

1 Scope, Quantities, Specific Technical Requirements & Tests

1.1 Scope

The scope of work includes design, engineering, manufacturing, assembly with Bought out items, testing before supply, inspection, packing, loading at works, transportation to site, Material reconciliation at site, Erection, testing & commissioning at site of all the required Material and accessories for the complete 400kV Switchyard area (including roads within switchyard fence), GIS building along with ventilation building for GIS building with Store, Switchyard Control room building. Performance test including Lux level measurement is in the scope of bidder.

The Contract shall be on Bill of Quantity (BOQ) basis for the package. After award of the contract, Bidder to design & estimate the quantity of each item of the contract Bill of Quantity. In case of change in scope after award of the contract or change in BOQ as per detailed design & customer approved BOQ, the additions/ deletions to the original/initial contract BOQ shall be as per the breakup unit rates for all the equipment and services furnished by the bidder in their offer.

After contract, the bidder has to design the system as per relevant standard/ codes to the satisfaction of BHEL/Customer.

It is not the intent to specify herein all the details of design and manufacturing. The equipment and the system shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to BHEL/Customer, who will interpret the meaning of drawings and specifications and shall be entitled to reject material, which in his judgment is not in full accordance herewith.

The bidder shall have deemed to have understood completely all the tender drawings and documents and quoted accordingly.

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

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

The equipment is required for the following project:

Name of customer:	TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)
Name of the project:	2 x 660 MW Udangudi STPP (Stage-I)

1.1.1. SCOPE OF SUPPLIES & SERVICES

- i. System Design Engineering is included in vendor's scope, which includes design of complete lighting system for indoor and outdoor areas. Please refer the list of reference drawings for the tentative areas to be covered by the lighting system. The aspect of engineering covers preparation of electrical distribution and control schemes, quantity estimation, luminaire layout drawings, conduit layout drawings, wiring schemes upto luminaires, cable schedules and all associated design work not specifically mentioned in the specification. Conduit layout drawing shall be submitted on priority to facilitate civil works at site. Design engineering charges are considered

- to be included in main equipment supply price. No separate charges shall be applicable.
- ii. The main items to be furnished for Switchyard under this contract are detailed in **Annexure-BOQ-Supply and Spare** and shall be read in conjunction with other clauses of this specification.
 - iii. **DELETED**
 - 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. **DELETED**
 - vii. Review of sub-vendor's documents by the purchaser shall not relieve the vendor from the responsibility of design & supply.
 - viii. **DELETED**
 - ix. **DELETED**
 - 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 earthing 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 earthing wire.
 - xii. Supply of all other items such as wires, steel wire, lugs, cable glands (if cables are supplied by bidder), earthing material etc. required to complete the work is in bidder's scope.
 - xiii. Cable gland plate in all the panels shall be minimum 2.0 mm.
 - xiv. The documents shall be in English language and MKS system of units.
 - xv. All accessories shall be wired upto a terminal block or a separate weatherproof metallic terminal box suitable for 2.5 sq. mm. copper wire termination.
 - xvi. Single line diagrams of power distribution upto Lighting Panels. Separate drawing for complete lighting distribution shall also be prepared by vendor.
 - xvii. Preparation of As-Built drawing and submission of the same in hard copy and softcopy is in vendor scope.
 - xviii. Conducting of lux level measurement as per approved designs to the satisfaction of owner/ purchaser shall be under bidder's scope.
 - xix. **DELETED**
 - xx. Complete earthing work of all items being supplied under illumination system is in Bidder's scope. Supply & ETC of all earthing material as per Clause 2.11 including laying, cutting, bending, welding with 40 mm dia MS rod riser/GS strip, clamping to structure/building wall etc. to complete earthing work is in Bidder's scope. Hardware required for connecting of earthing material on structure, equipment, luminaries, switches etc. is included in Bidder's scope. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint. Equipment bolted connections after being tested and checked shall be painted with anti- corrosive paint/compound.
 - xxi. Minor civil works such as grouting, filling up of crevices/ cut outs etc during installation of equipment shall also be in contractor's scope. Any other damage caused to civil works during ETC work of the Illumination equipment/system shall be made good to the original finish by the Contractor at no extra cost to the Purchaser.

1.1.2. EXCLUSIONS / BHEL ISSUED ITEMS FOR ILLUMINATION

Following items shall be supplied by BHEL for illumination system. Remaining all items required for successful completion of illumination system is under scope of bidder. However, bidder must submit quantity required with calculation sheet for BHEL supplied items during contract stage.

