 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.



- d) Switch boards / boxes shall have conduit knock outs on the sides. Adequate provision shall be made for ventilation of these boxes.
- e) Flush type receptacles where provided shall be so located that only the plug projects outside.
- f) Switches shall have quick-make and quick-break mechanism operated by a suitable external handle complete with position indicator.
- g) Occupancy switches shall be provided in service building.

6.09.00 Maintenance Equipment

- a) The Contractor shall supply one (1) no. mini truck mounted adjustable hydraulic lift for the maintenance of street lights.
- b) For the maintenance of lighting fixtures within the high bay areas, the contractor shall also supply four (4) nos. free standing adjustable aluminium ladder, adjustable from 5m. To 10m.
- c) Three (3) nos. portable aluminium ladders of various sizes suitable for main control room, switchyard control room, etc

6.10.00 Special Requirement

- a) All outdoor illumination fixtures, unless it is fed from photo cell time switch controlled lighting panel, has to be provided with outdoor type local switches.
- b) 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.

6.11.00 Conduits and Accessories

- a) Conduits shall be rigid steel, hot-dip galvanized, furnished in standard length of 3 metres, threaded at both ends.
- b) 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 19 mm.
- c) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushings at both ends.



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

6.12.00 Junction Box

- a) Junction boxes shall be of 16 SWG sheet steel hot-dip galvanized, dust and damp proof, generally conforming to IP-66.
- b) Junction boxes shall be complete with gasket inspection cover, conduit knock out/threaded hub and terminal blocks.
- c) Junction boxes for outdoor use shall be FRP weatherproof IPW-66 and those for hazardous location shall be flame-proof type.
- d) Junction boxes shall have following indelible markings :
1. Circuit nos. on top
 2. Circuit nos. with ferrules (inside) as per drawing
 3. DANGER sign in case of 415V circuit

6.13.00 Lighting Cables & Wires

6.13.01 All wiring from lighting panels to fixtures and receptacles shall be carried out by PVC wires in G.I. Conduits.

6.13.02 Heavy duty AYWY FRLS cables will be used only for connections:

1. From main lighting distribution boards to area lighting panels
2. From street/area lighting panel to street light poles/towers.
3. From 415V MCCs to receptacles of 63A and above.

6.13.03 Lighting Cable shall be heavy duty, 1100 Volt grade, multi-core stranded aluminium conductor, PVC insulated, extruded PVC inner sheath, single round G.I. wire armoured and overall PVC sheathed conforming to IS 1554.

6.13.04 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.

6.13.05 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.

6.14.00 Terminals

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

6.14.02 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.

7.00.00 ENERGY SAVING SYSTEM Energy saving system is not considered for the panels feeding LED & CFL lamps

7.01.00 Panels

The energy saving system panels shall consist 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.

7.02.00 Lamps

Latest energy saving LED type lighting fixture/ lamps and/or CFL and T5 fluorescent tubes with electronic ballast or tri-phosphorous tubes or Light Emitting Plasma.

7.03.00 Board/Panel Equipment

- a) Each board shall consist of 2 x 100% dry type transformer housed in the different cubicles voltmeter with selector switch, C.T. operated ammeter and incoming triple pole switch. Outgoing feeder from the Lighting Distribution Board shall have MCCB.
- b) Each lighting panel shall have an incoming triple pole switch with neutral link and a number of outgoing miniature circuit breakers (MCB).
- c) Board/Panel access door shall be interlocked with incoming switch unit such that the door can be opened only when the switch is in OFF position. Means shall be provided to defeat this interlock.
- d) Contactors shall be air-break electromagnetic type. Push buttons shall be push to actuate type.
- e) MCB shall be suitable for manual closing and opening and also automatic trip on overload and short circuit.
- f) 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.
- g) Voltmeter / Ammeter shall be of accuracy class 2.0 or better as per IS: 1248 Voltmeter / Ammeter selector switch shall be of reputed make.
- h) Each lighting panel shall be provided with adequate number of outgoing LCBs/MCBs for controlling fixtures. 5A, 3Pin sockets shall be fed from the lighting panel through separate circuits.

8.00.00**LIGHTING POLES/TOWERS**

Suitable number of Flood Lighting Towers / Lighting Masts with adequate metal halide Flood Light or LEP (Light Emitting Plasma) will be provided for crushed coal



pile, and other necessary outdoor areas.

The fixtures shall not be fixed to gantry structures in outdoor areas.

8.01.00 Street Light Poles

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

~~b) 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).~~

8.02.00 Flood Light Tower

a) Flood light towers shall be a lattice structure with maintenance platform and approach ladder. All structural members and hardware shall be hot-dip galvanized.

b) 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.

8.03.00 Lighting High Masts

a) Applicable standards

- | | | |
|---------------------------|---|--|
| 1. IS-875 (Part-III) 1987 | - | Code and practice for design loads for Structures. |
| 2. BSEN 10025/DIN 17100 | - | Grade of M.S. Plates. |
| 3. BS-5135/AWS | - | Welding |
| 4. BS.ISO 1461 | - | Galvanizing |
| a) TR. No. 7200 of ILE | - | UK Specification for Mast and foundation. |

b) 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.

2. 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.

9.00.00 CHIMNEY LIGHTING

9.01.00 Electrical System

415V, normal and emergency AC power supply for chimneys shall be derived from main plant power supply system. Emergency supply shall feed 20% of platform lighting, 50% of staircase lighting, aviation obstruction lighting and elevator load. All other loads shall be connected on normal power supply.

Ambient temperature for design of all equipment shall be considered as 55°C, which is likely to be encountered inside the chimney.

The distribution boards of chimneys shall comprise switch fuse units of appropriate ratings. Emergency board shall have two incomers, one from emergency supply and other from normal AC distribution board itself. Auto changeover scheme shall be provided in emergency board to enable changeover to healthy source on failure of any source.

Dry type isolating transformer of Dyn11 connection shall be provided in emergency board to obtain neutral lead, in case 3 – phase 3-wire, emergency supply is derived from main plant.

9.02.00 Lighting system

Various platforms shall be illuminated by 70/150W metal halide well glass lighting fixtures. Staircase lighting shall be with 70W metal halide well glass fixtures. Average



illuminations level of 150 lux shall be maintained on equipment and 50 lux on platforms/staircases. Lighting system shall be controlled through MCB provided in lighting panel. Six numbers of metal halide flood lights focused towards chimney shall be provided on each external platform for aesthetics view during night times.

Lighting and power panel each shall be located at grade level and at other in between levels as required. All distribution boards, aviation lighting controls, etc. shall be located at grade level only. At each platform, 1 No. 63A, 415V welding receptacle and 1 No. 15 A, 240V receptacle shall be provided and shall be fed from power panel. Wiring installation for lighting fixture shall be of PVC insulated copper/aluminum wires through galvanized steel conduits.

Aviation obstruction lighting system shall conform to the requirements of the latest rules and regulations of the International Civil Aviation Organization (ICAO), National Airports Authority (NAA) and Directorate of Air Routes and Aerodromes (DARA) or any other statutory body and also to conform to IS: 4998. The obstruction lighting shall be done as per Appendix 6 figure 6.2 of ICAO i.e. Combination of Low intensity (Multi LED type- B) & Medium intensity (Multi LED type- B). The life of light fittings shall be 20 years maintenance free. Minimum Low intensity fittings 12 nos. (1/6, 1/2 & 5/6 level) & Medium intensity fittings 12 nos. (1/3, 2/3 & top level) and marking/painting shall be done as per ICAO. A minimum of six levels will be provided with aviation obstruction lights and there will be four lights per level. 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.

One (1) photo controller along with suitable controller arrangement to be supplied by the contractor to switch ON and OFF the aviation warning light automatically based on the intensity of natural light during day/night.

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.



Aviation obstruction lighting shall be complete with lights, photocell, controller, special cables, etc. and IP65 shall be followed for all panels.

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. 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.

10.00.00 Portable Emergency Lighting Unit

The portable emergency lighting unit shall be complete with storage battery (rechargeable), inverter, automatic charger, twin 9W CFL lamp and test switch. Contractor shall furnish make, type and catalogue.

11.00.00 24V AC Maintenance Lighting System

Each 24 V A.C. supply module for maintenance purposes (for hand lamps and for hand operated tools) shall have one(1) no. double wound dry types, 1-phase, 50HZ, 240/24V transformer with 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.

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.

12.00.00 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.



13.00.00 Painting

All sheet steel enclosures shall be chemically cleaned, rinsed, phosphated, rinsed and dried. After the treatment, steel surfaces shall be given undercoats of primer and finished with two coats of sprayed-on enamel or lacquer of approved shade.

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

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

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

14.00.00 Samples

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

15.00.00 SPECIFIC REQUIREMENTS-SERVICES**15.01.00 Consumables and Hardware**

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

15.01.02 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.



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

15.02.00 Erection Tools & Tackles

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

15.03.00 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.

15.04.00 Flood Lighting Tower

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

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

15.05.00 Lighting High Masts (winch operated)

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. Min. 30 Nos. shall be provided, locations shall be decided during detailed engineering.

15.06.00 Wiring

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

15.06.02 Wires shall not be pulled through more than two equivalent 90° bends in a single conduit run.



- 15.06.03 Wiring shall be spliced only at junction boxes with approved type connections or terminal strips. Maximum two wires can be connected to each way of the terminal block. Splicing of only one phase shall be done in a junction box.
- 15.06.04 For lighting fixtures, connections shall be feed off through suitable round conduit or junction box, so that the connection can be attended without taking down the fixture.
- 15.06.05 For vertical run of wires in conduit, wires shall be suitably supported by means of wooden/hard rubber plugs at each pull/ junction box.
- 15.06.06 A.C. and D.C. circuits shall not be run in the same conduit and junction boxes. Circuits fed from different transformers shall be run through different conduits and Junction boxes.
- 15.06.07 Receptacle circuits shall be kept separate and distinct from lighting and fan circuits.
- 15.06.08 Separate neutral wire shall be provided for each circuit. Wiring throughout the installation shall be such that there is no break in the neutral wire in form of switch or fuse.
- 15.06.09 Wires of different phases shall run in separate conduits wires of lighting and power receptacles shall be run in separate conduits and on separate circuits.
- 15.07.00 Cabling**
- 15.07.01 In outdoor areas, main runs from lighting panels shall be by means of cables, directly buried in ground or laid in trenches for the underground portion and through conduit for the above ground portion.
- 15.07.02 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.
- 15.07.03 When buried cables cross road/railway track, additional protection to be provided in form of G.I. pipe.
- 15.08.00 Grounding**



- 15.08.01 All lighting panels, junction boxes, receptacles, fixtures, conduit etc. shall be grounded in compliance with the provision of I.E. Rules.
- 15.08.02 Ground connections shall be made from nearest available ground grid. All connections to ground grid shall be done by arc welding.
- 15.08.03 Panels/Boards shall be directly connected to ground grid by two nos. 35 x 6 mm G.I. flats. (for panels/two nos. 50x6 mm G.I. flats (for distribution boards)).
- 15.08.04 All junction boxes, receptacles, lighting fixtures etc. shall be grounded with 8 SWG G.I. wire.
- 15.08.05 Each street lighting Pole shall be grounded at two points by two nos. 50x6 mm G.I 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 GI wire. One 16 SWG G.I wire shall be taken upto the junction box from lighting fixtures and connected to grounding point.
- 15.08.06 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.I. wire – The flood lighting fixtures shall be grounded by one (1) 16 SWG G.I 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.I. flat down conductor.
- 15.08.07 A continuous ground conductor of 12 SWG G.I. 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.



All junction boxes, receptacles, fixtures etc. shall be connected to this 12 S WG ground conductor.

15.09.00 Foundation & Civil Works

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

15.09.02 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.

15.10.00 Excavation and Back Filling

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

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

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

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

15.11.00 Steel Fabrication

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

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

15.11.03 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

15.12.00 Cleaning up of Work Site



15.12.01 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.

15.12.02 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.

16.00.00 INSPECTION & TESTING

16.01.00 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.

16.02.00 The installation shall be then tested and commissioned in presence of the Engineer and put on trial run for stipulated contract period.

16.03.00 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.

17.00.00 LIST OF TESTS TO BE CONDUCTED

17.01.00 Shop Tests

17.01.01 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.

17.01.02 Tests on Control gear / Lighting Distribution Boards / Lighting Panels shall include:

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

17.01.03 The tests on lighting fixtures shall include:

- a) All routine tests as per relevant I.S.



- b) Rain-proof test for outdoor type luminaries and respective control gearbox as type test.
- c) Temperature rise test on ballast/choke as type test. Dust proof test as type test.

17.02.00 Site Tests

- 17.02.01 Contractor shall thoroughly test and meggar all cables, wires and equipment to prove the same are free from ground and short circuit.
- 17.02.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.
- 17.02.03 All equipment shall be demonstrated to operate in accordance with the requirements of this specification.
- 17.02.04 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.

18.00.00 DRAWINGS, DATA & MANUALS

18.01.00 To be submitted with the Bid

- 18.01.01 Make, type and catalogue number of lighting fixtures, lamps and accessories along with technical leaflets, data sheets, polar curves etc.
- 18.01.02 Typical outline drawings, showing constructional features, cable / conduit entry, fixing arrangements etc. of:
 - a) General Arrangement Drawing of Lighting Transformer.
 - b) ~~Lighting Distribution Board &~~ Panel/receptacles/junction boxes.
 - c) ~~Street light pole.~~
 - d) ~~Flood light towers.~~



- 18.01.03 Technical leaflets and data sheet on each piece of equipment/device such as M.C.B., switch fuse, receptacle etc.
- 18.01.04 Technical Particulars Sheets.
- 18.01.05 Type test certificates on lighting fixtures and lighting panels, transformer, ballast, power cables.
- 18.02.00 To be submitted for Approval and Distribution**
- 18.02.01 Detail dimensional drawings showing constructional features, cable/ conduit entry, grounding, fixing arrangement etc. of :
- a) Lighting Transformer.
 - b) Lighting panels & distribution boards.
 - c) Receptacles & Junction boxes.
 - d) Street light poles & towers.
 - e) Lighting fixture complete with lamps and accessories.
 - f) Non-integral/separate type control gear box for lighting fixtures, as applicable.
- 18.02.02 Data sheets for lighting fixture, lamps, accessories with light distribution curves, coefficient of utilization charts etc. Type and routine test certificates of transformer, cables, lighting fixture, lighting panels, ballast, etc.
- 18.02.03 Control schematic and wiring diagram of 415V AC /220V DC lighting panel with automatic changeover from AC to DC and vice-versa, 415V normal AC Street/area lighting panel with automatic ON/OFF feature.
- 18.02.04 Technical Particulars Sheets and Calculations
- 18.02.05 Technical leaflets and data sheet on each piece of equipment/ device such as MCB, switch, fuse, receptacle etc. Type and routine test certificates of transformer and cables.
- 18.02.06 Lighting layouts showing the disposition of fixtures, lighting panels/boards, circuit distributions, conduit & wire rolling.



- 18.02.07 Key Single Line Diagram for lighting distribution, board-wise single line diagram with feeder loading, cable schedule and interconnection chart, design calculation for lighting.
- 18.02.08 AS-BUILT Lighting layout and erection drawings, properly incorporating the changes/alterations/field modifications, if any, as carried out at field alongwith circuit distribution schemes of all lighting panels, conduit and cable routing and as acceptable to the Owner.
- 18.02.09 Any other relevant drawings, data and manuals necessary for satisfactory installation, operation and maintenance.
- 18.02.10 The Contractor may note that the drawings, data and manuals listed are minimum requirement only. The Contractor shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment offered are submitted with his bid.



ANNEXURE – 1

ILLUMINATION LEVELS (In line with Section-1)

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.

S.No.	Area/Structure	Average Illumination in Lux	Type of Luminaire	Type of lamp
1.0	Turbine Generator Building			
1.1	General Auxiliary Equipment Areas	200	Industrial Well Glass	70W/150W metal halide /125W metal halide Lamp
1.2	Cable Spreader Room	100	Industrial type fluorescent lamp with vitreous enamel reflectors	T5 fluorescent tube with electronic ballast or tri phosphorous tube.
1.3	All Switchgear Room Area	200	Industrial type fluorescent lamp with vitreous enamel reflectors	LED Lamp Fixtures
1.4	TG Building Operating Floor	200	Industrial integral high bay	250W/400W metal halide Lamp
1.5	Main Control Rooms, Computer Rooms	400	Decorative recessed mounted with mirror optic (Dark Lighter)	LED Lamp Fixtures
1.6	Battery Rooms	200	Industrial Corrosion proof luminaire	2 x 40W/36W FTL
1.7	Unloading and Maintenance bay	250	Industrial integral high bay	250 W/400 W HPMV Lamp
1.8	Service Building	300	Industrial type fluorescent lamp with vitreous enamel reflectors/ Industrial integral high bay	2 x 36W FTL/250W metal halide Lamp
2.0	Boiler Area			



2.1	Boiler area and platforms	100	Dust proof/dust tight integral well glass luminaire.	70W metal halide / 125 W metal halide lamp
2.2	Coal Bunker and Mill bay area, feeder floor, trippler floor	150	Dust proof/dust tight integral well glass luminaire	1 x80 W/125 W metal halide Lamp
2.3	ESP areas and Platforms	120	Dust proof/dust tight integral well glass luminaire	70 W metal halide /125 W metal halide Lamp
2.4	ESP Control room	400	Decorative recessed mounted with mirror optic for clean room areas	LED Lamp Fixtures
3.0	Transformer Yard			
3.1	General	50	General purpose flood light	250W/ 400 W metal halide Lamp or LEP
3.2	Near equipment	70	Dust proof/dust light integral well glass	1 x 70 W metal halide Lamp
4.0	Various Off-site building			
4.1	Equipment / Switchgear Room	200	Industrial type fluorescent lamp with vitreous enamel reflectors upto mounting height of 3.5M or industrial medium bay integral luminaire for mounting heights between 3.5 to 8.0 M	LED Lamp Fixtures.
4.2	Pump House	200	Industrial Well glass	70 W metal halide /125 W metal halide Lamp
5.0	Cooling Water Pump House area.			
5.1	Cooling tower area.	50	Industrial well glass.	70W metal halide /125W metal



				halide lamp.
5.2	CWPH	200	Industrial medium bay integral luminaire for mounting heights between 3.5 to 8M.	70/150W metal halide or 150/250W metal halide lamp.
6.0	DM Plant area.			
6.1	Control room.	300	Decorative recessed mounted with mirror optic for clean room areas.	LED Lamp Fixtures.
6.2	Pump House.	200	Industrial well glass.	70W metal halide /125W metal halide lamp.
7.0	Chemical House.			
7.1	Control room.	300	Decorative recessed mounted with mirror optic for clean room areas.	LED Lamp Fixtures.
7.2	Equipment rooms and Pump rooms.	150	Industrial Corrosion proof luminaire.	2x40W /36 FTL.
8.0	Ash Handling System.			
8.1	AH Pump Houses.	200	Industrial well glass.	70W metal halide /125W metal halide lamp.
8.2	Control room.	300	Decorative recessed mounted with mirror optic for clean room areas.	LED Lamp Fixtures
9.0	Coal Handling Plant			
9.1	Conveyors open/enclosed	70/100	Dust proof / dust tight integral well glass luminaire	1 x 80 W / 125 W metal halide Lamp
9.2	Crusher house, Junction towers	100	Dust proof / dust tight integral well glass luminaire	1 x 80 W/125 W metal halide Lamp
9.3	Coal Stock yard	50	Non-integral flood light	250 W/400 W metal halide Lamp



9.4	SWGR Room	200	Industrial type fluorescent lamp with vitreous enamel reflectors	LED Lamp Fixtures
9.5	Control Room	300	Decorative recessed mounted with mirror optic for clean room areas	LED Lamp Fixtures
9.6	Underground conveyor	100	Flame proof and dust proof well glass	1 x 80 W/125 W metal halide Lamp.
9.7	Pipe Conveyor (ECHS)	70	Dust proof / dust tight integral well glass luminaire	1 x 80 W metal halide Lamp
10.0	Fuel Oil Tank Area			
10.1	Tank Area	50	Non-integral flood light	LEP or 250 W/400 W metal halide Lamp.
10.2	Fuel oil area pump house	100	Flame proof well glass	1 x 80 W/125 W metal halide Lamp.
11.0	Road & Yard Lighting			
11.1	Main Roads	25	Integral type street lighting luminaire with aluminium reflector	LED Lamp Fixtures.
11.2	Secondary roads	15	-do-	LED Lamp Fixtures
11.3	Perimeter (compound lighting)	15	-do-	LED Lamp Fixtures
11.4	Yard Lighting	20	Flood light	LEP or 250 W metal halide
12.0	Diesel Generator			
12.1	DG Room	150	Industrial trough type	1 x 80 W/125 W metal halide Lamp
12.2	Compressor Room	150	-do-	-do-
13.0	Stores			
13.1	Cement stores	100	Industrial trough type fluorescent dust proof	1 x 80 W/125 W metal halide Lamp



13.2	Chemical stores	150	Corrosion proof	
13.3	Permanent stores	150	Industrial trough type/ metal halide	1 x 80 W/125 W HPMV Lamp
14.0	Hydrogen Plant			
14.1	Hydrogen Plant Building	150	Explosion proof metal halide / Fluorescent fittings suitable for class-I and Division –II	1 x 80 W/125 W metal halide Lamp
15.0	Laboratory			
15.1	Electrical Laboratory	250	Mirror optics fluorescent	LED Lamp Fixtures
15.2	Chemical laboratory	300	Corrosion resistant, fluorescent	CFL
16.0	Cable Galleries			
16.1	Cable galleries	100	Industrial trough type fluorescent	
17.0	General			
17.1	Offices, conference rooms, etc.	300	Decorative mirror optics type	LED Lamp Fixtures
17.2	Corridors, Walkways, Staircase, Lockers etc.	70	Industrial Type CFL with vitreous enamel reflectors	LED Lamp Fixtures
17.3	Toilet Wash room etc.	70	Industrial Type CFL with vitreous enamel reflectors	LED Lamp Fixtures
17.4	Garage/Car Parking	50	Industrial trough type fluorescent	LED Lamp Fixtures
17.5	Facility building, canteen	150	Industrial trough type fluorescent	LED Lamp Fixtures



18.0	Administration Building			
18.1	Main office areas (air conditioned)	300	Decorative recessed type with mirror optic reflector	LED Lamp Fixtures
18.2	Main office areas (non A/c)	300	Decorative with wide mirror optic reflector	LED Lamp Fixtures
19.0	DC Lights Fittings			
19.1	Control Room (with false ceiling)	50	Recess mounted Down lighter	1 x 100 W GLS lamp
19.2	Other areas (without false ceiling)	20	Industrial bulk head	1 x 100 W GLS Lamp.

Note:

1. The lux level and type of fitting for any area not specified shall be finalized during detailed engineering without any price implication.
2. N/E AC lighting and DC lighting shall be identified with suitable colour code.

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.

ANNEXURE B: 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 covers 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.



CHAPTER – 17

CABLING SYSTEM

1.00.00 SCOPE OF SUPPLY

1.01.00 The scope of work shall include complete supply, installation, testing, commissioning and putting into successful commercial operation of the cabling system for the entire plant covering all indoor & outdoor areas and offsite buildings like ICHS Stage I, Sea water intake plant, etc.

1.02.00 The equipments and materials within the scope of supply shall include but not limited to

- i. Power & control cabling works (including that of special cables):
Supply and installation of cable and cable trays/raceways, supports, conduits, duct bank, cable accessories such as jointing/termination kits, cable glands, lugs, ferrules, etc. as required for all the systems & equipments.
- ii. Supply and installation (including laying & termination) of control cables, special cables, instrumentation cables for all equipments and systems.
- iii. Supply and installation (including laying & termination) of all power cables (HV and LV) of all power cables (HV and LV) for all equipments and systems.
- iv. Cable routing has to be planned such that it shall not cross the steam lines, oil lines.
- v. Fire Sealing Arrangement: All cable entries into the panel (HV & MV & LV SWGR panels) should be provided with fire sealing arrangements.
- vi. Cable/cable tray openings in walls and floors or through pipe sleeves from one area to another or from one elevation to another within the unit shall be sealed by a fire proof sealing system (FPSS). The FPSS shall effectively prevent the spread of fire from the flaming to non-flaming side of a fire



2.00.00

CODES AND STANDARDS

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. 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 as applicable.

IS:513	Cold rolled low carbon steel sheets and strips.
IS:1079	Hot Rolled carbon steel sheet & strips
IS:1239	Mild steel tubes, tubular and other wrought steel fittings
IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating
IS:1367 Part-13	Technical supply conditions for threaded Steel fasteners. (Hot dip galvanized coatings on threaded fasteners).
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:9537	Conduits for electrical installation.
IS:9595	Metal – arc welding of carbon and carbon manganese steels - recommendations.
IS:13573	Joints and terminations for polymeric cables for working voltages from 3.3kv up to and including 33kv performance requirements and type tests.
BS:476	Fire tests on building materials and structures
DIN 46267 (Part-II)	Non tension proof compression joints for Aluminium conductors.
DIN 46329	Cable lugs for compression connections, ring type ,for Aluminium conductors
VDE 0278	Tests on cable terminations and straight through joints
BS:6121	Specification for mechanical Cable glands for elastomers and plastic insulated cables.
	Indian Electricity Act.
	Indian Electricity Rules.



2.01.00 Equipment complying with other internationally accepted standards such as IEC, BS, DIN, 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 Contractor shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

3.00.00 DESIGN AND CONSTRUCTIONAL FEATURES

3.01.01 Inter Plant Cabling

Interplant cabling for main routes shall be laid along overhead trestles/duct banks. However, from tap-offs, same can be through shallow trenches. All the switchgear room shall be provided with cable spreader room at ground floor. The cable trenches are allowed between switchyard control room and transformer yard only.

3.02.00 Transformer yard

In transformer yard cables shall be laid in RCC concrete trenches with RCC covers. The main cable routes coming out from Main plant building and crossing the Transformer yard shall be laid in overhead trestles/duct banks. Minimum clear height of trestle shall be 3 m and for Rail/road crossing, it shall be as per rail/road crossing norms.

False floors are not to be provided for cabling purpose.

3.03.00 Cable entry

Cable entry from outdoor underground/cable routes to the buildings, if any, shall be above the finished floor level of the building.

3.04.00 All Buildings shall have suitable cable spreader rooms /cable vaults.

3.05.00 Trenches

3.05.01 PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

3.05.02 No sub zero level cable vault/trenches shall be provided below control building/switchgear rooms in main plant areas.

3.05.03 All field switches for equipments corresponding to a stream located within a radius of 4-5 m shall be wired out to a field junction box and from field junction box to control panel/Input – Output cabinet by screened instrumentation cables.



- 3.05.04 For CHP following shall also be applicable.
- a) All cable routes shall be overhead along the route of the conveyor gallery by separate supporting structures and cables shall be laid in vertical trays. The bottom of the steel shall be such that the existing facilities, movement of trucks/human beings etc. does not get affected. The cable trestle shall have a minimum 600 mm clear walk way and shall have maintenance platforms as required. The bottom of the steel supporting structure shall be generally at 3.0 M above the grade level except for rail/road crossings where it shall be at 8.0 M above grade level. However in bunker area the bottom of the cable trestle shall be 10 to 14 M depending on boiler/bunker layout.
 - b) Cables shall not be routed through the conveyor galleries except for the equipment located in the conveyor galleries for a particular conveyor i.e. protection switches receptacles etc.
 - c) Cables for Pull cord switches and belt sway switches shall be taken in cable trays. The trailing cables of the mobile machines shall also be laid in cable trays.
- 3.05.05 Cable trench shall be allowed only between switchyard control room and 'A' row column of TG building.
- 4.00.00 EQUIPMENT DESCRIPTION**
- 4.01.00 Cable trays, Fittings & Accessories**
- 4.01.01 Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.), accessories (like side coupler plates, etc.) and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.
- 4.01.02 These shall be either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron trays free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized as per relevant IS.
- 4.01.03 Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Minimum thickness of mild steel sheets used for fabrication of



- | | |
|---------|---|
| 4.02.00 | Support System for Cable Trays |
| 4.02.01 | Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make". |
| 4.02.02 | Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types: (i) C1:- having provision of supporting cable trays on one side and (ii) C2:- having provision of supporting cable trays on both sides. The support system shall be the type described hereunder |



- a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardware such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.
- b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardware's fittings and accessories shall be prefabricated factory galvanised.
- c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvanized surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied.
- d. All steel components, accessories, fittings and hardware shall be hot dip galvanized after completing welding, cutting, drilling and other machining operation.
- e. The main support channel and cantilever arms shall be fabricated out of minimum 2.5 thick rolled steel sheets conforming to IS.
- f. Cantilever arms of 300 mm, 600 mm and 750 mm in length are required. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.
- g. Cable trays in areas subjected to excessive coal dust or mechanical damage shall have hot dip galvanized sheet steel metal trays cover installed on front tray in vertical run and inverted 'V' type on upper tray in horizontal run with consideration for ventilation.
- h. FRP Cable trays shall be used for areas like intake raw water pump house, Desalination plant, CHP, Battery room, NDCT and chemical house.

4.02.03

The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above are indicative only. Nevertheless, the support system shall be designed by the contractor to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Contractor without any



additional cost. The contractor shall submit the detailed drawings of the system offered by him along with the bid.

4.03.00 Pipes, Fittings & Accessories

4.03.01 Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

4.03.02 GI Pipes shall be of medium duty as per IS: 1239

4.03.03 Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

4.04.00 Junction Boxes

4.04.01 Junction Boxes shall comprise of a case with hinged door constructed from cold rolled sheet steel of minimum thickness 2mm. Top of the boxes shall be arranged to slope towards rear of the box. Gland plate shall be 3 mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanised as per relevant IS, and suitable for mounting on wall, columns, structures etc. The boxes shall include brackets, bolts, nuts, screws M8 earthing stud etc. required for installation.

4.04.02 Glass Fibre Reinforced Junction Boxes

No. of Ways: 12/24/36/48 with 20% spares terminals.

4.04.03 Junction boxes shall be Glass Fibre Reinforced with saturated polyester conforming to standards like DIN 16911 type 803/16913 type 834, 5 self extinguishing in accordance with ASTM D635/UL 94 VO.

Junction boxes for use in outdoor or damp locations shall be sturdy construction. Temperature resistance shall be between – 10 to 100°C. Impact resistance shall be greater than 7 Nm, (EN 50014). Protective insulation shall be in line with VDE 0100, dielectric strength shall be greater than 10 KV/mm, halogen free toxicity, the enclosure and door cover shall be painted and electro statically power coated (preferably in RAL 7032). Earth connection (studs size shall be M 6) shall be provided on the cover as well as door.



- 4.04.04 Doors
With integrated viewing window of 3mm resistant plexi glass or equivalent. The doors shall be industrial heavy duty hinges. The doors shall be easily but firmly lockable with quick release fastener.
- 4.04.05 Protection Class

Protection Category shall be IP 66 to EN 60529. There shall be guaranteed perfect seal to meet Protection class IP 66 providing arrangement like highly elastic foamed in special type seal like polyurethane/chloroprene. The sealing rubber shall not have aging effect and shall retain its sealing characteristics for more than 20 years. Contractor shall indicate this in data sheet. The rubber seal should be pasted at its place with pasting technology for like more than 20 years (double sealing arrangement is preferred).
- 4.04.06 Mounting clamps and accessories

Junction boxes shall be suitable for mounting on walls, columns and structure. Brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass. The accessories like mounting plates etc. of steel shall be powder coated. The support rails for terminal box shall be zinc coated.
- 4.04.07 General

 1. JBs shall have small canopy at the top.
 2. There shall be rainwater collection arrangement from top and side of the outer ages to ensure that any leakage into the junction box shall be avoided and it shall fall outside.
 3. Cable entry shall be from bottom side only.
 4. Ensure gland plate sealing perfect. It shall be of the same quality and arrangement as that of door to cover arrangement.
- 4.04.08 Steel Junction Boxes
- 4.04.09 No. of Ways

12/24/36/48 with 20% spares terminals.



4.04.10 Junction boxes shall be designed in accordance with NEC, article 370, paragraph 18, 19 & 20 or equivalent standards.

4.04.11 Enclosure

Junction boxes for use in outdoor or damp locations shall be sturdy steel construction. The enclosure and door cover shall be surface finished clean, degreased, phosphated, deep coated primed (preferably in RAL 7044) and electro-statically powder coated (preferably in RAL 7032). Earth connection (studs size shall be M6) shall be provided on the cover as well as door. The sheath steel thickness shall be more than 2 mm.

4.04.12 Doors

The doors shall be hinged and lockable. The doors shall have industrial heavy duty hinges. The doors shall be easily but firmly lockable with quick release fastener.

4.04.13 Protection Class

Protection Category shall be IP 66 to EN60529/1091 complies with NEMA 4. There shall be guaranteed perfect seal to meet Protection class IP 66 providing sealing arrangement like highly elastic foamed in special type seal like polyurethane. There shall be an arrangement like multifold protection channel for additional stability and prevention of ingress of dust and water when the enclosure is open.

The sealing rubber shall not have aging effect and shall retain its sealing characteristics for more than 20 years. Contractor shall indicate this in data sheet. The rubber seal should be pasted at its place with pasting technology for like more than 20 years (double sealing arrangement is preferred).

4.04.14 Mounting clamps and accessories

The mounting clamps and accessories shall be suitable for mounting on walls, columns and structure. Brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass.

4.04.15 General

i) JBs shall have small canopy at the top.



- ii) There shall be rainwater collection arrangement from top and side of the outer ages to ensure that any leakage in to the junction box shall be avoided and it shall fall outside.
- iii) Cable entry shall be from bottom side only.
- iv) Ensure gland plate sealing perfect. It shall be of the same quality and arrangement as that of door to cover arrangement.

4.04.16 Junction boxes shall be provided with two nos. earthing terminals (externally available) suitable for connection of 8 SWG G.I. wire. Knockouts shall be provided at bottom and both sides. These shall be provided by fixing plates in order to make them detachable type with suitable neoprene gaskets. Bottom and side plates for cable/conduit connection shall be provided. All unused holes shall be sealed with suitable grommets.

4.04.17 Junction boxes shall be provided with external designation label. The label inscriptions shall be informed to the Contractor by the Owner. Junction boxes shall be provided with danger sign in case of 415V circuit.

4.04.18 Junction boxes shall be of two types, viz. One suitable for control cabling and the other suitable for power cabling.

Junction boxes for control cabling shall have 24 way/ 48 way terminal blocks suitable for up to 2.5 sq.mm. Cu. Cable. However, for instrumentation junction boxes there shall be 24/48 ways suitable for terminating cable of 0.5 sq.mm. Cu. Cable.

4.04.19 Junction boxes for power circuit cabling shall be suitable for 1 no. 3 core 16 sq.mm. Al. Incoming cable and 1 no. 3 core 2.5 sq.mm Cu. Outgoing cable.

4.05.00 Terminal blocks

Terminal blocks shall be 650 volts grade, rated for 10 Amps and in one piece, rigid, Bakelite moulded, with disconnecting /shorting link. It shall be complete with insulating barriers, Klip-on-type terminals and identification strips, terminal studs, washers, nuts, lock nuts, marking strips etc.

Marking on terminal strip shall correspond to the terminal numbering on wiring diagrams. It shall be Elmex type CSLT-1 with insulating material of Melamine conforming to ESI Standard 12.1 or equivalent. Cage clamp type terminal block suitable for terminating 2 wires of 2.5 sq mm. on both sides arranged to facilitate easy termination shall be provided.

20% spare terminals shall be provided.



4.06.00 Terminations & Straight through Joints

- 4.06.01 Termination and jointing kits for 33/11/3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be pre-moulded type, taped type or heat shrinkable type. 33/11/3.3 kV grade joints and terminations shall be type tested as per IS: 13573. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the aluminium solder less crimping type cable lugs & ferrule as per DIN standard.
- 4.06.02 Straight through joint and termination shall be capable of withstanding the fault level for 33kV, 11 kV and 3.3 kV systems.
- 4.06.03 1.1 KV grade straight through joints shall be of proven design.

4.07.00 Cable glands

- 4.07.01 Cable glands shall conform to BS: 6121 and be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating. Rubber components shall be of neoprene and of tested quality. Necessary cable dimensions shall be furnished to the successful contractor.
- 4.07.02 Cable glands shall be single compression for indoor use, double compression type for outdoor use. Glands for classified hazardous areas shall be double compression type flameproof and weather proof duly certified by CMRS and approved by CCE.

4.08.00 Cable lugs/ferrules

- 4.08.01 The cables lugs shall be conforming to IS: 8309.
- 4.08.02 Machine ferruling shall be adopted.
- 4.08.03 Cable lugs for power cables shall be Aluminium solder less crimping type suitable for aluminium compacted conductor cables.
- 4.08.04 The cable lugs for control/instrumentation/ telephone cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments.



Cable lugs shall be suitable for termination of different cross-sections of control/instrumentation /telephone cables and shall be of following types.

- i) Copper tubular terminal end for solder less crimping to copper conductors.
- ii) Cable lugs for control cable termination shall be insulated type. These lugs shall be flat type/ring type/U type to suit the terminals provided in the pan
- iii) Pin type lugs shall not used.
- iv) Aluminium tubular terminal ends for solder less crimping of to Aluminium conductor.

Solder less crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/instrumentation cables shall be PVC insulated/sleeved type.

4.09.00 Cable Clamps & Straps

- 4.09.01 The cable clamps required to clamp multicore cables on vertical runs shall be made up of Aluminium strip of 25x3 mm size. For clamping the multicore cables on horizontal trays, self-locking, de-interlocking type nylon clamps/straps shall be used. The clamps/straps shall have sufficient strength and shall not get affected by direct exposure to sun rays and outdoor environment.
- 4.09.02 Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength to withstand the forces generated by the system short circuit current of 105 KA peak.

4.10.00 Galvanizing

- 4.10.01 Galvanizing of steel components and accessories shall conform to IS: 2629 & IS: 2633. Additionally galvanizing shall be uniform, clean smooth, continuous and free from acid spots
- 4.10.02 The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS: 1367. The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified.



4.11.00 Welding

4.11.01 The welding shall be carried out in accordance with IS: 9595. All welding procedures and welders qualification shall also be followed strictly in line with IS: 9595

5.00.00 INSTALLATION**5.01.00 Cable tray and Support System Installation**

5.01.01 Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures. All cable trays shall be in vertical configuration in boiler, CHP & ESP areas.

5.01.02 Horizontally running cable trays shall be clamped by bolting to cantilever arms and vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 1500 mm. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per relevant Standard. The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated in the relevant approved tray layout drawings.

5.01.03 All cable way sections shall have identification, designations as per approved cable way layout as and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted/ stenciled with identification numbers at every floor.

5.01.04 In certain cases it may be necessary to site fabricate portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. In such cases the Contractor shall fabricate at site suitable sections of trays, supports and accessories to make the installation complete for the specific purpose after obtaining owner's prior approval, which shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint.



5.02.00 Conduits/Pipes/Ducts Installation

5.02.01 The Contractor shall be fully responsible for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made water proof by the Contractor.

5.02.02 GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.

5.02.03 Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material.

5.02.04 Cable routing between lined cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 150 to the trench wall. In case of larger dia cables i.e. 50mm and above, adequately sized pipe with larger bend radius shall be provided for ease of drawing of cable or for replacement. In places where it is not possible, a smaller trench may be provided if approved by Site Engineer.

5.02.05 Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

Conduit /pipe size (dia).	Spacing
Up to 40 mm	1 M
50 mm	2.0 M
65-85 mm	2.5 M
100 mm	3.0 M

5.02.06 In areas like WTP, chemical handling, battery room etc. exterior surface of the conduits shall be further coated with chromate or polymer for better resistance to corrosion.

5.02.07 All G.I. pipes shall be laid as per approved layout drawings and site requirements. Before fabrication of various profiles of pipe by hydraulically operated bending machine (which is to be arranged by the contractor), all the burrs from the pipes shall be removed. The bends formed shall be smooth. GI Pipes with bends shall be buried



in oil/concrete in such way that that the bends shall be totally concealed. For GI pipes shall be undertaken well before paving is completed and necessary co-ordination with paving agency shall be the responsibility of Electrical Contractor. The open ends of pipes shall be suitably plugged with G.I. plugs after they are laid in final position. G.I. plugs shall be supplied by the contractor at no extra cost.

5.03.00 Junction Boxes Installation

5.03.01 Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the approved drawings or as decided by Owner and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations.

5.04.00 Cable Laying and Installation

5.04.01 Cable network shall include power, control, lighting, communication and fire alarm system cables, which shall be laid in trenches, cables trays/conduits as detailed in the approved drawings and cable schedules. Erection of cable trays and aligning and leveling as required shall be the responsibility of the contractor.

5.04.02 Cable installation shall be carried out as per IS: 1255 and other applicable standards. Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall be drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.

5.04.03 Laying of cables directly buried in ground is not acceptable.

5.04.04 For coal handling plant the cables shall not be routed along conveyor galleries. The cables shall be routed on independent cable trestles.



- 5.04.05 All tray levels shall be checked after erection and marked in as built drawings. Cable routing given on the layout drawings shall be checked in the field to avoid interference with structures, heat sources, drains, piping, air-conditioning duct etc. and minor adjustments shall be done to suit the field conditions wherever deemed necessary. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings. The contractor shall have to secure rack/tray supports by welding to those inserts or other available building steel surfaces. Outdoor trays shall be installed by welding on the steel/concrete structure with inserts by the contractor. As far as practicable, cable trays shall be supported from one side only in order to facilitate installation and maintenance of cables from the other side.
- 5.04.06 While laying cable, ground rollers shall be used at every 2 metre interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements. Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables.
- 5.04.07 All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all cables shall be tapped with an approved PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted.
- 5.04.08 Cables installed above grade shall be run in trays, exposed on walls, ceilings or structures and shall be run parallel or at right angles to beams, walls columns. Cables shall be so routed that they will not be subjected to heat from adjacent hot piping or vessels.
- 5.05.00 Laying of cables in cable trays**
- 5.05.01 Cables shall be laid on cable trays strictly in line with cable schedule furnished. Where specific cable layouts are not shown on approved drawings, contractor shall route these as directed by the Owner.
- 5.05.02 Power and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.V. cables shall be laid on topmost tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil



formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre. All multicore cables shall be laid in touching formation. LT power cables above 95 sq.mm size shall be laid in single layer touching formation in trays while cables upto & including 95 sq.mm shall be laid in maximum of 2 layers. Control and Instrumentation cables can be laid upto a maximum of three layers in each tray.

- 5.05.03 All communication cables (telephone, P.A. System) RTD Cables shall run on instrument trays/ducts/trenches. Wherever these are not available, cables shall be taken in a separate trench/trays with a minimum clearance of 600mm away from electrical trench/trays as per the direction of Site Engineer and Communication cables shall cross power cables at right angles
- 5.05.04 Power and control cables shall be secured fixed to trays/support with self locking type nylon cable straps with de-interlocking facilities. For horizontal trays arrangements, multicore power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multicore power cables and control cables shall be secured at every one meter by nylon cable strap. After completion of cable laying work in the particular vertical tray, all the control cables shall be binded to trays/supports by aluminium strips at every five meter interval and at every bend.
- 5.05.05 Bending radii for cables shall be as per manufacturer's recommendations and IS: 1255.
- 5.05.06 Individual cables or small groups which run along structures/walls etc will be clamped by means of 16 SWG GI saddles on 25x6mm saddle bars. The cost of saddle and saddle bars shall be deemed to have been included in the installation of cables. Alternatively small group of cables can be taken through 100mm slotted channel/ISMC 100. They shall be rightly supported on structural steel and masonry, individual or in groups as required, if drilling of steel must be drilled where the minimum weakening of the structure will result.
- 5.05.07 Cables shall be supported so as to prevent unsightly sagging. In general distance between supports shall be approximately 300mm for cables upto 25mm diameter and maximum 500mm for cables larger than 25mm dia and cables laid in vertical run of cable trays shall be clamped at an interval of 900mm.



- 5.05.08 Where cables cross roads/rail tracks, the cables shall be laid in Hume pipe/PVC pipe. At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends.
- 5.05.09 Power and Control Cables, as far as possible, shall be laid in complete, uncut lengths from one termination to the other. Straight through joints in power cable shall be allowed only in nearest of rare situation only after approval of owner.
- 5.05.10 Joints for less than 250 Meters run of cable shall not be permitted.
- 5.05.11 In each cable run some extra length shall be kept at suitable point to enable one LV/two HV straight through joints to made, should the cable develop fault at a later stage. Control cable termination inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.
- 5.05.12 Wherever few cables are branching out from main trunk route troughs shall be used.
- 5.05.13 Cables shall be neatly arranged in the trenches/trays in such a manner so that criss-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trenches/trays shall be the responsibility of the contractor.
- 5.05.14 The contractor shall ascertain the exact requirement of cable for a particular feeder by measuring at site and avoiding interference with structure, foundation, pipelines or any other works. Before the start of cable laying, cable drum schedule shall be prepared by electrical contractor and get that approved by site engineer to minimize/avoid straight through joints. The actual number of straight through joints required shall be worked out by the contractor. During the erection period the contractor shall furnish a monthly report on cable position in an approved proforma so as to keep the owner appraised of the position.
- 5.05.15 The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.
- 5.05.16 Minimum number of spare cores required to be left for interconnection in control cables shall be as cl.3.07.00, chapter 16.



- 5.05.17 Electrical cable trays exposed to hazardous process fluid shall be covered with detachable G.I. covers. The covers shall be suitable to resist wind forces.

For cables laid above ground in cable racks, asbestos sheeting of 3mm thickness shall be provided below the bottom cable tray to protect the cables from fire.