- i. 415V Main Lighting Distribution Board
- ii. 415V AC Emergency Lighting Distribution Board
- iii. Lighting Transformers for MLDB & ELDB
- iv. Multicore armoured power & control cable cables
- v. Power Cables: Following are the various cable sizes that may be used for project execution. Bidder shall estimate the cables required for successful completion of the full scope of illumination works. The quantity of the cables shall be free issued to the successful bidder as per the estimate given by bidder.
 - 2 core x 6 sq.mm (XLPE/ Al.)
 - 4 core x 6 sq.mm (XLPE/ Al.)
 - 4 core x 16 sq.mm (XLPE/ Al.)
 - 3.5 core x 70 sq.mm (XLPE/ Al.)
 - 3.5 core x 150 sq.mm (XLPE/ Al.)
 - 3.5 core x 300 sq.mm (XLPE/ Al.)
 - 1 core x 630 sq.mm (XLPE/ Al.)
- vi. 75x8 & 50x6mm GS flat for earthing works, **however GS flat of size less than 50X6 shall be supplied by bidder.**
- vii. 100/50mm GI/ PVC pipe for cabling works
- viii. 40mm dia MS rod for earthing works

1.2 Quantities

For Supply & spare scope: As per **Annexure-BOQ-Supply and Spare.**

For Erection, testing & commissioning scope: As per **Annexure-BOQ-ETC.**

Quantity Variation: Total Purchase order/Work order value may vary by $\pm 30\%$, however individual items can vary to any extent.

Lot-wise technical manufacturing clearance will be provided based on approval of relevant BOQ & drawings/ documents:

- LOT 1: Switchyard control room Building
- LOT 2: GIS building along with ventilation building for GIS building with Store
- LOT 3: Outdoor switchyard area
- LOT 4: Street lighting

1.3 Specific Technical Requirements

Refer DESIGN MEMORANDUM FOR LIGHTING SYSTEM (400KV SWITCHYARD): TB-400-558-127-14-REV 00.

Refer Section 2 of this document.

1.4 Technical Pre-Qualifying Requirements

The bidder should have experience of design, supply and Erection, testing & commissioning (ETC) of Illumination System for at least One (1) projects of State Electricity Boards/ Central Utilities/State or Central Transmission Utilities/ Industrial Installations.

The following Documents to be submitted along with Technical bid submission for qualifying:

- a. Proof of design: Approved design documents and drawings of indoor & outdoor areas, duly approved by customer.
- b. Proof of Supply: Purchase Order copy defining the scope & value with Material receipt certificate/dispatch note document from customer/contractor.
- c. Proof of ETC: Handing over report/completion certificate/other document indicating completion of ETC work duly signed by customer/contractor.

1.5 Tests

- 1.5.1. Equipment offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished. For the various bought out items test certificates from equipment Manufacturer shall be furnished.
- 1.5.2. Routine tests shall be carried out for all the equipment as per applicable standards/Quality plan.
- 1.5.3. In case type test reports are found to be technically not acceptable to BHEL/TANGEDCO, the type tests shall be conducted without cost and delivery implication to BHEL.

1.6 Quality plan

Bidder to follow valid TANGEDCO/BHEL approved quality plan at contract stage. Bought out items should be of reputed make and make of items is subject to customer approval.

1.7 Drawings & Engineering Documents

The successful bidder shall have to extend all possible support like timely submission/resubmission of drawings, visit to end customer to facilitate documents approval without any commercial implications to BHEL. Acceptance of bidder's documents shall be subject to end customer approval.

Date of Submission of first lot of drawings will be counted only from the date of submission of reasonably correct drawings.

1.8 Erection, Testing & commissioning

- 1.8.1. The Erection & commissioning materials (all necessary interconnecting/ terminating/ fixing accessories & fixing hardware such as double compression cable glands, conduit fittings viz. couplers, elbows, bends, tees, circular boxes etc., conduit accessories viz. clips, saddles, spacing plates, entry bushes, lock nuts, plugs, heavy duty lugs, ferrules, expansion fasteners, covers for power outlets in wash rooms and showers, ball & sockets, earth clips, fan boxes, clamps, screws, ceiling rose, casing and capings etc. form part of erection activities) including commissioning & operational spares up to system handing over to customer has to be worked out for complete and successful erection & commissioning. The price of Erection &



commissioning material shall be inclusive in the individual Erection & commissioning item as per Annexure-BOQ-ETC.

- 1.8.2.** Fabrication & painting charges of structural steel shall be part of erection charges of those equipment for which the same is being used.
- 1.8.3.** All measuring and testing instruments required during erection, testing, commissioning and performance testing shall be arranged by the bidder and taken back.