- 5.05.18 Supporting steel shall be painted before laying of cables. The painting shall be done with one coat of red lead paint and two coats of approved bituminous aluminium paint unless otherwise specified.

- 5.05.19 Separation

Sufficient spacing not less than 300 mm shall be provided between different tiers of trays and the same shall be maintained to permit adequate access for installation and maintenance of cables.

At least 300mm clearance shall be provided between :

- HV power & LV power cables,
- LV power & LV control/instrumentation cables,

- 5.05.20 Segregation

Segregation means physical isolation to prevent fire jumping.

Cables from two different services viz. supply from Station Board and Unit Board shall be segregated.

Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.

For Coal Handling Plant all the cables of one stream shall be segregated from the cables of the other stream and shall run on either side of the trestle.

- 5.06.00 Cable fire sealing**

Cable/cable tray openings in walls and floors or through pipe sleeves from one area to another or from one elevation to another within the unit shall be sealed by a fire proof



sealing system (FPSS). The FPSS shall effectively prevent the spread of fire from the flaming to non-flaming side of a fire.

Wherever the cables/cable trays pass through walls/floors, fire proof cable penetration seals rated for one hour shall be provided. This shall be by suitable block system using individual blocks with suitable framework or by silicon RTV foaming system. In case foaming system is offered, damming board, if used, shall not be considered for fire rating criteria. Any of the system offered shall be of proven type as per BS: 476 (Part-20) or equivalent standard.

In order to prevent fire propagation through cable penetrations, after laying, dressing & clamping of cables, all the openings shall be properly sealed by using Fire Stop Mortar Seal and Fire Retardant Cable coating compound. Also the cable runs both before and after the fire scale shall be suitably sprayed with anti-fire propagation liquid.

5.07.00 Cable laying in trenches between switchyard and Transformer yard

- 5.07.01 RCC cable trenches with removable covers will be provided by the contractor. Cables shall be laid in 3 or 4 tiers in these trenches. Concrete cable trenches shall be filled with sand where specified to avoid accumulation of hazardous gases. RCC covers of trenches in process area shall be effectively sealed to avoid ingress of chemicals etc. Removal of concrete covers for purposes of cable laying and reinstating them in their proper positions after the cables are laid shall be done by the contractor at no extra cost.
- 5.07.02 For cable trays are laid in trench in more than two tiers a space of minimum 600 mm shall be available for maintenance. In case two or more tiers of cable trays are running parallel along both sides of trench walls there shall be space of minimum 600 mm between them.
- 5.07.03 Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cable leaving trenches shall be coiled and provided with a protective pipe or cover till such times the final termination to the equipment is completed.
- 5.07.04 Prior to laying of cables inside trenches, the contractor shall properly clean inside of those trenches.



- 5.07.05 When cables are laid in multiple tiers, spacing between individual tiers shall be as approved by Site Engineer. Space between individual tiers shall be filled and compacted with soil and sand.
- 5.07.06 As each row of cables is laid in place and before covering with sand every cable shall be given on insulation test in the presence of Site Engineer. Any cable, which proves defective, shall be replaced before the next groups of cables are laid.
- 5.07.07 All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/lined trench.
- 5.07.08 Where cables rise from trenches to motor, control station, lighting panels etc., they shall be taken in G.I. Pipes for mechanical protection up to a minimum of 150mm above grade.
- 5.07.09 Cable ends shall be carefully pulled through the conduit, to prevent damage to these cables. Where required, approved cable lubricant shall be used for this purpose. Where cable enters conduit the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by the manufacturer.

Following guide of the pipe fill shall be used for sizing the pipe size:

- a) 1 cable in pipe - 53% full
- b) 2 cables in pipe - 51% full
- c) 3 or more cables - 43% full
- d) Multiple cables - 40% full

After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/'PUTTI' for sealing purpose. Alternatively, G.I. Lids or PVC bushes shall be employed for sealing purposes. The cost for the same shall be deemed to have been included in the installation of G.I. pipe and no separate payment shall be allowed.



- 5.07.10 Where cables pass through foundation walls or other underground structures, the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures, the electrical contractor shall determine their location and obtain approval of the Site Engineer before cutting is done.

6.00.00 CABLE IDENTIFICATION

- 6.01.00 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry & exit, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties of 'TY-CAB' or equivalent type with cable number heat stamped on the cable tags.

- 6.02.00 If laying of underground cable is specifically agreed by Owner as a special case then the underground cables shall be provided with identity tags of Stain less steel securely fastened every 30 M of its underground length with at least one tag at each end before the cable enters the ground. In unpaved areas cable trenches shall be identified by means of markers. These posts shall be placed at location of changes in the direction of cables and at intervals of not more than 30 M for straight run and at cable joint locations with additional inscription 'Cable Joint'. For buried cables the marker shall project 150mm above ground.

- 6.03.00 Drum number of each cable from which it is taken shall be recorded against the cable number in the cable schedule.

7.00.00 CABLE TERMINATIONS & CONNECTIONS

- 7.01.00 The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer" instructions, drawings and/or as directed by Site Engineer. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.

- 7.02.00 Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated



- sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Engineer in charge of TANGEDCO.
- 7.03.00 Responsibility of proper termination shall lie on the contractor. Guarantee for termination shall also have to be given by the contractor.
- 7.04.00 The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2mm thick aluminium sheets.
- 7.04.00 Contractor shall drill holes for fixing glands wherever necessary at no extra cost. Gland plate shall be of non-magnetic material/aluminium sheet in case of single core cables. If the cable end box or terminal chamber provided on the equipment is found unsuitable and requires major modifications the same shall be carried out by the contractor at the discretion of the Engineer- in-Charge.
- 7.05.00 Control cable cores entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self locking type nylon cable ties with de interlocking facility to keep them in position.
- 7.06.00 The panels where a larger number of cables are to be terminated and cable identification may be difficult, each core ferrule shall include the complete cable number. The ferrules shall be indelible interlocking type and shall fit tightly on cores. Spare cores shall have similarly ferrules with a suffix letter 'S' alongwith cable numbers and coiled up after end sealing.
- 7.07.00 All cable terminations shall be appropriately tightened to ensure secure and reliable connections.
- 7.08.00 It is the responsibility of the Contractor to terminate the cables at motor terminals in correct phase sequence to ensure the proper direction of rotation.
- 7.09.00 All cables upto 1.1KV grade shall be terminated at the equipments by means of compression type cable glands. They shall have a screwed nipple with conduit electrical threads and check nut.
- 7.10.00 All cable entries shall be through bottom only and top entry terminations are made only after getting approval of Site Engineer.



7.11.00 Power cables, wherever colour coding is not available, shall be identified with red, yellow and blue PVC tapes. Where copper to aluminium connections is made, necessary bimetallic washers shall be used. For trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the Switchgear/Control panels and Control Switches.

7.12.00 In case of control cables all cores shall be identified at both ends by their terminal numbers by means of PVC ferrules. Wire numbers shall be as per schematic/wiring/ inter-connection diagram. Contractors shall have the samples of PVC markers approved before starting the work. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends. Control cables shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.

7.13.00 Where threaded cable gland is screwed into threaded opening of different size, suitable brass threaded reducing bushing shall be used provided.

7.14.00 The cable shall be taken through glands inside the panels or any other electrical equipment such as motors. The individual cores shall then be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Only control cables of single strand and lighting cables may be directly terminated on to the terminals.

In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom, close fit hole should be drilled in the bottom plate for all the cables in one line, and then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables it should be sealed with cold setting compound. Cables shall be clamped over the open armouring to connect it to earth bus.

7.15.00 Cable leads shall be terminated at the equipment terminals by means of crimped type solder less connectors.

Crimping shall be done by hand crimping/hydraulically-operated tool and conducting jelly shall be applied on the conductor.

Insulation of the leads should be removed immediately before the crimping. Conductor surface shall be cleaned and shall not be left open.



7.16.00 Termination and connection shall be carried out in such a manner as to avoid strain on the terminals.

7.17.00 All cable entry points shall be properly sealed and made dust and vermin proof. Unusual opening, if any, shall be effectively closed. Sealing work shall be carried out with approved sealing compound having fire withstand capability for at least three hours.

7.18.00 Cable accessories for H.V. Systems

7.19.00 The H.V. cables terminations/joints shall be done by skilled and experienced jointers duly approved by the Site Engineer.

7.20.00 The termination and straight through joint kits for use on high voltage system shall be suitable for the type of cables offered by the contractor or the type of cables issued by owner for installation. The materials required for termination and straight through joints shall be supplied in kit form. The kit shall include all insulating and sealing materials apart from conductor fittings and consumable items. An installation instruction shall be included in each kit.

7.21.00 The termination kits shall be suitable for termination of the cables to an indoor switchgear or to a weatherproof cable box of an outdoor mounted transformer/motor. The termination kits shall preferably be as of the following types.

a. 'PUSH ON' type for LV cables.

b. Heat-shrinkable sleeve type for LV & HV cables.

However, termination kits for HV cables shall be of Heat Shrinkable type of makes with specific approval of owner.

For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.

7.22.00 The straight through jointing kits shall be suitable for underground buried installation with uncontrolled backfill and possibility of flooding by water. The jointing kit shall be one of the following types.

a. 'TAPEX' of M-seal make or equivalent for LV cables



b. Heat-shrinkable sleeve type for LV & HV cables.

However, termination kits for HV cables shall be of Heat Shrinkable type of makes with specific approval of owner.

For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.

8.00.00 QUALITY ASSURANCE PROGRAMME

Contractor shall furnish detailed Quality Assurance Programme and Quality Plans for all materials and accessories to be supplied and installed under the scope of the specification as per General Technical Conditions of technical specification. The Quality Plans shall include all tests/ checks as per relevant National/International Standards and the requirements of this specification including tests listed in this section.

9.00.00 LIST OF TESTS TO BE CONDUCTED

9.01.00 Type tests on Cable Trays support system

A) Test 1A:

On main support channel type-C2 for cantilever arms fixed on one side only. A 3.5 metre length of main support channel shall be fixed vertically at each end to a rigid structure as per appropriate fixing arrangement. Eight (8) nos. 750 mm cantilever arms shall be fixed to the main channel and each arm shall be loaded over the outboard 600 mm with a uniform working load of 100 kg. Subsequently a point load of 100 kg shall be applied on arm 2. A uniform proof load on all the arms equal to twice the working load shall be then be applied. Deflections shall be measured at the following load intervals and other necessary points:

- i) Working load
- ii) Working load + point load
- iii) Off load



- iv) Proof load + point load
- v) Off load

The deflection measured at working loads shall not exceed 16 mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied.

B) Test 1B: Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2

Test 2: On Main support channel type -C2 for cantilever arms fixed on both sides

a)Test 2A: A 3.5 m length of main support channel C2 for cantilever arms fixing on both sides shall be fixed at each end to rigid structure as per appropriate fixing arrangement. Six (6), 750 mm cantilever arms shall be attached to each sides and each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at the following load intervals and other necessary points.

- i) Working load
- ii) Working load + Point load
- iii) Off load
- iv) Proof load + Point load
- v) Off load

The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of



proof load and point load applied

- b) **Test 2B:** The test 2 A shall be repeated with the assembly but with an asymmetrical load on the C2 column and point load applied to arm 8. The 100 kg and 200 kg uniformly distributed loads shall be applied to the upper three arms on one side and the lower three arms on the opposite side.

Test 3: Tests on Channel Fixed on Beam/Floor

A length of main support channel section shall be fixed to steel structure/floor and have loads applied as detailed below and other important points not mentioned herein.

- a) **Test 3A :** A length of steel structure shall be rigidly supported. It should be fitted on a metre length of channel section using beam clamps welded/bolted. A point load of 1200 kg shall be applied to the centre point via two brackets. No distortion or pulling of the components shall take place.
- b) **Test 3B:** With the components assembled as in Test 3A, two perpendicular point loads of 600 kg shall be simultaneously applied at positions 150 mm either side of the centre line, no distortion or pulling of the components shall take place.
- c) **Test 3C:** With the components assembled as in Test 3A, a perpendicular point load shall be applied at a point 150 mm on one side of the centre line.

The load shall be gradually increased to the maximum value that can be applied without causing distortion or pulling of the components. This value shall be recorded.

Test 4 Channel nut slip characteristics (what ever applicable)

Tests 4A1, 4A2, 4A3:

A length of channel C1 section 200 mm long shall have fitted bracket with the two bolts fixing.



With loads applied at the appropriate position nut slip shall be determined with bolt torque of 30 NM, 50 NM and 65 NM No fewer than three measurements shall be made or each torque setting.

A minimum loading of 720 kg shall be obtained before nut slip with bolt torque of 65 NM.

Tests 4B1, 4B2, 4B3:

The length of channel C1 section 200 mm long shall have fitted bracket with the one bolt fixing. With loads applied at the appropriate position, nut slip shall be determined with bolt torques of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting.

A minimum loading of 350 kg shall be obtained before nut slip with a bolt torque of 65 NM

Test 5 Weld Integrity Test

After deflection test as per test 1A, 1B, 2, 3 & 4 weld integrity shall be checked by magnetic particle inspection to detect sub-surface cracks developed, if any.

Cable termination kit and straight through joints should have been tested as per IS: 13573 for 3.3kV and 11kV class.

Fire proof Cable Penetration system should have been tested for the following tests:

- a) Accelerated Ageing test
- b) Water absorption test
- c) Fire rating test
- d) Hose Stream test
- e) Vibration test followed by fire rating test

9.02.00 Routine/ Acceptance Tests

Following routine/acceptance tests shall be carried out on all the equipments, devices & materials supplied:

9.02.01 Galvanizing Tests



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

- i) Uniformity of coating – The coating of any article shall withstand four 1 minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.
- ii) The quality of cadmium/zinc plating on items with screw threads shall be inspected visually and shall be free from visible defects such as unplanted areas, blisters and modules.
- iii) In addition, the plating thickness shall be determined microscopically/chemically or electronically.

9.02.02 Welding

The quality of welding shall be visually inspected, particular attention being paid to the following points.

- 1) The welded joints shall be continuous along its length on both sides and of uniform width and thickness. It should be free from blow holes.
 - 2). The weld metal shall be properly fused with the parent metal without undercutting.
 - 3) The outside surface of the weld shall be clean. All slag shall have been removed. All welding shall be regularly checked for cracking using magnetic particle inspection or their equivalent technique.
-
- 1. Physical and dimensional checks for all items.
 - 2. All conduits/pipes, etc. shall be routine/acceptance tested as per relevant standards.
 - 3. All acceptance and routine tests on cable glands as for BS: 6121. Additionally Proof torque test shall be carried out as acceptance on each body group of cable glands.
 - 4. Deflection test cable trays.
 - 5. All acceptance and routine tests on Junction boxes.



6. Following tests shall also be carried out on each type of equipments, devices and materials/items supplied:

- 1) Physical and Dimensional checks
- 2) Check/measurement of thickness for Nickel chrome plating for cable glands and tinning for cable lugs.
- 3) Check chemical composition of brass parts for cable glands.
- 4) Hardness check on gaskets.
- 5) Test for uniformity of galvanization.

9.02.03 Cable trays / supports and accessories

- 1) Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories.
- 2) Check for continuity of cable trays over the entire route.
- 3) Check that all sharp corners, burrs, and waste materials have been removed from the trays supports.
- 4) Check for earth continuity and earth connection of cable trays.





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SECTION-2 (PART-A)

GENERAL REQUIREMENTS FOR LIGHTING FIXTURES, LAMPS & MISCELLANEOUS ITEMS



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INTENT OF SPECIFICATION

- 1.1 The requirements given in specification for supply of equipment and system design engineering shall be fully complied with.
- 1.2 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.
- 1.3 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.
- 1.4 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 as specified in Data Sheet-A.
- 2.3 In case of conflict between the applicable reference standard and this specification, stringent requirement shall govern.

3.0 LIGHTING SYSTEM DESCRIPTION (CONCEPTUAL VIEW)

- 3.1 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.
- 3.2 Lighting system shall also cover the low voltage power services such as power receptacles and single phase feeders.
- 3.3 Lighting system shall be fed through various power sources such as AC Normal, AC Emergency and DC Emergency supply to achieve the desired reliability.
- 3.4 Power tapped from various sources shall be distributed through lighting distribution boards and lighting panels upto the various luminaires and power outlet sockets / feeders.

4.0 SYSTEM DESIGN ENGINEERING



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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.

- 4.1 **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.

4.1.1 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

4.1.2 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



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- iv. AC Emergency lighting requirement
- v. DC lighting requirements
- vi. Maintenance factor
- c) Requirement of sockets

4.1.3 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

4.2 DESIGN CRITERIA:

4.2.1 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 respects including viewing of all instruments, alarms, annunciators 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.



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- d) Complete power distribution system shall be designed keeping following criteria in view :
- Simplicity
 - Controlled voltage drop
 - Cost effectiveness

4.2.2 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. Lighting & LV power services in different areas shall be provided as per **Annexure-2B** enclosed.
- c) 24V AC lighting for maintenance purposes (for hand lamps and/or hand operated tools) shall be supplied from 240/24V fixed/ portable lighting module.

4.2.3 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

At strategic locations in the CRB & GIS Hall, 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



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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 switchgear. 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.

4.2.4 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.

4.2.5 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



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- Maintainability
- Aesthetics
- 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.

b) 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.



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- 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.

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.

4.3 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,



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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.
- 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.

5.0 LUMINAIRES, ACCESSORIES AND LAMPS



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

5.2 LUMINAIRE TYPES & OTHER ITEMS



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5.2.1 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":
 - Perspex acrylic diffuser.
 - High purity, anodised aluminium, mirror optic reflectors with anodised aluminium matt finish transverse fins to control glare.
 - Opal polystyrene louvers and sheet steel side panels.
 - 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 Data Sheet A and "Luminaire details".

c) Industrial Fluorescent Luminaires (General Purpose)

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



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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.



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- 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.
- 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.



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- 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)

- 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.



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- 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.
- 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.



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- 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.
- 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 70 Lm/W.
- The LED used in the luminaires shall have colour rendering index (CRI) of Min 65. Colour designation of LED shall be "cool day light" (min 5700K) type.
- 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%.



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



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- 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.

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.



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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.
- 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



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- 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.
 - 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 **Datasheet-2A** 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.



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- 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.
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 mm ² stranded aluminium conductors & with one no.6A HRC fuse and link.

5.12 RECEPTACLES



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- 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 Data Sheet A.
- c) Steel boxes shall be hot dip galvanised/ painted as specified in Datasheet-A 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. 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 :
 - 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.
 - II. Type RB: It shall have the following:



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- 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 backelite (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.
- 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 RA 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 below. Fan regulators shall be supplied separately.
- i. Type SWB1 - Switch board with 1 no. 5A switch, JB type SW1.
 - ii. Type SWB2 - 3 nos. 5A switches and 1 no. fan regulator, JB type SW2.
 - iii. Type SWB2a - 4 nos. 5A switches, JB type SW2.
 - iv. Type SWB3 - 7 nos. 5A switches, 3 nos. fan regulator, JB type SW3.
 - v. Type SWB3a - 8 nos. 5A switches, JB type SW3.

JB details for lighting control switch boxes are as below :

JB-SW1 Provided with four (4) way stud type terminals, each terminal suitable for terminating upto two nos. of **4 mm²** stranded copper conductor.

JB-SW2 Similar to the JB-SW1 but provided with ten (10) way terminals.

JB-SW3 Similar to the JB-SW1 but provided with eighteen (18) way terminals.

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.



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- 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

- 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



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- 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 INSPECTION & TESTING

- 9.1 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.
- 9.2 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.
- 9.3 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.
- 9.4 All manufacturing processes viz. machining, sheet forming, electroplating, wire routing, cleating & crimping, assembly, surface preparation shall conform to good manufacturing practices.
- 9.5 Inspection for dimensional & visual checks especially of the following, with respect to contract drawings, documents & standards shall be conducted:
- a) General sturdiness & rigidity of equipment
 - b) Surface finishing
 - c) Gasketting



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- d) Inter-changeability
- e) Constructional features viz. location, accessibility & marking of components, segregation, accessibility to live parts (shrouding) etc.
- f) Completeness of scope

9.6 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.

10.0 SPARES

- 10.1 Mandatory spares (if applicable) are indicated in BOQ-cum-price schedule.
- 10.2 Erection & commissioning spares are included in the bidder's scope of supply. BE&C spares are indicated in BOQ-cum-price schedule.
- 10.3 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.

11.0 TOOLS AND TACKLE

- 11.1 Tools & tackle which are essential to facilitate assembly, adjustments, erection, maintenance & dismantling of equipment shall be provided as part of equipment supplied.
- 11.2 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.
- 11.3 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.
- 11.4 Schedule of tools & tackle shall be filled up by bidder.

12.0 DOCUMENTATION

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

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

12.2 Documents to be submitted during detailed engineering of contract

12.2.1 Engineering documents (refer clause 4.3) to be generated by the vendor, if applicable.

- a) Lighting calculations for indoor areas.
- b) Lighting calculations for outdoor areas.
- c) SLD of power distribution upto LPs.



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- 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.

12.2.2 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

12.3 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.



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- vii. Maintenance procedures.
- 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.

12.4 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.



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ANNEXURE-LUMINAIRE

LUMINAIRE DETAILS

LUMINAIRE CODING SCHEME

1.0 Code Structure

A A NN (no. x W) — Number of lamps x Wattage of each lamp
| |
| | Classified Serial Number (Numeric)
| | Luminaire type (Alpha)
| | Lamp type (Alpha)

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 :

1. Flood lighting luminaires to have non-integral control gearbox.
2. All other luminaires shall have integral control gearbox, unless specifically mentioned otherwise in enclosed sheets.
3. 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. |



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- | | | | |
|------|------|--------|---|
| 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. |
| 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 Mercury Vapour (HPMV) Lamp Luminaire

- | | | | |
|-----|------|----------|--|
| 2.1 | MB01 | 1 x 250 | Mercury, high bay, industrial type. |
| 2.2 | MB02 | 1 x 400 | Mercury, high bay, industrial type. |
| 2.3 | MB03 | 1 x 1000 | Mercury, high bay, industrial type. |
| 2.4 | MB04 | 1 x 250 | Mercury, high bay, totally enclosed industrial type. |
| 2.5 | MB05 | 1 x 400 | Mercury, high bay, totally enclosed industrial type. |
| 2.6 | MB06 | 1 x 250 | Mercury, high bay with non-integral controlgear box. |
| 2.7 | MB07 | 1 x 400 | Mercury, high bay with non-integral controlgear box. |
| 2.8 | MB11 | 1 x 250 | Mercury, medium bay, industrial type. |



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2.9	MB12	1 x 400	Mercury, medium bay, industrial type.
2.10	MB13	1 x 250	Mercury, medium bay, totally enclosed industrial type.
2.11	MB14	1 x 400	Mercury, medium bay, totally enclosed industrial type.
2.12	MB17	1 x 80	Mercury, low bay, industrial type.
2.13	MB18	1 x 125	Mercury, low bay, industrial type.
2.14	MB19	1 x 80	Mercury, low bay, totally enclosed industrial type.
2.15	MB20	1 x 125	Mercury, low bay, totally enclosed industrial type.
2.16	MW41	1 x 80	Mercury, well glass, vapour proof with vitreous enamelled reflector.
2.17	MW42	1 x 125	Mercury, well glass, vapour proof with vitreous enamelled reflector.
2.18	MW51	1 x 80	Mercury, well glass, dust proof with vitreous enamelled reflector.
2.19	MW52	1 x 125	Mercury, well glass, dust proof with vitreous enamelled reflector.
2.20	MW91	1 x 80	Mercury, well glass, flame proof with vitreous enamelled reflector and cast aluminium alloy LM6 housing.
2.21	MW92	1 x 125	Mercury, well glass, flame proof with vitreous enamelled reflector and cast aluminium alloy LM6 housing.
2.22	MW93	1 x 80	Mercury, well glass, flame proof with vitreous enamelled reflector and cast aluminium alloy LM6 housing
2.23	MW94	1 x 125	Mercury, well glass, flame proof with vitreous enamelled reflector and cast aluminium alloy LM6 housing.
2.24	MW95	1 x 80	Mercury, well glass, flame proof increased safety luminaire with vitreous enamelled reflector and cast aluminium alloy LM6 housing for Div.-2 areas.
2.25	MW96	1 x 125	Mercury, well glass, flame proof increased safety luminaire with vitreous enamelled reflector and cast aluminium alloy LM6 housing for Div. 2 areas.
2.26	MW98	1 x 125	Mercury, well glass, flame proof increased safety luminaire with vitreous enamelled reflector and cast aluminium alloy LM6 housing



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- | | | | |
|------|------|---------|---|
| 2.27 | MS61 | 1 x 125 | Mercury, street light with one piece cast aluminium body. |
| 2.28 | MS62 | 1 x 250 | Mercury, street light with two piece cast aluminium body. |
| 2.29 | MS63 | 1 x 400 | Mercury, street light with two piece cast aluminium body. |
| 2.30 | MF61 | 1 x 250 | Mercury, flood light, general purpose. |
| 2.31 | MF62 | 1 x 400 | Mercury, flood light, heavy duty type. |
| 2.32 | MF63 | 2 x 400 | Mercury, flood light, heavy duty type. |
| 2.33 | MP21 | 1 x 80 | Mercury, post top lantern |
| 2.34 | MP22 | 1 x 125 | Mercury, post top lantern |

3.0 High Pressure Sodium Vapour (HPSV) Lamp Luminaire

- | | | | |
|------|------|---------|---|
| 3.1 | SB01 | 1 x 150 | Sodium, high bay, industrial type. |
| 3.2 | SB02 | 1 x 250 | Sodium, high bay, industrial type. |
| 3.3 | SB03 | 1 x 400 | Sodium, high bay, industrial type. |
| 3.4 | SB04 | 1 x 150 | Sodium, high bay, totally enclosed industrial type. |
| 3.5 | SB05 | 1 x 250 | Sodium, high bay, totally enclosed industrial type. |
| 3.6 | SB06 | 1 x 400 | Sodium, high bay, totally enclosed industrial type. |
| 3.7 | SB07 | 1 x 150 | Sodium, high bay with non-integral controlgear box. |
| 3.8 | SB08 | 1 x 250 | Sodium, high bay with non-integral controlgear box. |
| 3.9 | SB09 | 1 x 400 | Sodium, high bay with non-integral controlgear box. |
| 3.10 | SB11 | 1 x 150 | Sodium, medium bay, industrial type. |
| 3.11 | SB12 | 1 x 250 | Sodium, medium bay, industrial type. |
| 3.12 | SB13 | 1 x 150 | Sodium, medium bay, totally enclosed industrial type. |
| 3.13 | SB14 | 1 x 250 | Sodium, medium bay, totally enclosed industrial type. |
| 3.14 | SB17 | 1 x 70 | Sodium, low bay, industrial type. |



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- | | | | |
|------|------|---------|---|
| 3.15 | SB18 | 1 x 150 | Sodium, low bay, industrial type. |
| 3.16 | SB19 | 1 x 70 | Sodium, low bay, totally enclosed industrial type. |
| 3.17 | SB20 | 1 x 150 | Sodium, low bay, totally enclosed industrial type. |
| 3.18 | SW41 | 1 x 70 | Sodium, well glass, vapour proof with vitreous enamelled/
powder coated type reflector. |
| 3.19 | SW42 | 1 x 150 | Sodium, well glass, vapour proof with vitreous enamelled/
powder coated type reflector. |
| 3.20 | SW51 | 1 x 70 | Sodium, well glass, dust proof with vitreous enamelled reflector. |
| 3.21 | SW52 | 1 x 150 | Sodium, well glass, dust proof with vitreous enamelled reflector. |
| 3.22 | SW91 | 1 x 70 | Sodium, well glass, flame proof with vitreous enamelled reflector
and cast aluminium alloy LM6 housing. |
| 3.23 | SW92 | 1 x 150 | Sodium, well glass, flame proof with vitreous enamelled reflector
and cast aluminium alloy LM6 housing. |
| 3.24 | SW93 | 1 x 70 | Sodium, well glass, flame proof with vitreous enamelled reflector
and cast aluminium alloy LM6 housing. |
| 3.26 | 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. |
| 3.27 | 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. |
| 3.28 | SS61 | 1 x 70 | Sodium, street light with one piece cast aluminium body. |
| 3.29 | SS62 | 1 x 150 | Sodium, street light with one piece cast aluminium body. |
| 3.30 | SS63 | 1 x 250 | Sodium, street light with two piece cast aluminium body. |
| 3.31 | SS64 | 1 x 400 | Sodium, street light with two piece cast aluminium body. |
| 3.32 | SF61 | 1 x 250 | Sodium, flood light, general purpose. |
| 3.33 | SF62 | 1 x 400 | Sodium, flood light, general purpose. |
| 3.34 | SF63 | 1 x 250 | Sodium, flood light, heavy duty type. |



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3.35 SF64 1 x 400 Sodium, flood light, heavy duty type.

3.36 SF65 2 x 250 Sodium, flood light, heavy duty type.

3.37 SF66 2 x 400 Sodium, flood light, heavy duty type.

3.38 SP21 1 x 70 Sodium, post top lantern.

4.0 Tungsten Lamp Luminaires

4.1 TW41 1 x 100 Tungsten, well glass, vapour proof with vitreous enamelled reflector.

4.2 TW42 1 x 200 Tungsten, well glass, vapour proof with vitreous enamelled reflector.

4.3 TW51 1 x 100 Tungsten, well glass, dust proof with vitreous enamelled reflector.

4.4 TW52 1 x 200 Tungsten, well glass, dust proof with vitreous enamelled reflector.

4.5 TW91 1 x 100 Tungsten, well glass, flame proof with vitreous enamelled reflector.

4.6 TW92 1 x 200 Tungsten, well glass, flame proof with vitreous enamelled reflector.

4.7 TW95 1 x 100 Tungsten, well glass, increased safety (Div. 2) with vitreous enamelled reflector.

4.8 TW96 1 x 200 Tungsten, well glass, increased safety (Div. 2) with vitreous enamelled reflector.

4.9 TB21 1 x 60 Tungsten, bulk head, weather proof.

4.10 TB22 1 x 100 Tungsten, bulk head, weather proof.

4.11 TB91 1 x 100 Tungsten, bulk head, flame proof.

4.12 TB92 1 x 200 Tungsten, bulk head, flame proof.

4.13 TP21 1 x 200 Tungsten, post top lantern.



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- | | | | |
|--------------------|------|----------|---|
| 4.14 | TE02 | 1 x 20 | Tungsten, portable emergency unit with rechargeable battery. |
| 4.15 | TE02 | 1 x 40 | Tungsten, portable emergency unit with rechargeable battery. |
| 4.16 | TX01 | 1 x 60 | Tungsten, dispersive vitreous enamelled reflector. |
| 4.17 | TX02 | 1 x 100 | Tungsten, dispersive vitreous enamelled reflector. |
| 4.18 | TX03 | 1 x 75 | Decorative recessed mounting luminaire suitable for comptalux lamp. |
| 4.19 | TX04 | 1 x 100 | Decorative recessed mounting luminaire suitable for comptalux lamp. |
| 4.20 | TX05 | 2 x 100 | Double obstruction aviation light of cast Al. alloy with red glass. |
| 5.0 Halogen | | | |
| 5.1 | HF61 | 1 x 300 | Halogen, flood light, drip proof. |
| 5.2 | HF62 | 1 x 500 | Halogen, flood light, drip proof. |
| 5.3 | HF63 | 1 x 750 | Halogen, flood light, drip proof. |
| 5.4 | HF64 | 1 x 1000 | Halogen, flood light, drip proof. |



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DATA SHEET – A

S. No.	Description	Unit	Value
1.0	SYSTEM DESIGN DATA		
1.1	Design ambient	^o C	50
1.2	AC Supply		
a)	Rated voltage	V	415
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 -15%
c)	System fault level & duration	kA, sec.	25kA for 1 sec.
2.0	SCOPE OF SYSTEM DESIGN ENGINEERING		Included in vendor's scope
3.0	Lighting Concept		
3.1	Types of supplies considered (other than AC Normal)		
a)	AC emergency		☒ Yes ☐ No
b)	DC emergency		☒ Yes ☐ No
c)	DC Normal		☐ Yes ☒ No
3.2	Diversity Factor for Sockets	%	25%
4.0	LUMINAIRES, LAMPS & ACCESSORIES		
4.1	Type of false ceiling for recessed fluorescent luminaire		Grid False ceiling (600mm X 600mm) / Aluminium false ceiling(for



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			Control Room).
4.2	Degree of protection for drip proof luminaires		IP55
4.3	Deleted		
4.4	Deleted		
4.5	Deleted		
4.6	Emergency Lighting Unit		
a)	Lamp type		☐ FLT ☒ CFL ☐ LED
b)	Nos. of Lamp		2
c)	Lamp wattage	W	9
d)	Lumen output of lamp at rated voltage	Lumen	To furnished by Vendor.
e)	Type of battery (Rechargeable type)		☒ Ni-Cd ☐ Lead-Acid ☐ Li-Ion
f)	AH capacity of battery	AH	To furnished by Vendor.
g)	Battery voltage	V	9
h)	Battery backup time	Hr	2
i)	In built charger		Yes
4.7	Exit Sign		
a)	Lamp type		☒ FLT ☐ CFL ☒ LED
b)	Nos. of Lamp		1
c)	Lamp wattage	W	20
d)	Lumen output of lamp at rated voltage	Lumen	To furnished by Vendor.
e)	Type of battery		☒ Ni-Cd ☐ Lead-Acid ☐ Li-Ion
f)	AH capacity of battery	AH	To furnished by Vendor.
g)	Battery voltage	V	To furnished by Vendor.
h)	Battery backup time	Hr	1/2
4.8	24V AC Supply Module (Fixed type & portable type) For Quantities Refer BOQ		
a)	Enclosure		
	Enclosure material		☐ Cast aluminium alloy ☒ CRCA sheet steel



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	Enclosure thickness	mm	[] 3 for Cast aluminium alloy [√] 2 for CRCA sheet steel
	Louvers provided		[√] Yes [] No
b)	Surface treatment		[] Painted [√] Galvanized
c)	If galvanized		
	Process		Hot dip
	Weight of zinc	g/m ²	460 gm / mm ² (65 microns)
d)	If painted		
	Paint shade		
	Minimum paint thickness (DFT)	micron	
e)	Transformer		
	Rating	VA	500
	Voltage ratio & Current Rating	V	240 V/26.5 V [6A/16A]
	Class of insulation		Class F, temperature rise limited to Class-B
f)	24V Hand lamp unit		
	Lamp type		[] Halogen [√] LED
	Lamp wattage	W	40
g)	No. of outgoing sockets		4
h)	Whether cord coiling arrangement provided		[√] Yes air cooled [] No
5.0	Junction Box		
a)	Enclosure material		[] FRP [√] CRCA Sheet.
b)	Enclosure thickness	mm	1.6
c)	Galvanized (applicable for CRCA sheet)		[√] Yes [] No
d)	Degree of protection		IP-66(indoor) / Weather proof IPW-66 for outdoor area & Flameproof for hazardous area)
6.0	Industrial/ Welding Receptacle		
a)	Enclosure material		[] Heavy duty cast aluminium alloy [√] CRCA sheet steel
b)	Enclosure thickness	mm	[] 3 for cast aluminium alloy [√] 2 for CRCA sheet steel



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c)	Surface treatment		☐ Painted ☒ Galvanized
d)	If galvanized		
	Process		Hot dip
	Weight of zinc	g/m ²	460 gm / mm ² (65 microns)
e)	If painted		NOT APPLICABLE
	Paint shade		
	Minimum paint thickness (DFT)	micron	
f)	Degree of protection		IP-42 / IP 62(dusty area)
7.0	Decorative Receptacle		
a)	Enclosure material		☐ Cast aluminium alloy ☒ MS Sheet
b)	Enclosure thickness	mm	☐ 2 for cast aluminium alloy ☒ 1 for MS sheet
c)	Surface treatment		☐ Painted ☒ Galvanized/ Electro-plated
d)	If galvanized		
	Process		Hot dip
	Weight of zinc	g/m ²	460 gm / mm ² (65 microns)
e)	If painted		NOT APPLICABLE
	Paint shade		
	Minimum paint thickness	micron	
f)	Degree of protection		IP-42 / IP 62(dusty area)
9.0	Switch Box		
a)	Enclosure material		☐ FRP ☒ CRCA Sheet.
b)	Enclosure thickness	mm	2 MM CRCA sheet with 6mm thick Bakelite cover
c)	Galvanized		☒ Yes ☐ No
d)	Painted		☐ Yes ☒ No
d)	Degree of protection		IP-55
10.0	Conduit (Flexible)		
a)	Type		☒ Electrogalvanized cold rolled annealed & coated with PVC ☐ Lead coated



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b)	Size	mm	20
c)	Standard length	m	25 to 50
d)	Thickness of Galvanization	microns	
5.13	Cable Glands		By vendor for all incoming and outgoing cables
a)	Type		☒ Double compression ☐ Single compression
b)	Material		Brass
c)	Nickel Plating provided		☒ Yes ☐ No
d)	Flameproof glands with flameproof equipment		☒ Yes ☐ No
5.14	Cable Lugs		By vendor for all incoming and outgoing cables
a)	Type		Crimping type/ ring type
b)	Material		Tinned copper
12.0	LADDERS		
a)	Type		☐ Free standing ☐ wheel mounted ☒ both
b)	Material		☐ Steel ☒ Aluminium
c)	Duty		☐ Heavy ☒ Medium
d)	Surface treatment		☒ Galvanised ☐ Painted
e)	Reference Standard		IS: 4571, 3696

Note :

1. Detailed luminaire and lamp data shall be placed by vendor after award of contract.
2. Galvanization wherever applicable shall be hot dip galvanized with weight of Zinc as 460g/m² (65micron).



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LIST OF APPLICABLE STANDARDS

ILLUMINATION

Code of practice for interior illumination	IS
3646	
Code of practice for industrial lighting	IS 6665
Code of practice for lighting of public thoroughfare	IS 1944

LUMINAIRES

Luminaires	IS 10322
Industrial luminaires with metal reflector	IS 1777
Industrial lighting fittings with plastic reflectors	IS 3287
Decorative lighting outfits	IS 5077
Waterproof electric lighting fittings	IS 3528
Watertight electric lighting fittings	IS 3553
Dust-proof electric lighting fittings	IS 4012
Dust-tight electric lighting fittings	IS 4013
Flameproof electric lighting fittings - well glass & bulk head types	IS 2206
Electric lighting fittings for division 2 areas	IS 8224
General & Safety requirement of Luminaire	IS 1913
General Lighting. LEDs and LED modules Terms and definitions	IS 16101
General Lighting. LEDs and LED modules Terms and definitions	IS 16101
Self Ballasted LED Lamps for General Lighting Services.	IS 16102
LED modules for General lighting Safety Requirements.	IS 16103
Lamp control gear Part 2 particular	IS 15885(Part 2)
Requirements d.c. or a.c.Supplied Electronic control gear'for LED modules	IS 16104

LAMPS

Tungsten filament lamps for domestic and similar general lighting purpose	IS 418
Tubular fluorescent lamps for general lighting service	IS 2418
High pressure mercury vapour lamps	IS 9900
High pressure sodium vapour lamps	IS 9974



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LUMINAIRE COMPONENTS

Ballast for fluorescent lamps for switch start circuits	IS 1534
Ballast for high pressure mercury vapour lamps	IS 15882
Capacitors for use in tubular fluorescent high pressure mercury and low pressure sodium vapour discharge lamp circuits	IS 1569
Bi-pin lamp holders for tubular fluorescent lamps	IS 3323
Methods of measurement of lamp cap temperature rise	IS 8913
Starters for fluorescent lamps	IS 2215
Holders for starters for tubular fluorescent lamps	IS 3324
Cast acrylic sheets for use in luminaires	IS 7569

ASSEMBLED EQUIPMENT AND COMPONENTS

Low voltage switchgear and controlgear.	IS 60947
Code of practice for selection, installation & maintenance of switchgear & control gear	IS 10118
Explosive atmospheres	IS 60079
Classification of hazardous areas for electrical installations	IS 5572
Dry type transformers	IS 11171
Electrical Accessories - circuit breakers for over protection for household and similar installations	IS 60898
Low voltage Fuses for voltages not exceeding 1000 V ac or 1500 V dc	IS 13703
Indicator lamps (visual)	IS 1901

POLES, SOCKETS AND OTHER MISCELLANEOUS

Plugs and socket outlets of rated voltage upto and including 250 volts and rated current upto and including 16 amperes	IS 1293
Interlocking switch socket outlet	IS 4160
Electric ceiling type fans and regulators	IS 374
Structural steel (Standard quality)	IS 2062



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Danger notice plates	IS 2551
Enclosures for accessories for household and similar fixed electrical installations	IS 14772
General construction in steel - Code of practice	IS 800
Wrought aluminium and aluminium alloy bars, rods, tubes and sections for electrical purposes	IS 5082
Code of practice for phosphating of iron and steel	IS 6005
Colour for ready mixed paints & enamels	IS 5
Recommended practice for hot dip galvanising of iron & steel	IS 2629
Method of testing uniformity of coating on zinc coated articles	IS 2603
Flexible steel conduits for electrical wiring	IS 3480
Conduits for electrical installations	IS: 9537
Scaffolds & ladders - Code of safety	IS: 3696
Aluminium extension ladders	IS: 4571
General Requirement for enclosures for accessories for household & similar fixed electrical installations	IS: 5133



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TECHNICAL SPECIFICATION FOR
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SECTION-2
(PART-B)

GENERAL REQUIREMENTS FOR POLES & HIGH MAST



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TECHNICAL SPECIFICATION FOR
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1.0 INTENT OF SPECIFICATION

1.1 The requirement of this specification shall be fully complied with.

1.2 The "design" shall broadly cover the selection of components, materials, sizes etc. for the equipment of supply in vendor's scope. Complete responsibility of establishing the correctness of equipment design rests with the vendor.

1.3 It is not the intent to specify here 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 the required duties in a manner acceptable to Engineer / 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.

1.4 Make of all equipment and components shall be as per sub vendor list (Section I) and subjected to the approval of BHEL/BHEL's customer 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 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 as specified in Datasheet-B.

2.3 In case of conflict between the applicable reference standard and this specification, stringent requirement shall govern.

3 DESIGN REQUIREMENTS

3.1 LIGHTING POLES

3.1.1 Lighting poles as required for street lighting and flood lighting shall be of swaged/stepped tubular steel of swan neck construction as per applicable standard.

3.1.2 Where painted type of poles is specified (to be done at vendor's works);

- a) The poles shall be coated with black bituminous paint, conforming to applicable standard, throughout on the inside surface and on the outside surface up to the level which is embedded in ground.
- b) Exposed outside surface shall be painted with two coats of red oxide and zinc chromate in synthetic compound primer.
- c) Final painting shall be done at site after installation. Same is not in vendor's scope.

3.1.3 Where galvanization of poles is specified;

- a) All inside and outside surfaces of the pole and base plate shall be hot dip galvanised as per manufacturer's practice.
- b) Base plate shall be galvanised after welding to the pole base.
- c) Weight and thickness of zinc coating shall be as per Datasheet-B.



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- 3.1.4 Each street lighting pole shall be supplied with necessary pipe-reducer / fixing-bracket for fixing the luminaire.
- 3.1.5 Each street lighting pole shall be suitably provided with weather proof, galvanised steel junction box and two numbers fixing brackets suiting the diameter of the pole. The requirements of junction box are stipulated elsewhere. The fixing brackets shall be supplied loose.
- 3.1.6 Street lighting pole shall be provided with wiring hole. The location shall be coordinated with mounting position of street lighting pole JB. The diameter of hole shall be 20 mm. The hole shall be provided with a rubber / PVC grommet.
- 3.1.7 Flood lighting pole shall be provided with painted MS plate and shall be suitable for the number of flood lighting luminaires and controlgear boxes.
- 3.1.8 Provision for earthing shall be provided for flood / street lighting poles at a height 1 metre above the ground (MS flat size shall be informed during detailed engineering). The pole shall be earthed at two points.
- 3.1.9 Types of Lighting Poles

Exact type and designation of lighting pole is as given in Data Sheet B. Basic types are as follows:

- a) PS1 - Street Lighting Pole for one luminaire with 1200mm bracket arm.
- b) PS2 - Street Lighting Pole for one luminaire with 1800mm bracket arm.
- c) PS4 - Street Lighting Pole for two luminaires with 1800mm bracket arm each.
- d) PF1 - Flood Lighting Pole for one luminaire.
- e) PF2 - Flood Lighting Pole for two luminaires.

Details of luminaire shall be provided during detailed engineering.

3.2 POLE JUNCTION BOXES JB(S)

- 3.2.1 Junction boxes with terminals shall be supplied for branching and terminating lighting wires/cables.
- 3.2.2 Construction Features
- (a) The junction boxes shall be fabricated out of material specified in Datasheet-B 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.
 - (b) 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 14SWG GI earthing wires.



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- (c) The junction boxes shall be weather proof type conforming to IP-55 of IS:2147. Junction boxes for street light poles and lighting/lightning masts shall be provided with hinged doors and allen keys with bolts as locking arrangement.
- (d) The boxes and cover shall be hot dip galvanised.
- (e) The junction boxes shall be suitable for mounting on lighting poles, mast etc. The brackets, bolts, nuts, screws and any other erection accessories required for erection shall be provided along with the junction box.

3.2.3 Terminals

- (a) 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.
- (b) 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.

3.2.4 The junction boxes shall be of following types:

Type	Description
JB-S	Provided with four (4) way stud type terminals, each terminal suitable for terminating upto two nos. of 3.5Cx50 mm ² stranded aluminium conductors & with one no.6A HRC fuse and link.
JB-M	Provided with four (4) way stud type terminals, each terminal suitable for terminating upto two nos. of 4Cx16 mm ² stranded aluminium conductors & tap off of 3 nos. 2C x 2.5 sq. mm. Cu cable.