2 Equipment Specification

2.1 Lighting design

- 2.1.1. The plant lighting system shall comprise following categories:
- Normal 230 V AC Lighting System
 - Normal-cum-Emergency 230 V AC Lighting System
 - Emergency DC Lighting System
- 2.1.2. Normal AC lighting shall be provided by lighting distribution boards and lighting panel distributed throughout the switchyard. Supply to these lights shall be ON as long as the station AC supply is available. AC lighting fixtures shall be fed from respective area lighting panels. If fault level at lighting panel is more than 10 kA, lighting distribution boards shall be fed through 415/433 V ratio lighting transformers.
- 2.1.3. Emergency AC lighting shall be provided by DG set through unit emergency switchgear and lighting distribution boards. In main switchyard area, about 20% lighting shall be fed from AC emergency source.
- 2.1.4. In main switchyard area and other auxiliary switchyards, emergency DC lighting shall be provided in control rooms, in critical operating area, and for safe exit in case of black out. These lights shall be fed from DC distribution board backed by DC batteries. These lights shall be of LED type. DC lights shall remain continuously ON along with AC lighting system.
- 2.1.5. For Off-site buildings, where DC supply is not available, Emergency lighting units with integral batteries shall be used. Offsite area building emergency DC lighting shall be provided by self-contained emergency lighting fixtures. Each emergency fixture shall provide emergency light for 3-4 hours when the normal power source is lost. Each emergency light fixture shall be provided with Ni-cd gel battery, battery charger and two CFL/*equivalent LED lamps/tubes*.
- 2.1.6. Lighting shall be provided in all the areas of power plant. Lux level shall be as per Annexure-I: average lux level & type of fixtures, Document: TB-400-558-127-14-R0.
- 2.1.7. For indoor Areas, average lumen method shall be adopted to calculate luminance. Lighting level design shall include a Maintenance factor as follows to account for lamp lumen depreciation, luminaries' surface dirt and room surface dirt, etc.
- Air-conditioned clean interiors such as office rooms, Control and Electrical room: 0.8
 - Clean interiors such as office rooms, laboratories: 0.75
 - Industrial areas with normal interiors such as workshops.: 0.7
 - Industrial areas with dusty interiors: 0.6
 - Industrial areas with very dusty interiors: 0.5
- 2.1.8. Lighting level design shall also include the coefficient of utilization factor as calculated from table of reflectance provided by manufacturer for respective type of fixture.
- 2.1.9. For Outdoor flood lighting design, 'point by Point' method shall be adopted based on computer aided design package of the Contractor software. Uniformity in horizontal illuminance E_{min}/E_{avg} should be greater than 0.25.

2.2 Lighting control

- 2.2.1. Switch control shall be provided for controlling lighting fixtures located indoor.

- 2.2.2.** Electric power to light fixtures located outdoors shall be switched with photoelectric controllers and timers. Provision shall be made to bypass the photoelectric controller and timer. For Road lighting, alternative lighting fixtures shall be fed from different phases.
- 2.2.3.** Load on each lighting circuit and single-phase receptacle circuit shall be limited to about 1500 W and the number of luminaries connected to lighting circuit shall be limited to about fifteen (15).
- 2.2.4.** At least one 6/16 ampere, 230-volt AC universal socket outlet with switch shall be provided in offices, cabins, etc. In service building, at least 4 nos. 5 Amp plug points shall be provided in each cubicle. Receptacles with decorative cover plates shall be used in office / Control rooms.
- 2.2.5.** 2 no., 63 Amp, 415 V, 3 phase welding receptacles with isolating switch shall be provided in switchyard area. In GIS building 1 no. welding receptacle shall be provided. Welding receptacles shall be fed from nearest ACDB. Necessary arrangement for looping (in/out) incoming supply cables shall be provided.
- 2.2.6.** 1 no., 63 Amp, 415 V, 3 phase Oil filtration receptacle with isolating switch shall be provided in switchyard area near reactors. Oil filtration receptacles shall be fed from nearest ACDB. Necessary arrangement for looping (in/out) incoming supply cables shall be provided.
- 2.2.7.** Each receptacle panel shall be provided with one earth leakage circuit breaker rated 30 mA in outgoing circuits.