3.3 LIGHTING MASTS

3.3.1 Lighting mast shall be continuously tapered polygonal cross section hot dip galvanised. The Mast shall be of height as specified in Datasheet-B 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, aviation warning light, lightning protection arrangement 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 without carrying out any welding or bolting of joints at site. Lantern carriage shall be suitable for mounting flood light fixtures, numbers as specified in Datasheet-B (fixture details shall be provided during detailed engineering). Carriage shall be provided with JB type M to facilitate interconnection to lighting fixtures.

3.3.2 Permissible design parameters should be according to relevant standard. The deflection under the maximum wind pressure of 150 kg/sq.m shall not exceed 1 in 360. The Mast together with the fixtures shall be capable of withstanding the appropriate wind loads as per IS: 875 Part III.

3.3.3 The Mast shall be fabricated from special steel plates conforming to BS-EN10-025 and folded to form a polygonal section.



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- 3.3.4 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.
- 3.3.5 All surfaces (inside & outside) of steel sections, members and hardware used shall be hot dip galvanised as per applicable standard.
- 3.3.6 Necessary mounting facilities for mounting of luminaires and control gear boxes shall be provided at top platform. This shall include provision of holes in the fixing bracket for movable fixing plate. Adequate number of movable plates affixed to the bracket shall also be provided. Size of movable plates and the position of holes shall match with the luminaire fixing arrangement.
- 3.3.7 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).
- 3.3.8 Types of Lighting Masts
- a) LM20 - Lighting Mast with 20 m height
 - b) LM25 - Lighting Mast with 25 m height
 - c) LM30 - Lighting Mast with 30 m height

4 COMPONENTS OF MAST FEEDER PANEL

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.

4.1 SWITCH-FUSE UNITS

- 4.1.1 These units shall preferably comprise of switches having integral fuses, called composite units. Alternatively, combination units of separate switch and fuse may also be acceptable.
- 4.1.2 These units shall be provided for general purpose i.e. incoming or outgoing units.
- 4.1.3 The units shall be of the air break air insulated type and designed to ensure safety to operating personnel.
- 4.1.4 Composite units shall have integral fuses i.e. fuse carrier with fuse link (fuse link forming the moving contact). The design shall ensure that the moving contact is not live when switch is open i.e. in OFF position, so as to facilitate removal of fuse.



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- 4.1.5 The switch shall be capable making and carrying the system prospective fault current, but limited in magnitude and duration by the cut off characteristics of the largest HRC fuse link that may be fitted to that unit.
- 4.1.6 The fixed contact shall be so shrouded that maintenance of the unit can be carried out in safety with the busbars live.
- 4.1.7 Where one isolating switch is used as the incoming device, the incoming side fixed contacts shall be shrouded to ensure that maintenance can be carried out with the remote fuse and switch closed.
- 4.1.8 Composite switch-fuse or the combination of switch and fuse shall meet the requirements of its components as follows:
- 4.1.8.1 Isolating Switch
- (a) Switches shall be air-break, quick make, and quick break heavy duty type conforming to applicable standard.
 - (b) All switches shall have visible ON / OFF position indication and shall be padlockable in any (ON / OFF) position.
 - (c) Switches shall be door interlocked such that it shall not be possible to gain access to inside the unit unless the isolating switch is in OFF position.
 - (d) The switches shall be suitable for independent manual operation.
 - (e) The switch contacts shall be of silver alloy or silver plated copper and springs of non-corrosive material.
 - (f) Inter-phase barriers shall be provided to prevent possibilities of phase to phase fault in the switch. The switch shall also be shrouded from all sides to prevent access to live parts on the switch after opening the unit door. The barriers and shrouding shall extend upto the height of switch to fully enclose both side terminals of the device. The arrangement shall permit easy maintenance.
- 4.1.8.2 High Rupturing Capacity (HRC) Fuses
- (a) The fuse serving as the short-circuit protective device in isolating fuse-switch units shall be of HRC cartridge, current limiting and plug-in non-deteriorating type.
 - (b) The fuse carriers shall be easily withdrawable for replacement of fuse. Insulated fuse pullers shall be provided where fuses are not mounted in insulating carriers to remove and replace fuses in live conditions.
 - (c) Fuses shall preferably be fitted with a device to indicate operation (i.e. when the fuse has blown).
 - (d) Live terminals of fuse bases shall be shrouded to prevent contact with personnel where fuse links are not mounted in carriers and are directly plugged into the fuse base. Inter-phase barriers extending throughout the length of the fuse base shall be provided to prevent inter-phase short circuit. They shall be shrouded from all sides to prevent accidental contact.
 - (e) Fuse carriers and bases shall be of good quality moulded insulating material. Porcelain fuse bases and carriers will not be accepted.
 - (f) The rating and characteristics of fuse links shall be chosen appropriately for short circuit protection of circuits down stream.



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4.2 CONTACTORS

- 4.2.1 Contactors shall be of the air break type fitted with arc shields.
- 4.2.2 The operating coil shall be suitable for satisfactory operation in the range of 85% - 110% of nominal voltage, as specified in Datasheet-B. The coil shall be tropicalized having insulation not less than class 'E'.
- 4.2.3 Electrically independent auxiliary contacts not less than 2NO + 2NC for interlocking and indication shall be fitted to individual power contactor.
- 4.2.4 All springs shall be made out of a corrosion proof material.

4.3 MINIATURE CIRCUIT BREAKERS

- 4.3.1 The use of miniature circuit breakers (MCBs) combining thermal overload and magnetic short circuit protection shall be application for the outgoing circuits.
- 4.3.2 MCBs shall have suitable rating but not less than 20A, 10kA.
- 4.3.3 MCBs shall be suitable for housing in the panel and for connection of copper link bus bar at the incoming and copper lugs at the outgoing ends.
- 4.3.4 The terminals of MCB and ON / OFF positions shall be clearly and indelibly marked.

4.4 SELECTOR SWITCHES

- 4.4.1 The rating and other features of the switches shall be suitable for the application. The number of positions and the number of contacts required for each switch shall be as required.
- 4.4.2 Selector switches shall be stay put type, provided with properly designated escutcheon plates clearly marked to show operating position.
- 4.4.3 Terminals carrying potential above 120 Volts shall be shrouded to prevent accidental contact with personnel.
- 4.4.4 Ammeter selector switches shall have make before break contacts.
- 4.4.5 The switches shall be suitable for semi-flush mounting with the front plate and operating handle projecting out. All connection to the switches shall be from the back.
- 4.4.6 The arrangement for front mounting of these devices shall be such as to make them reasonably dust free so as not to interfere with normal operation.

4.5 INDICATION LAMPS

- 4.5.1 Indication lamps shall be complete with lens covers and holders.
- 4.5.2 Each lamp shall be fitted with a durable resistance integrally wired in series with the lamp. Alternatively, lamps with built in transformers are acceptable.
- 4.5.3 The lamp cover (lens) shall be translucent of appropriate colour.
- 4.5.4 Bulbs and covers shall be interchangeable, easily replaceable from the front without the need for any special means.
- 4.5.5 Terminals having potential above 120V shall be shrouded to prevent contact with personnel.

4.6 PUSH BUTTONS



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- 4.6.1 Push button shall be heavy duty, flush mounted suitable for the application.
- 4.6.2 Push button shall be provided with integral escutcheon plates marked with its function identified as per schemes.
- 4.6.3 Colour shall be appropriate to the function.
- 4.6.4 Minimum number of contacts shall be 1 NO + 1 NC or as per the requirements of control scheme.
- 4.7 TERMINALS
- 4.7.1 Terminals shall be stud type of copper material.
- 4.7.2 Terminals shall be provided with transparent cover(s).
- 4.7.3 Separate terminals shall be available for each termination of loop-in and loop-out power connections.
- 4.7.4 Terminals shall be suitable for ring type copper cable lugs of size depending upon the circuit rating.
- 4.8 CABLE GLANDS
- 4.8.1 Whether specifically mentioned or not, cable glands of suitable sizes shall be supplied along with each equipment for power and control cables.
- 4.8.2 Rubber components used in the gland shall be of neoprene.
- 4.8.3 Name / trade name of manufacturer, type no. and applicable range of outer diameter of cable shall be engraved / indelibly printed on the cable gland.
- 4.9 CABLE LUGS
- 4.9.1 All equipment shall be supplied with the power and control cable lugs of suitable size, whether specifically mentioned or not.
- 4.9.2 Name / trade name and size of lug shall be engraved/ indelibly printed on each cable lug.
- 4.10 TIMERS
- 4.10.1 Time Switch
- (a) Time switch shall be suitable for automatic switching ON and OFF of street lighting / flood lighting circuits.
- b) Time switch have 00 - 24 hrs clock base.
- c) Time switch shall indicate actual time and shall permit accurate time setting.
- d) Time switch shall be rugged, independent of normal fluctuations of voltage / frequency and free from maintenance.
- e) Contact rating, clock accuracy, rated voltage rating and frequency rating of timer shall be suitable to its application.
- f) Time switch shall be provided with Ni-Cd battery.
- g) Time switch shall be suitable for mounting inside the panel.



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4.10.2 On Delay Timer

- (a) Timer shall be fully static and suitable for operation on normal frequency and system voltage.
- (b) Timer shall have high setting accuracy, high repeat accuracy, low reset time and low power consumption.
- (c) Timer shall have the time setting range of 24 - 240 seconds, unless mentioned otherwise in Data Sheet B.
- (d) Timer shall be suitable for mounting inside the panel.

4.11 CIRCUIT DIAGRAM / DIRECTORY PLATE

- 4.11.1 A diagram is to be prepared for fixing to the inside cover of every mast feeder panel giving details of the points controlled by each circuit.

4.12 SURFACE TREATMENT FOR PANEL

- 4.12.1 All metal parts and the surfaces (exterior & interior) of equipment 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.
- 4.12.2 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.
- 4.12.3 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.
- 4.12.4 All parts shall then be subjected to a coat of red oxide primer paint.
- 4.12.5 All inside and outside surfaces of panel shall be spray painted with synthetic enamel of the shade as per Data Sheet B.
- 4.12.6 Electrostatic or powder coating painting shall be done as specified in Data Sheet B.
- 4.12.7 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.

5 PACKING

- 5.1 Loose items shall be packed, duly labelled in a box and sealed properly to avoid damage during transportation. Packing list shall be pasted on every box, listing the contents of the box.

6.0 INSPECTION & TESTING

- 6.1 Bidder shall confirm compliance with the BHEL Standard Quality Plan (PE-QP-999-558-E004) without any deviations. At contract stage, the successful bidder shall submit the same QP for BHEL/ ultimate customer's approval. 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.



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- 6.2 All the components and completely assembled equipment shall be tested as per the latest edition of standards. Any charges for these shall be deemed to be included in equipment price.
- 6.3 All the specified tests shall be carried out to verify the rating and performance of the equipment.
- 6.4 All manufacturing processes viz. machining, sheet forming, electroplating, wire routing, cleating & crimping, assembly, surface preparation shall conform to good manufacturing practices.

7.0 TOOLS AND TACKLE

- 7.1 Tools & tackle which are essential to facilitate assembly, adjustments, erection, maintenance & dismantling of equipment shall be provided as part of equipment supplied.
- 7.2 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.
- 7.3 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.
- 7.4 Schedule of tools & tackle shall be filled up by bidder.

8.0 SPARES

- 8.1 Mandatory spares (if applicable) are indicated in BOQ-cum-price schedule.
- 8.2 Erection & commissioning spares are included in the bidder's scope of supply. Bidder to furnish list of E&C spares in the relevant schedules of the Bid Form and Price Schedules.



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DATA SHEET - B

1.0 APPLICABLE STANDARDS & CODES

[A] POLES AND HIGH MAST

- | | | |
|-----|---|-----------------|
| 1. | Tubular steel poles for over head power lines | IS 2713 |
| 2. | Code and practice for design loads for structures | IS 875 Part III |
| 3. | Code of practice for general construction in steel | IS 800 |
| 4. | European structural steel standard | BS-EN 10025 |
| 5. | Code of practice for phosphating of iron and steel | IS 6005 |
| 6. | Colour for ready mixed paints & enamels | IS 5 |
| 7. | Recommended practice for hot dip galvanising of iron & steel | IS 2629 |
| 8. | Method of testing uniformity of coating on zinc coated articles | IS 2603 |
| 8. | Method of sampling for steel pipes, tubes & fittings | IS 4711 |
| 10. | Method of chemical analysis of pig iron, cast iron and plain carbon & low alloy steel | IS 228 |
| 11. | Steel tubes for structural purposes | IS 1161 |
| 12. | Mechanical testing of metals-Tensile Testing | IS 1608 |
| 13. | Specification for hot dip zinc coatings on structural steel and allied products | IS 4759 |
| 14. | Method for testing uniformity of coating on zinc coated articles | IS 2633 |

[B] ADDITIONAL STANDARDS FOR MAST

- | | | |
|----|---------|-------------|
| 1. | Welding | BS 5135/AWS |
|----|---------|-------------|



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- | | | |
|----|--|--------------------|
| 2. | Galvanizing | BS.ISO 1461 |
| 3. | UK Specification for Mast & Foundation | TR No. 7200 of ILE |

[C] ASSEMBLED EQUIPMENT AND COMPONENTS

- | | | |
|----|--|-----------|
| 1. | Low voltage switchgear and controlgear | IEC 60947 |
| 2. | General requirements for enclosures for accessories for household and similar fixed electrical installations | IS 14772 |
| 3. | Electrical accessories- Circuit breaker for overcurrent protection for household and similar installations | IEC 60898 |
| 4. | Low voltage Fuses for voltages not exceeding 1100V AC or 1500V DC | IS 13703 |
| 5. | Visual indicator lamps | IS 1901 |

2.0 TECHNICAL DETAILS

S. No.	Description	Unit	Value
1.0	System Design Data		
a	Rated voltage	V	415
b	Rated frequency	Hz	50
c	Voltage and frequency variation (permissible)	%	Voltage: $\pm 10\%$ Frequency: +5% to -5%
d	Combined voltage & frequency variation (permissible)	%	10% absolute
e	System fault level & duration	kA, sec	50kA for 1 sec
2.0	Lighting Poles		As per IS-2713
2.1	Type of Pole		
a	PS-1 (11m), Refer 3.1.9 Section-II		SP51 as per IS-2713
b	PS-2 (13 m), Refer 3.1.9 Section-II		SP67 as per IS-2713
c	PS-4 (13 m), Refer 3.1.9 Section-II		SP67 as per IS-2713



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d	PF-1 (11m), Refer 3.1.9 Section-II		SP51 as per IS-2713
e	PF-2 (11m), Refer 3.1.9 Section-II		SP51 as per IS-2713
2.2	Material		MS
2.3	Tensile Strength	MPa	[] 540 (For Alternative 1 – Refer BOQ) [√] 410 (For Alternative 2 – Refer BOQ)
2.4	Mounting arrangement		[√] PCC foundation [] Base plate
2.5	Grade of concrete		[] M20 [√] M25 [] M30
2.6	Surface Treatment		[] Painted [√] Galvanized
Note : - Tensile Strength shall be			
2.7	PAINTING details for poles (if applicable)		(NOT APPLICABLE)
a	Paint shade as per IS:5		
b	Paint Thickness	Microns	
2.8	GALVANISATION details for poles(if applicable)		
a	Process		Hot dip
b	Min weight of zinc coating	gm/m ²	910
c	Avg. thickness of zinc coating	Microns	
3.0	Lighting Masts		
a	Number of luminaires on each mast	nos.	[√] 12 [] 16
b	Type of design		Continuously tapered, Polygonal shape, at least 20 sided
c	Material		GI
d	Height	meter	[] 20 [] 25 [√] 30
e	Grade of concrete		[] M20 [√] M25 [] M30
f	Galvanisation details		
i)	Process		Hot dip



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ii)	Min weight of zinc coating	gm/m2	910
iii)	Avg. thickness of zinc coating	Microns	
4.0	Street Light Junction Box		
a	Enclosure material		[√] FRP [] CRCA Sheet.
b	Enclosure thickness(min)	mm	3
c	Galvanisation details		NOT APPLICABLE
i)	Process		
ii)	Min weight of zinc coating	gm/m2	
iii)	Avg. thickness of zinc coating	Microns	
d	Degree of protection		IPW-66
5.0	Feeder Panel(Applicable for High mast)		
a	Enclosure material		[√] FRP [] CRCA Sheet.
b	Enclosure thickness(min)	mm	3
c	Degree of protection		IPW-66
d	Paint shade		NOT APPLICABLE
e	Paint type		NOT APPLICABLE
f	Paint Thickness	Microns	NOT APPLICABLE
g	Galvanisation details		
i)	Process		
ii)	Min weight of zinc coating	gm/m2	
iii)	Avg. thickness of zinc coating	Microns	
5.1	Switch-Fuse Unit		
a	Utilisation category for main contacts		AC23
5.2	Miniature Circuit Breaker		
a	SPN MCB rating (min)	A	20
b	DP MCB rating (min)	A	20
c	TPN MCB rating (min)	A	63
d	Short time rating	kA	10



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e	Magnetic short circuit protection required		☒ Yes ☐ No												
f	Thermal overload protection required		☒ Yes ☐ No												
5.3	Power Contactors														
a	AC contactors voltage coil rating	V	240												
b	DC contactors voltage coil rating	V	220												
5.4	Selector switch														
a	Type of selector switch		☒ Stay put ☐ Wing knob												
b	Lockable		☒ Yes ☐ No												
5.5	Push Button														
a	Voltage grade	V	500												
b	Potential free contacts		2NO+2NC												
5.6	Time switch														
a	Type		Digital synchronous												
b	Range	Hr	00-24												
c	Coil voltage rating	V	240												
5.7	Timer along with Photocell														
a	Type														
b	ON delay timer range	Sec	0-5												
c	OFF delay timer range	Sec	0-180												
d	AC Coil voltage rating	V	240												
e	DC Coil voltage rating	V	220												
6.0	Cable Glands		By vendor for all incoming and outgoing cables at Pole JB and feeder panel												
a	Type		☒ Double compression ☐ Single compression												
b	Material		Brass												
c	Nickel Plating provided		☒ Yes ☐ No												
d	Size		Cable Gland shall be suitable for following cable sizes :- <table> <tr> <th>Cable Size</th><th>Cable Dia. under armour</th><th>Cable Dia over armour</th><th>Overall dia of cable</th></tr> <tr> <td>3.5C-25sqmm</td><td>18.7 (±1.5mm)</td><td>21.8 (±1.5mm)</td><td>24.9 (±1.5mm)</td></tr> <tr> <td>3.5C-</td><td>24.2</td><td>27.4</td><td>30.8</td></tr> </table>	Cable Size	Cable Dia. under armour	Cable Dia over armour	Overall dia of cable	3.5C-25sqmm	18.7 (±1.5mm)	21.8 (±1.5mm)	24.9 (±1.5mm)	3.5C-	24.2	27.4	30.8
Cable Size	Cable Dia. under armour	Cable Dia over armour	Overall dia of cable												
3.5C-25sqmm	18.7 (±1.5mm)	21.8 (±1.5mm)	24.9 (±1.5mm)												
3.5C-	24.2	27.4	30.8												



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			50sqmm	(±2.0mm)	(±2.0mm)	(±2.0mm)
			3.5C-95sqmm	31.4 (±2.0mm)	35.4 (±2.0mm)	38.8 (±2.0mm)
			4C-16sqmm	Shall be furnished later		
7.0	Cable Lugs		By vendor for all incoming and outgoing cables at Pole JB and feeder panel			
a	Type		[√] Crimping type [] Ring type			
b	Material		Tinned copper			
c	Size		Suitable for Cable sizes: 3.5C-25sqmm, 3.5C-50sqmm, 3.5C-95sqmm , 4C-16 sqmm armoured cable.			



**TECHNICAL SPECIFICATION FOR
LIGHTING PANELS**

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TECHNICAL SPECIFICATION FOR
LIGHTING PANELS

**SECTION – 2
(PART-C)**

**GENERAL TECHNICAL REQUIREMENTS
FOR LIGHTING PANELS**

Remark – Transformer for Lighting panels is not envisaged unless specified in bid price schedule



TECHNICAL SPECIFICATION FOR LIGHTING PANELS

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TECHNICAL SPECIFICATION FOR
LIGHTING PANELS

1.0 INTENT OF SPECIFICATION

- 1.1 The requirements given in specification shall be fully complied with.
- 1.2 The “design” shall broadly cover the selection of components, materials, sizes etc. for the equipment of supply in vendor’s scope. Complete responsibility of establishing the correctness of equipment design rests with the vendor.
- 1.3 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.
- 1.4 Make of all equipment and components shall be to the approval of Purchaser.

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 as specified in Data Sheet C.
- 2.3 In case of conflict between the applicable reference standard and this specification, stringent requirement shall govern.

3.0 DESIGN REQUIREMENTS

3.2.1 General Requirements of Lighting Panels

- a) LPs shall be totally enclosed, suitable for electrical system data as specified in Data Sheet C. The LP shall be suitable for mounting on wall / column / structure.
- b) Panels shall be suitable for indoor / outdoor application as specified.
- c) All components of the LP shall be fully mounted inside the panel. LPs shall have only one operational front. Door shall be provided to give full access to all the components. Door shall have padlocking arrangement.
- d) LPs shall consist of dust and vermin proof cubicles without the use of louvers.
- e) Good quality synthetic rubber / neoprene gaskets shall be put around the door. The door when closed, shall compress the gasket uniformly.
- f) The LPs shall be designed to prevent contact with live parts when the front door is open.



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TECHNICAL SPECIFICATION FOR
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- g) All busbars (phase, neutral, positive, negative as applicable) within a panel shall be of the same size.
- h) All control wiring inside the panels shall be carried out with 1100 V grade, PVC insulated flexible copper wire of 2.5 sq. mm size.
- i) The rated continuous current of the equipment and components shall be as per technical requirement. These ratings shall be obtained with the components mounted in their housing as in service without exceeding the permissible temperature rise.
- j) Each LP shall be fitted with M.S. mounting brackets.
- k) Panel shall be suitable for top / bottom cable / conduit entries. However, outdoor LPs shall have bottom cable / conduit entry. Removable undrilled gland plate of sheet steel shall be provided for entry of cables. Minimum thickness of gland plate shall be as per Data Sheet-C. The gland plate shall be of adequate size having knock-outs for requisite number cable connections. Gland plate shall be provided with gasket.
- l) The lighting panel shall be complete with copper busbars, and shall incorporate incomer and outgoing circuits as per Data Sheet-C. Number of outgoing circuits shall be as per BOQ.
- m) Each lighting panel shall be fitted with two GI earth studs located in accessible position on the outside of the panel on opposite sides.
- n) All metal parts of the panel except current carrying parts shall be bonded together electrically to the earthing stud.
- o) Each panel shall be fitted with phase barriers of fireproof insulating material in such a manner that it is not readily possible for personnel to touch the phase busbars. Insulating sheet shall be fitted around the MCBs such that only the surface and toggle of the MCBs are available on the front.
- p) The supply of cable lugs for power and control cable connections forms part of the supply of equipment.
- q) Each panel shall be provided with a circuit directory plate with inscriptions neatly typed and laminated, fitted on the inside of door.

4.0 COMPONENTS OF LDB/WDB AND LIGHTING PANEL

4.1 MOULDED CASE CIRCUIT BREAKERS

- a) MCCBs in AC circuits shall be of single throw, air break, heavy duty type triple pole construction arranged for simultaneous three pole manual closing and opening and for automatic tripping at short circuit and overload. Neutral link shall be provided for LDB/ WDB without transformers.



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TECHNICAL SPECIFICATION FOR
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- b) Operating mechanism shall be quick make, quick break and trip free type.
- c) The ON, OFF & TRIP positions of the MCCB shall be clearly indicated so as to be visible to the operator when mounted as in service. Operating handle shall be provided on front of the LDB/ WDB.
- d) MCCBs shall be capable of withstanding the thermal stresses caused by overloads and short circuits. The maximum tripping time under short circuit shall not exceed 20 milli-seconds.
- e) MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings.
- f) Under voltage releases and other releases shall be provided as required.

4.2 SWITCH-FUSE UNITS

- a) These units shall preferably comprise of switches having integral fuses, called composite units. Alternatively, combination units of separate switch and fuse may also be acceptable.
- b) These units shall be provided for general purpose i.e. incoming or outgoing units.
- c) The units shall be of the air break air insulated type and designed to ensure safety to operating personnel.
- d) Composite units shall have integral fuses i.e. fuse carrier with fuse link (fuse link forming the moving contact). The design shall ensure that the moving contact is not live when switch is open i.e. in OFF position, so as to facilitate removal of fuse.
- e) The switch shall be capable making and carrying the system prospective fault current, but limited in magnitude and duration by the cut off characteristics of the largest HRC fuse link that may be fitted to that unit.
- f) The fixed contact shall be so shrouded that maintenance of the unit can be carried out in safety with the busbars live.
- g) Where one isolating switch is used as the incoming device, the incoming side fixed contacts shall be shrouded to ensure that maintenance can be carried out with the remote fuse and switch closed.
- h) Composite switch-fuse or the combination of switch and fuse shall meet the requirements of its components as follows:

Isolating Switch

- i. Switches shall be air-break, quick make, and quick break heavy duty type conforming to applicable standard.



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TECHNICAL SPECIFICATION FOR
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- ii. All switches shall have visible ON / OFF position indication and shall be padlockable in any (ON / OFF) position.
- iii. Switches shall be door interlocked such that it shall not be possible to gain access to inside the unit unless the isolating switch is in OFF position.
- iv. The switches shall be suitable for independent manual operation.
- v. The switch contacts shall be of silver alloy or silver plated copper and springs of non-corrosive material.
- vi. Inter-phase barriers shall be provided to prevent possibilities of phase to phase fault in the switch. The switch shall also be shrouded from all sides to prevent access to live parts on the switch after opening the unit door. The barriers and shrouding shall extend upto the height of switch to fully enclose both side terminals of the device. The arrangement shall permit easy maintenance.

High Rupturing Capacity (HRC) Fuses

- i. The fuse serving as the short-circuit protective device in isolating fuse-switch units shall be of HRC cartridge, current limiting and plug-in non-deteriorating type.
- ii. The fuse carriers shall be easily withdrawable for replacement of fuse. Insulated fuse pullers shall be provided where fuses are not mounted in insulating carriers to remove and replace fuses in live conditions.
- iii. Fuses shall preferably be fitted with a device to indicate operation (i.e. when the fuse has blown).
- iv. Live terminals of fuse bases shall be shrouded to prevent contact with personnel where fuse links are not mounted in carriers and are directly plugged into the fuse base. Inter-phase barriers extending throughout the length of the fuse base shall be provided to prevent inter-phase short circuit. They shall be shrouded from all sides to prevent accidental contact.
- v. Fuse carriers and bases shall be of good quality moulded insulating material. Porcelain fuse bases and carriers will not be accepted.
- vi. The rating and characteristics of fuse links shall be chosen appropriately for short circuit protection of circuits downstream.

4.3 MINIATURE CIRCUIT BREAKERS

- a) The use of miniature circuit breakers (MCBs) combining thermal overload and magnetic short circuit protection shall be application for the outgoing circuits of Lighting Panels.
- b) MCBs shall have suitable rating as specified in Data Sheet C.



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- c) MCBs shall be suitable for housing in the lighting panel and for connection of copper link bus bar at the incoming and copper lugs at the outgoing ends.
- d) The terminals of MCB and ON/OFF positions shall be clearly and indelibly marked.

4.4 CURRENT TRANSFORMERS

- a) CTs shall be air insulated having insulation class E or better, cast resin type and shall be capable to withstand the thermal and mechanical stresses resulting from maximum short circuit.
- b) The short time current duration for CTs shall be one second.
- c) CT primary current shall not be less than the full load thermal rating of the associated circuit. CT secondary current shall be as specified in Data Sheet C. Polarity shall be marked in a suitable manner. The ratings shall be adequate to cater for the burden of connected instruments.
- d) CTs shall be of bar primary / wound primary / ring type capable of carrying the rated primary current.

4.5 VOLTAGE TRANSFORMER

- a) Voltage transformers (VT) shall be dry, cast resin type comprising of single phase or three phase units. They shall have their primary windings protected by current limiting fuses with interrupting capacity corresponding to that of the lighting board / panel.
- b) VT secondary windings shall be earthed in LDB/ WDB / LP through link, which can be removed for insulation testing.
- c) Three phase voltage transformers shall be as per Data Sheet C.

Single phase VTs shall have voltage rating of (Nominal System Voltage / $\sqrt{3}$) V / (110 / $\sqrt{3}$) V so that secondary voltage shall be 110 volts phase to phase when the secondary winding is star connected.

- d) VTs shall have an output rating adequate to cater to the burden connected to them.

4.6 INDICATING METERS

- a) Meters shall be panel mounted, flush type and suitable for rear terminal connection.
- b) Meters and instruments shall be enclosed in dust proof, moisture resistant black finished cases and shall be suitable for tropical use. Instruments shall be suitable for operation from the secondary windings of CTs and VTs.



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- c) All instruments shall be calibrated to enable direct reading of primary quantities. Instruments shall be adjusted and calibrated at manufacturer's works and shall have means of calibration, checking and zero adjustment at site.
- d) All the divisions and the quantity to be measured shall be clearly marked. Instruments shall conform to applicable standard having black numerals and lettering on white anti-parallax dial with knife edge pointer. Indicating instruments shall be of moving iron type for AC and moving coil type for DC circuits.
- e) Instruments having metallic cases shall be fitted with earthing terminals.

4.7 CONTACTORS

- a) Contactors shall be of the air break type, electromagnetic type fitted with arc shields.
- b) The operating coil shall be suitable for satisfactory operation in the range of 85% - 110% of nominal voltage specified under the Data Sheet C. The coil shall be tropicalized having insulation not less than class 'E'.
- c) Electrically independent auxiliary contacts not less than 2NO + 2NC for interlocking and indication shall be fitted to individual power contactor.
- d) All springs shall be made out of a corrosion proof material.

4.8 RELAYS

- a) Relays shall be provided on the various circuits as per schemes. Relays shall be flush mounted on front of the board. Relay case shall be painted with dull black or egg shell black enamel and with back connected terminals. Metal cases and frames of relay shall be earthed.
- b) All relays shall be of withdrawable type with built-in testing facilities, with provision for inspection, maintenance and replacement. Where built-in test facility is not provided for a particular relay, separate suitable test block shall be provided on the board for this purpose.
- c) Relay performance shall not alter due to mechanical shock or vibration or external magnetic field which may be present at the place of mounting.
- d) Each relay shall not have less than two independent pairs of contacts.

4.9 TIMERS

4.9.1 Time Switch

- a) Time switch shall be suitable for automatic switching ON and OFF of street lighting / flood lighting circuits.
- b) Time switch have 00 - 24 hrs clock base.



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- c) Time switch shall indicate actual time and shall permit accurate time setting.
- d) Time switch shall be rugged, independent of normal fluctuations of voltage / frequency and free from maintenance.
- e) Contact rating, clock accuracy, rated voltage rating and frequency rating of timer shall be suitable to its application.
- f) Time switch shall be provided with Ni-Cd battery.
- g) Time switch shall be suitable for mounting inside the panel.

4.9.2 On/Off Delay Timer

- a) On delay timer shall be required for continuation of DC supply for a limited duration when the AC Emergency supply has been restored and DG set is under stabilisation.
- b) Timer shall be fully static and suitable for operation on normal frequency and system voltage.
- c) Timer shall have high setting accuracy, high repeat accuracy, low reset time and low power consumption.
- d) Timer shall have the time setting range as mentioned in Data Sheet C.
- e) Timer shall be suitable for mounting inside the panel.

4.10 SELECTOR SWITCHES

- a) The rating and other features of the switches shall be suitable for the application. The number of positions and the number of contacts required for each switch shall be as indicated in the schemes
- b) Selector switches shall be stay put type, provided with properly designated escutcheon plates clearly marked to show operating position.
- c) Terminals carrying potential above 120 Volts shall be shrouded to prevent accidental contact with personnel.
- d) Ammeter selector switches shall have make before break contacts.
- e) The switches shall be suitable for semi-flush mounting with the front plate and operating handle projecting out. All connection to the switches shall be from the back.
- f) The arrangement for front mounting of these devices shall be such as to make them reasonably dust free so as not to interfere with normal operation.

4.11 PUSH BUTTONS



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- a) Push button shall be heavy duty, flush mounted suitable for the application.
- b) Push button shall be provided with integral escutcheon plates marked with its function identified as per schemes.
- c) Colour shall be appropriate to the function.
- d) Minimum number of contacts shall be 2 NO + 2 NC or as per the requirements of control scheme.

4.12 INDICATION LAMPS

- a) Indication lamps shall be complete with lens covers and holders.
- b) Each lamp shall be fitted with a durable resistance integrally wired in series with the lamp. Alternatively, lamps with built in transformers are acceptable.
- c) The lamp cover (lens) shall be translucent of appropriate colour.
- d) Bulbs and covers shall be interchangeable, easily replaceable from the front without the need for any special means.
- e) Terminals having potential above 120V shall be shrouded to prevent contact with personnel.
- f) Terminals shall be suitable for ring type copper cable lugs of size depending upon the circuit rating.

4.13 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.

4.14 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.

4.15 TERMINALS

- a) Terminals shall be stud type of copper material.
- b) Terminals shall be provided with transparent cover(s).



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- c) Separate terminals shall be available for each termination of loop-in and loop-out power connections.

5.0 LABELING

- 5.1 Labels to identify all the Main assemblies, Sub-assemblies and components of the LDB/ WDB and LPs shall be provided.
- 5.2 Name and rating plate / marking shall be provided as required by relevant standard applicable to each component / assembly to be identified.
- 5.3 Labels shall be of two colour, three layer plastic material with matt or semi matt finish or of the anodised aluminium sheet.
- 5.4 All labels other than "Danger" or "Warning" labels shall have black lettering on a white background. Danger labels shall be as per applicable standard and shall not be affixed on to removable parts.
- 5.5 All labels shall be securely fixed on to the equipment by means of self tapping screws or other approved means.
- 5.6 Stick-on type labels of good quality and permanent mounting shall be acceptable for internally mounted components only.
- 5.7 A list of all such items to be labeled and text and type of labels to be provided is given below:

a) BOARD DESIGNATION (MAIN EQUIPMENT LABEL)

- i. **Inscription :**
Designation & LDB/ WDB number for LDB/ WDB.
Designation and LP number for LPs.
- ii. **Location :**
Top centre in the front of the LDB/ WDB.
Top centre in the front of the LP.
- iii. **Material :**
3 Layer plastic material, fixation by self tapping, non-rusting screws, black inscription on white back ground.

b) OUTGOING - FEEDER DESIGNATION

- i. **Inscription :** Module number, LP number / purpose.
- ii. **Material :**
Black engraving on white anodised aluminium plate of thickness 1.6 mm or more. Plate to be secured with screws.

c) COMPONENT DESIGNATION



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- i. **Inscription** : Letter symbol / Legend as assigned in schemes.
- ii. **Location** : Near or on the component
- iii. **Material** : Stick-on type

5.8 CIRCUIT DIAGRAM / DIRECTORY PLATE

- a) A diagram is to be prepared for fixing to the inside cover of every lighting panel giving details of the points controlled by each circuit.
- b) The circuit list shall be typed or printed stating the location of the equipment served, rating of the protective unit and the circuit loadings.
- c) The list shall be mounted on the inside of the cover door and shall be protected by an acrylic sheet cover to be easily removable to permit circuit modifications.

6.0 SURFACE TREATMENT

- 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 and minimum thickness as per Data Sheet C.
- 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 Packing procedure shall conform to the following :



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- a) The equipment shall be properly packed before dispatch. The packing shall prevent damage to the contents while handling and lengthy period of outdoor storage.
- b) The equipment shall be wrapped in weather proof packing using polythene sheets/ air bubble sheets/ thermocol sheets and then secured in wooden packing cases. Wood for wooden packing cases/ crates shall be chemically treated to prevent deterioration due to fungi and attack by termites, borers, and any other kind of infection.
- c) The equipment shall be secured by fixing base plate/ frame with the help of bolt and nuts etc. to bottom frame of the wooden packing cases/ crates. Suitable cushioning material like rubberised coir (min. 50 mm thick & 100 mm wide) shall be provided on the bottom support. Gap between the panel and casing shall be filled with rubberised coir with distance between consecutive supports less than 500mm.

7.2 Specification for the sea worthy packing, if enclosed, for the export jobs shall form part of the specification.

8.0 INSPECTION & TESTING

- 8.1 Bidder shall confirm compliance with the BHEL Standard Quality Plan (PE-QP-999-558-E005) without any deviations. At contract stage, the successful bidder shall submit the same QP for BHEL/ ultimate customer's approval. 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.
- 8.2 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.
- 8.3 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.
- 8.4 Functional testing shall be carried out for Lighting/Welding Distribution Boards/ Lighting Panels.
- 8.5 All manufacturing processes viz. machining, sheet forming, electroplating, wire routing, cleating & crimping, assembly, surface preparation shall conform to good manufacturing practices.
- 8.6 Inspection for dimensional & visual checks especially of the following, with respect to contract drawings, documents & standards shall be conducted:



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- a) General sturdiness & rigidity of equipment.
- b) Surface finishing.
- c) Gasketting.
- d) Inter-changeability.
- e) Constructional features viz. location, accessibility & marking of components, segregation, accessibility to live parts (shrouding) etc.
- f) Completeness of scope.

8.7 Safety interlocking verification shall be done.

8.8 Each lighting transformer shall be routine tested and one transformer of each rating shall be type tested in accordance with relevant standard in case type test certificates of similar transformers are not available / not acceptable to the purchaser.

8.9 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.

9.0 TOOLS AND TACKLE

9.1 Tools & tackle which are essential to facilitate assembly, adjustments, erection, maintenance & dismantling of equipment shall be provided as part of equipment supplied.

9.2 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.

9.3 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.

9.4 Schedule of tools & tackle shall be filled up by bidder.

10.0 SPARES

10.1 Mandatory spares (if applicable) are indicated in BOQ-cum-price schedule.

10.2 Erection & commissioning spares are included in the bidder's scope of supply. Bidder to furnish list of E&C spares in the relevant schedules of the Bid Form and Price Schedules.



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DATA SHEET – C

S. No.	Description	Unit	Value
1.0	DELETED		
2.0	DELETED		
3.0	DELETED		
4.0	LIGHTING PANELS		
4.1	Operational Front		Single Front
4.2	Type of execution of modules (functional unit)		☒ Fixed ☐ Draw out
4.3	Application		☐ Indoor ☐ Outdoor ☒ Both
4.4	Type of sheet		FRP
4.5	FRP thickness (minimum)		3.0
4.6	Degree of Protection		
a)	Indoor panel		IP-54
b)	Outdoor panel		IPW-55, Weatherproof
c)	Canopy in outdoor panel		☒ Yes ☐ No
d)	Transformer cubicle		IP-42 (If applicable)
4.7	Bus bar material		Electrolytic grade hard drawn Aluminium
4.8	Earth bus bar required		☒ Yes ☐ No
4.9	Earth bus bar material		☒ GI Strip ☐ Aluminium ☐ Copper
4.10	Gland Plate	mm	3.0
4.11	Earthing studs required		☒ Yes ☐ No
4.12	Hinged door with locking facility		☒ Yes ☐ No
4.13	AC Lighting Panel		
a)	Incomer rating	A	Ref. section-1
b)	Type of Incomer		☐ SFU ☒ MCCB
c)	Earth Leakage Circuit Breaker (ELCB) in incomer required		☒ Yes ☐ No



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d)	Type of Outgoing Feeders (non-flameproof panel)		Ref. section-1
e)	Type of Outgoing Feeders (Flameproof panel)		☐ DP MCB ☐ TPN MCB
f)	Type of Outgoing Feeders (Street Light panel)		Ref. section-1
g)	ESS required for AC indoor/Outdoor panel		☒ Yes , as per BOQ cum price schedule ☐ No
h)	ESS required for DC panel		☐ Yes ☒ No
i)	ESS required for street panel		☐ Yes ☒ No
j)	Timer required Street Light panel		☒ Yes ☐ No
k)	Photocell required for Street Light panel		☒ Yes ☐ No
l)	Outgoing feeders rating	A	Ref. section-1
4.14	DC Lighting Panel		
a)	Incomer rating	A	Ref. section-1
b)	Type of Incomer		☐ DP SFU ☒ DP MCCB
c)	Type of Outgoing Feeders (non-flameproof panel)		☒ DP MCB
d)	Type of Outgoing Feeders (Flameproof panel)		☐ DP MCB
e)	Outgoing feeders rating	A	Ref. section-1
5.0	COMPONENTS OF LIGHTING SYSTEM EQUIPMENT		
5.1	Moulded Case Circuit Breaker (MCCB)		
a)	Rated voltage	V	415
b)	Number of poles		Three
c)	Rated short circuit duty	kA	50
d)	Rated breaking capacity (rms)	kA	50KA



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e)	Rated making current (peak)	kA	105KA
f)	Release with short circuit		YES
g)	Release with overload		YES
h)	Release with under voltage		NO
i)	Auxiliary contacts		
	Numbers	NO+NC	2NO+2NC
	Rating	A	As per manufacturer data
5.2	Switch-Fuse Unit		
a)	Utilisation category for main contacts		AC23
b)	Breaking Capacity: With conditions: a) Voltage b) Power Factor		3 times rated current 110% of rated voltage 0.3
5.3	Miniature Circuit Breaker		
a)	SPN MCB rating (min)	A	Refer Sl. No. 3 & 4
b)	DP MCB rating (min)	A	Refer Sl. No. 3 & 4
c)	TPN MCB rating (min)	A	Refer Sl. No. 3 & 4
d)	Short time rating	kA	10
e)	Magnetic short circuit protection required		☒ Yes ☐ No
f)	Thermal overload protection required		☒ Yes ☐ No
5.4	Current Transformer		
a)	Type		Cast resin
b)	Secondary current rating	A	☒ 1 ☐ 5
c)	Burden	VA	10
d)	Accuracy class		1.0



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e)	Instrument Safety Factor		<5
5.5	Indicating Meters		
5.5.1	Voltmeter		
a)	Type		Digital
b)	Shape		Square
c)	Size		96mm x 96mm
d)	Accuracy		2.0
e)	AC voltage coil rating	V	0-500
f)	DC voltage coil rating	V	0-250
5.5.2	Energy meter (if applicable)		
a)	Type		[] Analog [√] Digital
b)	Accuracy		1.0
c)	Current coil rating	A	1
d)	Voltage coil rating	V	0-500
5.6	Power Contactors		
a)	Coil voltage (nominal)		
	AC contactors	V	240
	DC contactors	V	220
b)	Current rating of contacts		
	Power	A	As per manufacturer data
	Control	A	As per manufacturer data
5.7	Timer		
5.7.1	Time switch		
a)	Type		Digital synchronous
b)	Range	hr	0-24
c)	Coil voltage rating	V	240
5.7.2	On delay timer		
a)	No. of contacts		
	ON time delay	NO+NC	As per scheme requirement



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	OFF time delay	NO+NC	As per scheme requirement
	Instantaneous	NO+NC	As per scheme requirement
b)	Coil voltage rating		
	AC timer	V	240
	DC timer	V	220
c)	Time delay range		
	AC timer	min	0-15
	DC timer	Sec	NA
5.8	Selector switch (voltage selector switch\auto manual control switch\ energy saving mode by pass control switch)		
a)	Type of selector switch		☒ Stay put ☐ Wing knob
b)	Lockable		☐ Yes ☒ No
5.9	Push Button		
a)	Voltage grade	V	500
b)	Potential free contacts		2NO+2NC
5.10	Indicating Lamps		
a)	Lens Colour		
	ON condition		Red
	OFF condition		Green
b)	Circuit voltage	V	240V
5.11	Cable Glands		By vendor for all incoming and outgoing cables
a)	Type		☒ Double compression ☐ Single compression
b)	Material		Brass
c)	Nickel Plating provided		☒ Yes ☐ No
d)	Flameproof glands with flameproof equipment		☒ Yes ☐ No
5.12	Cable Lugs		By vendor for all incoming and outgoing cables
a)	Type		Crimping type/ ring type



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b)	Material		Tinned copper
5.13	Load Manager		Class 0.5,digital,240V AC
6.0	Colour		
6.1	Colour shade		
a)	FRP LPs		Siemens gray (RAL-7032)

SECTION – 3

PROJECT INFORMATION AND GENERAL TECHNICAL REQUIREMENTS

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CHAPTER 1

PROJECT SYNOPSIS

1.0 GENERAL BACKGROUND AND SALIENT FEATURES

1.1 Introduction

Tamilnadu Generation and Distribution Corporation owns the proposed green-field 1320 MW (2 units of 660 MW each) Coal Based Thermal Power Station at Katupalli. This is an expansion of North Chennai Thermal Power Station (NCTPS) and located on some portion of the ashdyke of NCTPS.

1.2 Location

The proposed site for main power plant is located near Ennore port (approx 5 kms).
The nearest Railway station is at Ashipattu Pudunagar (approx 5 kms)
All weather road from Pattamandri on the Thiruvottiyur-Ponneri district highway is the nearest road access.
The nearest airport is at Chennai at a distance of 60 km.

1.3 NA

1.4 PROJECT INFORMATION

Project Title : **2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power Project at Ash Dyke of NCTPS**

Owner : **TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)**

LOCATION

The site is located near Vayalur Village, Ennore

Latitude : 13⁰17' N to 13⁰18' N

Longitude : 80⁰18' E to 80⁰19' E

Distance from Chennai City : 35 km

Nearest Airport is at Chennai at a

Distance of : 60 km

Nearest Seaport is : Ennore

Nearest Railway Station is : Athipattu Pudunagar (approx 5 kms)

Meteorological Condition

Climate : Tropical ,very dry and hot summer, dry and cold winter and good rain-fall in monsoon accompanied with strong wind.

Climatological data	:		
Ambient temp. (°C)	:	Annual Maximum Mean Temp	41.5(°C)
	:	Annual Minimum Mean Temp	24(°C)
	:	Design Ambient temperature	50(°C)
Relative Humidity	:	Maximum 100% Minimum 36% Design 75%	
Annual Rainfall	:	Maximum 2540 mm Average 1600 mm Minimum 1175 mm	
Prevailing Wind Direction	:	Nov to Jan – From NW & NE Feb to Mar – From East & SE Apr to May – From South & SE June – From SW July to Aug – From NW Sept to Oct – From SE & SW Wind Speed 11.8 kmph (avg) 50 kmph (max)	

Seismic Zone	:	Seismic Zone III as per IS:1893-2002 minimum 0.16 g horizontal	
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1.5

1.7

Access to Site

Site is well connected to all weather road from Pattamandri on the Thiruvottiyur – Ponneri district highway. Site is located adjacent to the Chennai – Howrah broad gauge line and thus well connected by rail also.

CHAPTER – 2

GENERAL TECHNICAL REQUIREMENTS

1.00.00 ELECTRICAL SYSTEM PARTICULARS

1) Standard voltage levels

The standardized voltage levels as shall be adopted as specified elsewhere in this specification.

2) Permissible variations:

The system unit/plant equipment shall be designed suitable for continuous operation with variation in voltage and frequency as indicated below:

3) Variation in voltage and frequency

	Voltage	Frequency
Permissible variation for power supply with rated Performance /rated current and control effectiveness maintained	+/- 10%	-5% to +3%
Permissible variation for control and regulation equipment with rated Performance and control quality maintained		

4) Basic insulation levels

Equipment shall be designed suitable for basic insulation levels as given below:

Nominal Voltage (kV)	BIL kV (peak)
400 kV	1425
33 kV	170
11 kV	75
3.3 kV	40

5) Symmetrical short circuit ratings

The three phase symmetrical short circuit ratings of the switchgear at different voltage levels shall be as indicated in the Table below:

S. No.	Voltage level	Symmetrical Breaking Capacity	Making Capacity
1.	400 kV	63 kA for 1 sec	163 kA
2.	33 kV	25 kA for 3 sec	62.5 kA
3.	11 kV	50 kA for 3 sec	125 kA
4.	3.3 kV	40 kA for 3 sec	100 kA
5.	415 V	50 kA for 1 sec	125 kA
6.	220 V DC	25 kA for 1 sec	-
7.	48 V DC	10 kA for 1 sec	

6) Criteria for selection of voltage levels for motors

Sr. No	Rating	Voltage Level
1	LV Motors- Up to 160 kW	415 V, 3 phase, 50 Hz
2	MV Motors- More than 160 kW and up to 1500 kW	3.3 kV, 3 phase, 50 Hz
3	HV Motors- Above 1500 kW	11 kV, 3 phase, 50 Hz

7) System Earthing

- i. 33kV/11 kV and 3.3 kV : Resistance grounded.
- ii. 415 V : Solidly grounded.

8) Degree of Protection:

Degree of protection for various electrical equipment shall be as follows:

S.No.	Equipment	Degree of Protection
1.	Marshalling Boxes, Panels, Motors located outdoor	IP55
2.	Electrical Equipment of CH System	IP55 with dust proof enclosure
3.	HV Switchgear	IP-4X for bus bar chamber, IP-6X for other compartments
4.	LV Switchgear	IP52 up to 1600 A and IP42 above 1600 A

2.00.00 GENERAL TECHNICAL PARTICULARS FOR EHV SYSTEM

(a)	Rated voltage	400 kV
(b)	Rated frequency	50 Hz
(c)	Rated short time current withstand capacity	63 kA rms for one (1) second
(d)	Rated one minute power frequency withstand voltage	650 kV rms between live terminals and earth b) 815 kV rms across isolating distance
(e)	Rated lightning impulse withstand voltage	a) 1425 kVp between live terminals b) 1425 (+240) kVp across isolating distance & earth.
(f)	Rated Switching Impulse withstand voltage	a) 1575 kVp (between phases) b) 900 (+345) (across isolating distance)
(g)	Phase to phase spacing	4000 mm
(h)	Rated terminal load	Adequate to withstand 100 kg static load as well as wind, seismic and short circuit forces without impairing reliability or current carrying capacity.
(i)	System neutral earthing	Effectively earthed
(j)	Support structure height	Adequate so that lowest part of support insulator of equipment is 2550 mm (minimum) from ground and/or plinth level.
(k)	Creepage distance	Minimum 31 mm / kV
(l)	Electrical Clearances	

Clearances shall be as given below and as per relevant statutory rules/codes.		
1.	Phase to earth	3500 mm
2.	Phase to phase	4000 mm
3.	Sectional clearance	6500 mm
4.	Ground clearance	8000 mm

3.00.00 NA

4.00.00 COMPLETENESS

4.01.00 Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure that a completely engineered plant is provided.

4.02.00 All equipment furnished by the Bidder shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation & maintenance of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All similar standard components/ parts of similar standard equipment provided, shall be interchangeable with one another.

5.00.00 CODES & STANDARDS

5.01.00 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following:

- (a.) Bureau of Indian Standards (BIS)
- (b.) Indian electricity act
- (c.) Indian electricity rules
- (d.) Indian Explosives Act

- (e.) Indian Factories Act and State Factories Act
- (f.) Indian Boiler Regulations (IBR)
- (g.) Regulations of the Central Pollution Control Board, India
- (h.) Regulations of the Ministry of Environment & Forest (MoEF), Government of India
- (i.) Pollution Control Regulations of Department of Environment, Government of India
- (j.) State Pollution Control Board.
- (k.) Rules for Electrical installation by Tariff Advisory Committee (TAC).
- (l.) Any other statutory codes / standards / regulations, as may be applicable.

5.02.00 Unless covered otherwise by Indian codes & standards and in case nothing to the contrary is specifically mentioned elsewhere in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:

- (a.) Japanese Industrial Standards (JIS)
- (b.) American National Standards Institute (ANSI)
- (c.) American Society of Testing and Materials (ASTM)
- (d.) American Society of Mechanical Engineers (ASME)
- (e.) American Petroleum Institute (API)
- (f.) Standards of the Hydraulic Institute, U.S.A.
- (g.) International Organisation for Standardization (ISO)
- (h.) Tubular Exchanger Manufacturer's Association (TEMA)
- (i.) American Welding Society (AWS)
- (j.) National Electrical Manufacturers Association (NEMA)
- (k.) National Fire Protection Association (NFPA)
- (l.) International Electro-Technical Commission (IEC)
- (m.) Expansion Joint Manufacturers Association (EJMA)
- (n.) Heat Exchange Institute (HEI)

5.03.00 Other International/ National standards such as DIN, VDI, BS, etc. shall also be accepted for only material codes and manufacturing standards, subject to the Owner's approval, for which the Bidder shall furnish, alongwith the offer, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned else

where in the specification together with the complete word to word translation of the standard that is normally not published in English.

~~5.04.00~~ NA

5.05.00 NA

5.06.00 NA

5.07.00 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Owner shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Bidder to bring to the notice of the Owner such changes and advise Owner of the resulting effect.

6.00.00 EQUIPMENT FUNCTIONAL GUARANTEE

6.01.00 The Equipment and Auxiliaries shall be capable of continuous operation in frequency range of 47.5 to 51.5 Hz.

7.00.00 DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS

7.01.00 Design of Facilities

All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.

The Bidder shall be responsible for the selection and design of appropriate equipment to provide the best co-ordinate performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling.

7.02.00 Maintenance and Availability Considerations

Equipment offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list.

Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely the minor and major overhauls shall be specified in maintenance manuals, clearly defining the spare parts and man-hour requirement for each stage.

8.00.00 DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY BIDDER

8.01.00 Each of the equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required ensuring a completely engineered plant shall be provided as per the scope.

The Bidder shall furnish engineering data/drgs. in accordance with the schedule of information as specified in Technical Specification and data sheets.

- 8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of documents is given in Chapter 4.
- 8.03.00 The documentation that shall be provided by the Bidder is indicated in various sections of specification. The documentation shall include but not be limited to the following:

Basic Engineering Documentation

Prior to commencement of the detailed engineering work, the Bidder shall furnish a Equipment Definition Manual within 4-6 weeks from the date of the Purchase Order. This manual shall contain the following as a minimum:

- i. System description of all the mechanical, electrical, control & civil systems.
- ii. Technology scan for each system / sub-system & equipment.
- iii. Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.
- iv. NA.
- v. Sizing criteria of all the systems, sub-systems including various equipment/ structures/ equipment foundations along with all calculations justifying and identifying the sizing and the design margins.
- vi. Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.
- vii. Operation Philosophy and the control philosophy.
- viii. General Layout plan.
- ix. NA
- x. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.
- xi. NA
- xii. NA
- i. Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.
- ii. NA

- iii. NA
- iv. NA
- v. NA
- vi. Technical data sheets for all bought out and manufactured items. Bidder shall use the specifications as a base for placement of orders on their sub-vendors.
- vii. Detailed design calculations for components, system/sub-system, etc., wherever applicable including sizing calculations as per criteria specified elsewhere in specification.
- viii. NA
- ix. NA
- x. NA
- xi. NA
- xii. NA
- xiii. Power supply single line diagram, block logics, control schematics, electrical schematics, etc.
- xiv. NA
- xv. Interconnection diagrams.
- xvi. Cable routing plan.
- xvii. Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring diagrams of panels and enclosures etc.
- xviii. Alarm and annunciation list and alarms & trip set points.
- xix. Sequence and protection interlock schemes.
- xx. Type test reports
- xxi. Control system configuration diagrams and card circuit diagrams and maintenance details.
- xxii. Detailed software manuals & source software listing.
- xxiii. Detailed flow chart for digital control system.
- xxiv. Mimic diagram layout.
- xxv. Civil Task drawings(for the Engineering by BHEL),Design and Drawings.
- xxvi. Model study reports wherever applicable.
- xxvii. NA
- xxviii. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.
- xxix. Documentation in respect of commissioning as listed out elsewhere in this specification.

8.03.01 Instruction Manuals

The Bidder shall submit, draft Instruction Manuals for all the equipment covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalization and approval of the BHEL / OWNER the Instruction Manuals shall be submitted as indicated in Chapter-4. **The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals with As Built drawings have been supplied.** The Instruction Manuals shall comprise of the following.

Erection Manuals

The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

- a) Erection strategy.
- b) Sequence of erection.
- c) Erection instructions.
- d) Critical checks and permissible deviation/tolerances.
- e) List of tool, tackles, heavy equipment like cranes, dozers, etc.
- f) Bill of Materials
- g) Procedure for erection.
- h) General safety procedures to followed during erection/installation.
- i) Procedure for initial checking after erection.
- j) Procedure for testing and acceptance norms.
- k) Procedure / Check list for pre-commissioning activities.
- l) Procedure / Check list for commissioning of the system.
- m) Safety precautions to be followed in electrical supply distribution during erection

Operation & Maintenance Manuals

- i. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall be in sufficient detail to enable the BHEL / OWNER to operate, 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, operation, maintenance, dismantling and repair including periodical activities such as chemical cleaning of the generator. Each manual shall also include a complete set of drawings together with performance/rating curves of the equipment and test certificates wherever applicable. The contract shall not be considered to be completed for purposes for taking over until these manuals have been supplied.
- ii. If after the commissioning and initial operation of the plant, the manuals require any modification / additions / changes, the same shall be incorporated and the updated final instruction manuals shall be submitted to the BHEL / OWNER for records.
- iii. 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 with all relevant pamphlets and drawings.

- iv. 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.
 - c) Where applicable, fault location charts shall be included to facilitate finding the cause of maloperation or break down.
- v. Detailed specifications for all the consumables including lubricant oils, greases, chemicals etc. system/equipment/assembly/sub-assembly - wise required for the complete plant.
- vi. On completion of erection, a complete list of bearings / equipment giving their location, and identification marks etc. shall also be furnished to the BHEL / OWNER indicating lubrication method for each type/category of bearing.

8.03.02

Plant Handbook

The Bidder shall submit to the BHEL / OWNER a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various equipment and systems covering the complete project including	
1.	Design and performance data.
2.	Process & Instrumentation diagrams.
3.	Single line diagrams.
4.	Sequence & Protection Interlock Schemes.
5.	Alarm and trip values.
6.	General layout plan
7.	Important Do's & Don't's
8.	The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of BHEL / OWNER's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03

Project Completion Report

The Bidder shall submit a Project Completion Report at the time of handing over the plant.

8.03.04

Drawings

- (a.) All documents submitted by the Bidder for BHEL / OWNER's review shall be in electronic form (soft copies) **along with the desired**

number of hard copies as per Chapter-4. The soft copies to be supplied shall be either in CDs, or through direct transfer via E-mail, etc. depending upon the nature/volume/size of the document. The drawings submitted for approval could be in the Image form.

- (b.) Final copies of the approved drawings shall be submitted on CD-ROM along with the requisite number of hard copies as per Chapter-4.
- (c.) The completed plant documentation with equipment drawings, data sheets, P&ID, BOQ, schematics, logic diagrams, test reports and quality plan, etc. shall be furnished to BHEL / OWNER.
- (d.) All documents/text information shall be in latest version of MS Office.
- (e.) All drawings submitted by the Bidder including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipment and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.
- (f.) Each drawing submitted by the Bidder (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the BHEL / OWNER, Consultant, name of the Project, system designation, the specifications title, the specification number, drawing/document number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.
- (g.) The Bidder shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the BHEL / OWNER. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY".
- (h.) Similarly, all the drawings/ documents submitted by the Bidder during detailed engineering stage shall be stamped "FOR APPROVAL" or "FOR INFORMATION" prior to submission.
- (i.) The furnishing of detailed engineering data and drawings by the Bidder shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Owner will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipment provided by others and external connections & dimensions which might affect plant layout. The review by the Owner should not be construed to be a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy

of the information submitted. The review and/ or approval by the BHEL / OWNER / Project Manager shall not relieve the Bidder of any of his responsibilities and liabilities under this contract.

- (j.) After the approval of the drawings, further work by the Bidder shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the BHEL / OWNER.
- (k.) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Bidder's risk. The Bidder is expected not to make any changes in the design of the equipment /system, once they are approved by the BHEL / OWNER. However, if some changes are necessitated in the design of the equipment/system at a later date, the Bidder may do so, but such changes shall promptly be brought to the notice of the BHEL / OWNER indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.
- (l.) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of BHEL / OWNER prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/representative of BHEL / OWNER based on requirements of such piping indicated in approved / finalized Flow Scheme / Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.
- (m.) Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the Bidder well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.
- (n.) As Built Drawings

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

- (o.) 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 BHEL / 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 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 BHEL/OWNER's scope and submit all necessary drawings/ documents for the same.

- (p.) The Bidder shall submit adequate prints of drawing/data/document for Owner's review and approval. The BHEL/OWNER shall review the drawings and return one (1) copy to the Bidder authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Bidder to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.
- (q.) All engineering data submitted by the Bidder after final process including review and approval by the BHEL/OWNER shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the BHEL/OWNER in writing.

8.04.00 Engineering Information Submission Schedule

Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the BHEL/OWNER. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorised into the following parts.

- (a.) Information that shall be submitted for the approval of the BHEL/OWNER before proceeding further, and
- (b.) Information that would be submitted for BHEL/OWNER's information only.

The Engineering Information Schedule shall be updated monthwise.

The schedule should allow adequate time for proper review and incorporation of changes/modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.

8.05.00 Engineering Progress and Exception Report

8.05.01 Report giving the status of each engineering information including

- (a.) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission
- (b.) Drawings which were not submitted as per agreed schedule.

8.05.02 The draft format for this report shall be furnished to the BHEL/OWNER within four (4) weeks of the award of the contract, which shall then be discussed and finalized with the BHEL/OWNER.

8.06.00 Co-Ordination Meetings

8.06.01 The Bidder shall be called upon to attend monthly Design/ Co-ordination Meetings (if required) with the BHEL/OWNER/Owner's representatives, Project Consultant during the period of contract. The Bidder shall attend such meetings at his own cost at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.

8.06.02 The Bidder should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Bidder shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Bidder will be reviewed by the BHEL/OWNER as far as practicable within three (3) weeks from the date of receipt of the drawing. The comments of the BHEL/OWNER shall then be discussed across the table during the above co-ordination Meetings wherein best efforts shall be made by both sides to ensure the approval of the drawing.

8.06.03 The Bidder shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Bidder shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.

8.06.04 Should any drawing remain unapproved for more than six (6) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.

8.06.05 Any delays arising out of failure by the Bidder to incorporate Owner's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Bidder to alter the Contract completion date.

8.07.00 Design Improvements

The BHEL/OWNER or the Bidder may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Bidder proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

8.08.00 NA

8.09.00 NA

8.10.00 Lubricants, Servo Fluids and Chemicals

8.10.01 The Bidder's scope includes all the first fill and one year's topping, requirements of consumables such as oils, lubricants including grease, fluids, gases and essential chemicals etc. Consumption of all these consumables during the initial operation and final filling after the initial operation shall also be included in the scope of the Bidder. Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. used which is expected to be utilised during the first year of operation. This additional quantity shall be supplied in separate Containers.

8.11.00 NA

8.12.00 Material of Construction

8.12.01 All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilized for various components shall be those which have established themselves for use in such applications.

8.13.00 Rating Plates, Name Plates & Labels

8.13.01 Each main and auxiliary item of plant including instruments 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 BHEL/OWNER.

8.13.02 Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the BHEL/OWNER or as detailed in appropriate section of the technical specifications.

8.13.03 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. The name plates shall be suitably fixed on both front and rear sides.

8.13.04 Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with epoxy. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.

8.13.05 Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support/hanger.

8.13.06 Valves, steam traps and strainers shall be identified by BHEL/OWNER's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.

- 8.13.07 Safety and relief valves shall be provided with the following :
- (a.) Manufacturer's identification.
 - (b.) Nominal inlet and outlet sizes in mm.
 - (c.) Set pressure in Kg/cm² (abs).
 - (d.) Blowdown and accumulation as percentage of set pressure.
 - (e.) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.
- 8.13.08 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.
- 8.13.09 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

8.14.00 Tools and Tackles

The Bidder shall supply with the equipment one complete set of all special tools and tackles and other instruments required for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.

The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Bidder shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Bidder should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the BHEL/OWNER.

8.15.00 Welding

- 8.15.01 If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipment to be performed by others the requirements shall be submitted to the BHEL/OWNER in advance of commencement of erection work.

8.16.00 Colour Code for all Equipment/ Pipings/ Pipe Services

- 8.16.01 All equipment/ piping/ pipe services are to be painted by the Bidder in accordance with BHEL/OWNER's standard colour coding scheme, which will be furnished to the Bidder during detailed engineering stage.

8.17.00 Protection and Preservative Shop Coating

8.17.01 Protection

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or overground environment as the case may be.

8.17.02 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 atleast 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 colors shall be as per manufacturer's standards, to be selected and specified by the BHEL/OWNER at a later date.

8.17.03 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Bidder after obtaining specific approval of the BHEL/OWNER 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 Owner.

8.17.04 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.

8.17.05 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Owner. Lube oil piping or carbon steel shall be pickled.

8.17.06 Painting for Civil structures shall be done as per relevant part of technical specification.

9.00.00 QUALITY ASSURANCE PROGRAMME

9.01.00 The Bidder shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Bidder's works or at his sub-Bidder's premises or at the Owner's site or at any other place of work are in accordance with the specifications. Such programs shall be outlined by the Bidder and shall be finally accepted by the Owner/authorized representative after discussions before the award of the contract. The QA programme shall be generally in line with IS/ISO-9001. A quality assurance programme of the Bidder shall generally cover the following:

- (a.) His organization structure for the management and implementation of the proposed quality assurance programme
- (b.) Quality System Manual
- (c.) Design Control System
- (d.) Documentation and Data Control System
- (e.) Qualification data for bidder's key personnel.
- (f.) The procedure for purchase of materials, parts, components and selection of sub-Bidder's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- (g.) System for shop manufacturing and site erection controls including process, fabrication and assembly.
- (h.) Control of non-conforming items and system for corrective actions and resolution of deviations.
- (i.) Inspection and test procedure both for manufacture and field activities.
- (j.) Control of calibration and testing of measuring testing equipment.
- (k.) System for Quality Audits.
- (l.) System for identification and appraisal of inspection status.
- (m.) System for authorising release of manufactured product to the Owner.
- (n.) System for handling, storage and delivery.
- (o.) System for maintenance of records, and
- (p.) 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.

9.02.00 General Requirements - Quality Assurance

9.02.01 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 Bidder 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 Bidder's responsibility to draw up and implement such programme duly approved by the Owner. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Owner for approval. Schedule of finalisation of such quality plans will be finalised before award. Monthly progress reports on MQP/FQP submission/approval shall be furnished.

- 9.02.02 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 Bidder's/ Sub-Bidder'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. Compact Disc or E-mail in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM.
- 9.02.03 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.
- 9.02.04 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 Owner's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Owner shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Owner's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Owner in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner along with technical justification for approval and dispositioning.
- 9.02.05 No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Owner's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).
- 9.02.06 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.
- 9.02.07 The Bidder shall submit to the Owner Field Welding Schedule for field welding activities in the format No.: QS-01-QAI-P-02/F3 to be issued at contract stage.
- 9.02.08 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 Owner.

All welding/brazing procedures shall be submitted to the Owner or its authorised representative for approval prior to carrying out the welding/brazing.

- 9.02.09 All brazers, welders and welding operators employed on any part of the contract either in Bidder's/sub-Bidder'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 Owner.
- 9.02.10 Welding procedure qualification & Welder qualification test results shall be furnished to the Owner for approval. However, where required by the Owner, tests shall be conducted in presence of Owner/authorised representative.
- 9.02.11 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 equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.
- 9.02.12 Unless otherwise proven and specifically agreed with the Owner, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
- 9.02.13 No welding shall be carried out on cast iron components for repair.
- 9.02.14 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 9.02.15 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.

All plates of thickness above 40mm & all bar stock/Forging above 40mm dia shall be ultrasonically tested. For pressure parts, plate of thickness equal to or above 25mm shall be ultrasonically tested.

- 9.02.16 The Bidder shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors bought out items (BOI). All the sub-Bidder proposed by the Bidder 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 Bidder and finalised with the Owner, shall be subject to Owner's approval. The Bidder'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 sub-contractors enclosed and shall be submitted to the Owner for approval within the period agreed at the time of pre-awards discussion and identified in review category prior to any procurement. Monthly progress reports on sub-Bidder detail submission / approval shall be furnished. Such vendor approval shall not relieve the Bidder from any obligation, duty or responsibility under the contract.

- 9.02.17 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Owner, the Bidder's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-Bidder 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. Such quality plans of the successful vendors shall be finalised with the Owner and such approved Quality Plans shall form a part of the purchase order/contract between the Bidder and sub-Bidder. Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Owner on the monthly basis by the Bidder along with a report of the Purchase Order placed so far for the contract.
- 9.02.18 Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder's or their sub-Bidder's quality management and control activities. The Bidder shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.
- 9.02.19 The Bidder shall carry out an inspection and testing programme during manufacture in his work and that of his sub-Bidder's 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. Bidder shall carry out all tests/inspection required to establish that the items/equipment 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.
- 9.02.20 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Owner 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 Bidder in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.
- 9.02.21 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
- 9.02.22 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Owner/ authorised representative.
- 9.02.23 Burn in and Elevated Temperature Test Requirement for Electronics Solid State Equipment
- All solid state electronic systems/equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours (7 Days) continuously under energized conditions prior to shipment from manufacturing works, as per the following cycle.

Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours of the total 168 hours of testing, the ambient temperature shall be maintained at 50 deg.C. The equipment shall be interconnected with devices which will cause it 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 deg.C above the ambient temp. at 50 deg.C.

Burn in Test Cycle

The 48 hours elevated temperature test shall be followed by 120 hours of burn in 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.

In case the Bidder/ sub-Bidder is having any alternate established procedure of eliminating infant mortile components, the detail procedures followed by the Bidder/ sub- Bidder along with the statistical figures to validate the alternate procedure to be forwarded.

The Bidder/Sub-Bidder shall carry out routine test on 100% item at Bidder/sub-Bidder's works. The quantum of check/test for routine & acceptance test by Owner shall be generally as per criteria/sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check/test for routine / acceptance test shall be as agreed during detailed engineering stage.

9.03.00 QA Documentation Package

The Bidder shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (?) mark.

- 9.03.01 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 despatch. However CD-Rom may be issued not later than three weeks.

9.03.02 Typical contents of QA Documentation is as below:-

- (a.) Quality Plan

- (b.) Material mill test reports on components as specified by the specification and approved Quality Plans.
 - (c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
 - (d.) 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.
 - (e.) Heat Treatment Certificate/Record (Time- temperature Chart)
 - (f.) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).
 - (g.) CHP / Inspection reports duly signed by the Inspector of the Owner and Bidder for the agreed Customer Hold Points.
 - (h.) Certificate of Conformance (COC) wherever applicable.
 - (i.) MDCC
- 9.03.03 Similarly, the Bidder shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.
- 9.03.04 Before despatch / 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.
- (a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.
 - (b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize 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.
 - (c.) If a decision is made despatch, 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 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 despatch of equipment.

9.03.05 Transmission Of QA Documentation

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Owner.

For the particular case of phased deliveries, the complete quality document to the Owner shall be issued not later than 3 weeks after the date of the last delivery of equipment.

9.04.00 Project Manager's Supervision

9.04.01 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Owner's Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section General Conditions of Contract, the Bidder shall proceed to comply with the Project Manager's decision.

9.04.02 The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:

- (a.) Interpretation of all the terms and conditions of these documents and specifications:
- (b.) Review and interpretation of all the Bidder's drawing, engineering data, etc:
- (c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract :
- (d.) Inspect, accept or reject any equipment, material and work under the contract.
- (e.) Issue certificate of acceptance and/or progressive payment and final payment certificates
- (f.) Review and suggest modifications and improvement in completion schedules from time to time, and
- (g.) Supervise Quality Assurance Programme implementation at all stages of the works.

9.05.00 Inspection, Testing And Inspection Certificates

9.05.01 The word 'Inspector' shall mean the Project Manager and/or his authorized representative and/or an outside inspection agency acting on behalf of the Owner to inspect and examine the materials and workmanship of the works during its manufacture or erection.

- 9.05.02 The Project Manager or his duly authorized representative and/or an outside inspection agency acting on behalf of the Owner 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 Bidder shall obtain for the Project Manager and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works.
- 9.05.03 The Bidder shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Bidder's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, 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 Bidder 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.
- 9.05.04 The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Bidder, 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 Bidder 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.
- 9.05.05 When the factory tests have been completed at the Bidder's or sub-Bidder'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 Bidder's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 9.05.06 In all cases where the contract provides for tests whether at the premises or works of the Bidder or any sub-Bidder, the Bidder, 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 authorized representatives to carry out effectively such tests on the equipment in accordance with the Bidder and shall give facilities to the Project Manager/Inspector or to his authorized representative to accomplish testing.
- 9.05.07 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed Quality Assurance Programme forming a part of the contract.

- 9.05.08 To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 9.05.03- of this chapter, the Bidder 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.
- 9.05.09 All inspection, measuring and test equipment used by Bidder shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by the Owner. Wherever asked specifically, the Bidder shall re-calibrate the measuring/test equipment in the presence of Project Manager/Inspector.
- 9.06.00 **Associated document for quality assurance programme:**
- 9.06.01 List of items requiring quality plan and sub supplier approval.
- 9.06.02 Status of items requiring Quality Plan and sub supplier approval.
- 9.06.03 Field Welding Schedule
- 9.06.04 Manufacturing Quality Plan
- 9.06.05 Field Quality Plan
- Format for the above shall be issued at Contract stage.

10.00.00 PRE-COMMISSIONING AND COMMISSIONING FACILITIES

- (a.) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Owner and the Bidder for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Bidder's quality assurance programme as well as those included elsewhere in the Technical Specifications.
- (b.) The Bidder's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipment shall be operated integral with sub-systems and supporting equipment as a complete plant.

It will be the responsibility of the Bidder to assess and furnish a list of all commissioning spares required for successful commissioning of all the equipment covered under the contract. Such a list shall be

furnished by the Bidder within 12 months from the date of LOA, separately for each equipment and shall be reviewed by the Owner and discussed for mutual agreement. The commissioning spares will be so identified as not to allow the trial operation to suffer for want of such commissioning spares. The identification of commissioning spares will not in any way relieve the Bidder of any of his responsibilities of satisfactory performance under the provisions of other conditions of contract. All the commissioning spares shall be deemed to be included in scope of the Bidder as a part of the respective equipment package at no extra cost to the Owner.

- (c.) NA
- (d.) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.
- (e.) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Owner's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SLs (Standard Check List) / TS (Testing Schedule) / CS (Commissioning Schedule)] approved by the Owner.
- (f.) The Bidder during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.
- (g.) Bidder shall furnish the commissioning organization chart for review & acceptance of Owner at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain :
 - (1.) Biodata including experience of the Commissioning Engineers.
 - (2.) Role and responsibilities of the Commissioning Organisation members.
 - (3.) Expected duration of posting of the above Commissioning Engineers at site.

10.02.00 Initial Operation

- a) On completion of all pre-commissioning activities / tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.
- b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation

- of 720 hours, the unit shall operate continuously at full rated load for a period not less than 72 hours.
- c) The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.
 - d) The Bidder shall intimate the Owner about the commencement of initial operation and shall furnish adequate notice to the Owner in this respect.
 - e) Any loss of generation due to constraints attributable to the Owner shall be construed as Deemed Generation.
 - f) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Bidder. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Bidder to the full satisfaction of the Owner to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for withholding the aforesaid permission.

10.03.00 **Guarantee Tests**

- a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Bidder in presence of the Owner. The Bidder's Commissioning, Start-up Purchaser shall make the unit ready to conduct such test. Such test will be commenced and completed as per schedule.
- b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee.
- c) For performance/ demonstration tests instrumentations, of accuracy class, to the approval of the Owner shall be used. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Owner's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points.
- d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Bidder, free of cost.
- e) The Guarantee tests and specific tests to be conducted on equipment have been brought out in detail elsewhere in the specification.

11.00.00 **TAKING OVER**

Upon successful completion of Initial Operations and all the tests other than guarantee tests conducted to the Owner's satisfaction, the Owner shall issue to the Bidder a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Owner delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Bidder of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

12.00.00 TRAINING OF OWNER'S PERSONNEL

- 12.01.00 The scope of service under training of Owner shall include a training module in the areas of Operation & Maintenance.

Such training should cover the following areas as a minimum in order to enable these personnel to individually take the responsibility of operating and maintaining the power station in a manner acceptable to the Owner:

- (a.) Training for Electric Power Supply systems

The above training shall be provided taken by the Bidder in one of the reference power plant.

- 12.02.00 The scope of services under training shall also necessarily include training of Owner's Engineering personnel covering a training module of upto 2 man months. This shall cover all disciplines viz, Mechanical, Electrical, C&I, & QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design softwares of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. An indicative module of the training requirement of Owner's Engineering personnel is attached as Annexure-I (BOQ).
- 12.03.00 Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Owner's approval. Consolidated training period included above (i.e. 1 and 2 man months respectively for O&M and Engineering) is indicative only. Owner reserves the right to reappropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.
- 12.04.00 Refer Annexure-II for detailed scope of services under Training.
- 12.05.00 Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal within two (2) months from placement of award.
- 12.06.00 In all the above cases, wherever the training of Owner's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Owner's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.

12.07.00 Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Owner reserves the right to include or exclude these item(s) during place of Award. All expenses except travelling expenses shall be borne by the contractor.

13.00.00 SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

- (a.) Working platforms should be fenced and shall have means of access.
- (b.) Ladders in accordance with Owner's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.

14.00.00 NA

15.00.00 PACKAGING AND TRANSPORTATION

All the equipment & spares shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. Each spare shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packaged in a single case, a general description of the contents shall be shown on the outside of such a case and other packages must be suitably marked and numbered for the purpose of identification. All cases, containers or packages, are liable to be opened for such examination as may be considered reasonable by the Engineer. In case of equipment supplied with grease/lubricants from imported origin, the supplied shall clearly indicate the indigenous equivalent of the grease/lubricant and source of supply so as to enable the Owner to procure these items from indigenous sources. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Bidder shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting dispatch of equipment. Before dispatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & pre-assembly to bare minimum. The Owner's Inspector shall have right to insist for completion of works in shops before dispatch of materials for transportation.

- Manufacturer shall furnish detailed Packing list before dispatch of material
- Master Packing List for complete list of Equipment or Material to be furnished to BHEL for this project during detailed Engineering Stage.

The Packed item shall have Marking Plate with following details on Packing:

	BHEL-TBG-Noida-India
NAME OF ITEM	
CONSIGNEE	
MATERIAL	
CUSTOMER REF.	
DESPATCH ADVICE NOTE NO.	
DIMENSIONS (MM) LXBXH	
NET WEIGHT (KG)	
GROSS WEIGHT (KG)	
SPECIAL INSTRUCTIONS	HANDLE WITH CARE – KEEP DRY DO NOT DROP – DO NOT TILT (or manufacturer's instructions)
MO. NO.	
CASE NO.	

16.00.00 ELECTRICAL ENCLOSURE

All electrical equipment and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specification.

17.00.00 INSTRUMENTATION AND CONTROL

All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.

17.01.00 All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units as follows:

a)	Temperature	-	Degree centigrade (deg C)
b)	Pressure	-	Kilograms per square centimeter (Kg/cm ²). Pressure instrument shall have the unit

			suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.
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17.02.00 All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plug-in connection at rear.

17.03.00 All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalized & components shall be of industrial grade or better.

18.00.00 ELECTRICAL NOISE CONTROL

The equipment furnished by the Bidder shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Bidder's equipment, which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-801- 2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems.

19.00.00 NA

20.00.00 TAPPING POINTS FOR MEASUREMENTS

Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Bidder will be intimated about thread standard to be adopted.

The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Bidder.

- (a.) Temperature test pockets with stub and thermowell
- (b.) Pressure test pockets

21.00.00 ELECTRONIC MODULE/COMPONENT DETAILS

The Bidder shall have to furnish all technical details including circuit diagrams, specifications of components, etc., in respect of each and every electronic card/module as employed on the various solid state as well as microprocessor based systems and equipment including conventional instruments, peripherals etc.

It is mandatory for the Bidder to identify clearly the custom built ICs used in the package. The Bidder shall also furnish the details of any equivalents of the same.

22.00.00 ENVIRONMENTAL MONITORING & CONTROL MEASURES

Bidder to note that MOEF has declared Manali area as critically polluted area and also imposed certain restrictions on consideration of developmental projects.

Concerned authorities have been addressed to have self monitoring system (for Air, Water & Land) so as to ascertain the level of compliance of standards prescribed by MOEF and also to furnish the action plan ie., for the establishment of self monitoring system. It is also directed to undertake Environmental Audit (EA) to ascertain the compliance level of standards notified by MOEF.

CHAPTER - 3

PAINTING

1.0 SCOPE

This section defines the technical requirements for surface preparation, selection and application of paints on equipment, vessels, machinery, piping, ducts etc. However, manufacturers shall follow their standard procedures for painting their equipment. The bidder shall submit a detailed painting procedure for approval of owner/ owner's representative after the award of contract.

The following surface and material shall require painting:

- a. All un-insulated carbon steel and alloy steel equipment like columns, vessels, storage tanks, pumps, heat exchangers etc.
- b. All un-insulated carbon steel and low alloy piping, fitting and valves (including painting of identification marks).
- c. All pipe structural steel supports, walkways, platforms, handrails, ladders etc.

The following surfaces and materials shall not require painting :

- a. Non-ferrous materials
- b. Austentic stainless steel
- c. Plastic and / or plastic coated materials
- d. Insulated surface of equipment and pipes except color coating wherever required.
- e. Painted equipment like blowers, pumps, valves etc. with finishing coats in good condition and with matching color code.

2.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job :

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of pipelines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)

IS:158	:	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS:2932	:	Enamel Synthetic exterior (a) Undercoating (b) finishing
IS:4682	:	Code of practice for lining of vessels & equipment
SIS 559000	:	Swedish standard for blasting
ISO 8504-2	:	Preparation of steel substrates before application of paints and related products. Surface preparation methods Part 2 Abrasive blast cleaning
ISO 8501-1	:	Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Part 1 : Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
SIS 05 5800	:	Surface preparation by acid pickling
SSPC SP08	:	Surface preparation by acid pickling
IS 2629	:	Recommended practice for hot dip galvanizing of iron and steel
ASTM A780	:	Standard practice for repair of damaged galvanized coatings
SSPC	:	Steel structures painting council
NACE	:	National association of Corrosion Engineers
DIN	:	Deutsehes Institute for Normung
BS	:	British Standard
ASTM	:	American Society for Testing material
AWWA	:	American Water works association

3.0 SURFACE PREPARATION

The surface shall be prepared in a manner suitable for coatings. Chemical derusters or rust converters shall not be applied. Acid cleaning is subject to approval of Purchaser/ Purchaser's representative.

3.1 BLASTING

The surface of the part/ component shall be blasted before the coating material is applied.

Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air above 1100C. Blasting activity shall be performed at temperatures 30C above dew point and substrata temperature between 50C & 500C and relative humidity not exceeding 85% shall be maintained during painting. Necessary safety precautions for equipment and operator shall be adhered to and shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work.

Abrasive used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives are chilled iron grit, shot steel, malleable iron grit and shots of non metallic abrasive (aluminum oxide, copper slag, garnet etc.).

The grade of blasting shall be performed in line with the approved painting scheme.

The nature, quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the required surface profile depth and cleanliness.

Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and commencement of painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

The grades of surface finish

	ISO 8501-1	SIS 055900	SSPC	NACE
White metal	Sa3	Sa3	SP5	1
Near White metal	Sa 2½	Sa 2½	SP10	2
Commercial Blast	Sa2	Sa2	SP6	3
Brush off blast	Sa1	Sa1	SP7	4

Unless otherwise specified in the documents, the surface shall satisfy the following requirements after blasting

(a) Blasting according to SIS 055900, Grade Sa 2½

Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer coat shall be 15-25 µm.

3.2 Manual Rust Removal

Manual rust removal shall be allowed for welded zones and for touching up installed components.

3.3 Cleaning

Removal of impurity

	Impurity	Removal
a)	Dust, Loose deposits	Vacuum cleaning, brushing
b)	Adhesive deposits	Power brushing
c)	Oils, greasy impurities	Wet Blasting, Use of Detergent Additives by agreement
d)	Salt deposits	Rinsing
e)	Markings (eg felt up pen)	Organic solvents to manufacturer's specifications eg Trichloro trifluoro ethane and solvents containing acetone (renew solvent and rag frequently)

3.4 Acid Pickling

Prior to galvanizing the surface preparation shall be done by acid pickling as per SSPC-SP-08.

4.0 PROCESSING

4.1 General Application Conditions

The primer shall be applied to properly prepared surfaces only. The specifications of the coating material manufacturers shall be observed. The minimum temperature shall be + 5°C and the relative humidity shall not exceed 80%. The temperature of the work piece shall be at least 3°C above dew point.

4.2 Application Procedure

The primer shall be applied by means of brush or by spary. The top coats shall be applied by means of brush, roller or spray.

At points where coating application is interrupted, the individual layers shall be adequately stepped to ensure proper layer sequence when coating operations are resumed.

4.3 Touching Up

Before each layer is applied, previous coating shall be touched up where necessary by way of rust removal and cleaning according coating manufacturers specification. The final top shall be reapplies completely.

4.4 Uncoated Surfaces

Moving parts of machines (e.g stems, shafts, sliding and locating bearings), nameplates, instruments and sealing surface shall not be coated. Welds shall be left free of coating upto a distance of 30 mm on each side of the weld edge until erection and weld examinations, if any, have been completed.

4.5 Bond Strength

The pill off stress determined using the pull off test method for adhesion shall not be less than 1.5 N/mm², according to ISO 4624.

5.0 SURFACE CONDITIONS OF COATING SURFACES

The coating surface shall have a uniform film thickness, shade and gloss and shall be free from inclusions, sags and wrinkles.

6.0 COATING SYSTEMS

6.1 General Requirements for Coating Systems

Coating materials according to SSPC, BS 5493 or DIN 55 928 shall be used. Intermediate coats are to be pigmented with micaceous iron oxide. The materials shall be matched with each other so that they are compatible. Coatings deviating this specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years.

The colour and gloss of top coats shall be in accordance with sub clause suggested colour codes for painting (Sub Clause 6.8)

6.2 Standard Coating System (External Coatings)

(a) Steel Surfaces

- (i) All steel structures shall receive two primer coats and two sandwich coat of MIO Epoxy paint and one finish coat of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and

final alignment of the erected structures. Two intermediate coats and one finished coat shall also be applied after erection.

- (ii) Steel surface which is to be painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be abrasive blasted as explained in clause 3.1 to Sa 2½ finish as per SIS05-5900. Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer shall be 60 microns.
- (iii) Two intermediate MIO Epoxy paint, and one top polyurethane coating of approved brand shall be applied. Dry film thickness of each intermediate coat shall be 90 microns and top polyurethane coating shall be 30 microns. The under coat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 330 microns. All paints shall be of approved brand and shade as per owner's requirement.
- (iv) Joints to be site welded shall have weldable primer applied within 100 mm of welding zone. Similarly where friction grip fasteners are to be used removable anti corrosive coating shall be provided. On completion of the joint the surfaces shall receive the paint as specified.
- (v) Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams, supporting gratings or chequered plate shall receive one additional coat of finish paint over the above number of coats specified before erection. Portion of steel member embedded/ to be encased in concrete shall not be painted.

(b) Gratings and Step Threads

(i) Surface Preparation

Gratings and step threads shall be cleared by acid pickling as per SSPC-SP-08

(ii) Hot Dip galvanizing

The hot dip galvanizing shall be done as per IS 2629. The average mass of coating shall be 610 gm/m².

(iii) Post Treatment

Immediately after galvanizing post treatment such as chromating shall be applied to retard white rust attack.

(iv) Touch up mechanical damages

The repair of damages coatings shall be done as per the recommended practice ASTM A780.

CHAPTER 4

DRAWING DOCUMENT SUBMISSION

4.1 DISCREPANCIES BETWEEN DRAWING AND SPECIFICATION:

Should there be any discrepancy between the specifications and/or schedule of prices and/or drawings or any inconsistency, error or omission in either of them, reference must be made to the BHEL/CUSTOMER for an explanation and the Supplier will be held responsible for any errors that may occur in the work through neglect of this precaution. The explanation of the BHEL/CUSTOMER shall be final and binding on the Supplier.

4.2 APPROVAL PROCEDURE

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

i.	First Submission	Within 7 days from the date of LOI/PO
ii.	Approval/comments/by employer on Initial submission	Reasonable time
iii.	Resubmission	Within 7 days (whenever from date of comments required) Including both ways postal time.
iv.	Approval or comments	Within 2 weeks of receipt of resubmission.
v.	Furnishing of distribution copies	2 weeks from the date of last approval.

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

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

4.3 TITLE BLOCK

Following Title Blocks to be used in drawings at the time of drawing approvals

Project:	400kV GIS at 2 x 660 MW Ennore SEZ Supercritical Thermal Power Project at Ash Dyke of NCTPS, Chennai-120		
NOA No:	CE/P/SE/M/P/EE-10/E/P/F.2X660MW	ENNORE	SEZ
	STTP/D60/DT 27.027.2014		
Customer :	TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)		
Consultant	DESEIN PRIVATE LIMITED,NEW DELHI		
Contractor	BHARAT HEAVY ELECTRICALS LIMITED		

4.4 DOCUMENTS TO BE SUBMITTED ALONG WITH OFFER

- 1) Drawings
- 2) Guaranteed Technical Particulars
- 3) Type Test Reports
- 4) List of Part Supplies with rating

Drawings & Documents submitted at the time of offer shall be subject to review at contract stage.

4.5 DOCUMENTATION SCHEDULE

Following Documentation schedule to be followed per project.

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
			Hard Copy / Prints	Hard Copy / Prints	CDs
1	Drawings and Data Sheets	1	7	10	5
2	Drawings "As Built "	-	-	10	
3	Type Test Reports	1	7	10	
4	Erection Manuals	-	7	10	
5	Operation and Maintenance Manuals	-	7	10	
6	Manufacturing Quality Plan	-	7	10	
7	Field Quality Plan	-	7	10	

8	Inspection Test Reports	-	7	10	
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Supplier to submit Hard copies of the drawing to following address

To,
<Name of BHEL's concerned engineering official>
Bharat Heavy Electricals Limited
Transmission Business Group- Engineering Management
Advant Navis IT Business Park
Plot No.-7, Greater Noida Expressway,
Sector 142, **NOIDA**, Uttar Pradesh 201305

Note: Drawings will also be submitted in CD/DVD in Latest AUTOCAD version or any other CAD package along with conversion files for all major items.

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

Annexure-A: Schedule of Technical Deviations

Bidder shall list out all technical deviation(s) along with clause with respect to technical specifications.

<u>Sl. No.</u>	<u>Page No.</u>	<u>Clause No.</u>	<u>Deviation</u>	<u>Reason / Justification</u>
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Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date:

Bidder's Stamp & Signature