2.3 Lighting fixtures

- 2.3.1.** For all Outdoor switchyard, street lighting, service building, admin building, laboratory, conference rooms, SWAS room etc., LED lamp light fittings shall be used as per Document: TB-400-558-127-14-R0: DESIGN MEMORANDUM FOR LIGHTING SYSTEM (400KV SWITCHYARD).
- 2.3.2.** For other buildings/installations having room height of up to 5 metre, LED light fittings of following types shall be used:
 - Industrial trough type/Industrial General-purpose Rail type for all industrial areas
 - Corrosion proof type for battery room and chemical areas, etc.,
 - Anti-glare mirror optic type for Control rooms housing VDUs.
 - Mirror optic type for other Control rooms.
- 2.3.3.** In false ceiling areas, type of light fixtures shall suit the type of false ceiling provided.
- 2.3.4.** For high bay areas, LED light fittings of high bay type shall be used for the installations having room height of above 5 metre.
- 2.3.5.** For outdoor areas involving road lighting and flood lighting, fixtures shall be weatherproof type. All outdoor fixtures shall be with DOP IP-55.
- 2.3.6.** Road lighting / Flood lighting poles shall be of galvanised steel pole. Each Street lighting pole/Flood lighting pole shall be provided with MCB protection.
- 2.3.7.** Winch operated high mast lighting shall be provided in select outdoor areas such as transformer yard, switchyard, coal yard, stock yard, fuel tank farm etc.
- 2.3.8.** For DC lighting LED lights shall be used.
- 2.3.9.** AC lighting fixtures and accessories shall be suitable for operation on 240 V, AC, 50 Hz supply with supply voltage variation of $\pm 10\%$, frequency variation of $\pm 5\%$ and combined voltage and frequency variation of absolute sum of 10%. DC lighting

fixtures and accessories shall be suitable for operation on 220 V, DC with variation between 190 V & 240 V.

- 2.3.10.** Luminaires shall meet at least electrical safety class-I as per relevant IEC.
- 2.3.11.** The lighting fixtures shall be designed for minimum glare. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection.
- 2.3.12.** High bay fixtures shall be suitable for pendant mounting and provided with safety chains.
- 2.3.13.** Lighting fixtures shall meet below requirements:

FIXTURE DESCRIPTION	LUMEN
SUPPLY- ILLUMINATION EQUIPMENT: LIGHTING FIXTURE - SURFACE MOUNTED LED	≥ 3000
SUPPLY- ILLUMINATION EQUIPMENT: LIGHTING FIXTURE - RECESSED MOUNTED LED	≥ 3000
SUPPLY- ILLUMINATION EQUIPMENT: LIGHTING FIXTURE - SURFACE MOUNTED LED CORROSION RESISTANT	≥ 3000
SUPPLY- ILLUMINATION EQUIPMENT: LED INDOOR HIGH BAY FITTINGS TYPE IHB	≥ 14000
SUPPLY- ILLUMINATION EQUIPMENT: LIGHTING FIXTURE - AC LED DOWNLIGHTER	≥ 1000
SUPPLY- ILLUMINATION EQUIPMENT: LIGHTING FIXTURE - DC LED BULKHEAD	≥ 1000
SUPPLY- ILLUMINATION EQUIPMENT: LIGHTING FIXTURE - DC LED DOWNLIGHTER	≥ 1000
SUPPLY- ILLUMINATION EQUIPMENT: LIGHTING FIXTURE - LED FLOOD LIGHT TYPE 1	≥ 14000
SUPPLY- ILLUMINATION EQUIPMENT: LIGHTING FIXTURE - LED FLOOD LIGHT TYPE 2	≥ 23000
SUPPLY- ILLUMINATION EQUIPMENT: LIGHTING FIXTURE - LED STREET LIGHT	≥ 10000
SUPPLY- ILLUMINATION EQUIPMENT: LIGHTING FIXTURE - LED POST TOP LANTERN	≥ 3000

- 2.3.14.** Lighting fixtures shall have System Efficacy (Lumens/Watt) ≥80.

2.4 Lighting Panels & Receptacle Panel

- 2.4.1.** The panels shall be rated for 415 V, 3 phase, 4 wire, AC with neutral bus and suitable for either wall/column mounting as per site/project requirement. Indoor panels shall have degree of protection of IP 54 and outdoor type shall have degree of protection of IP 55 and shall have a sloping canopy. Panels shall be constructed from CRCA sheet. Sheet thickness shall be 2.0 mm.
- 2.4.2.** Miniature circuit breakers (MCB) shall have thermal elements for overload protection and an instantaneous magnetic trip to protect against severe faults. All MCBs provided shall be suitable for breaking capacity of 10 kA (minimum) at 240 V AC.
- 2.4.3.** Contactors shall be of the air break type fitted with arc shields. Time switch shall be suitable for automatic switching ON and OFF, of street lighting / flood lighting

circuits. Time switch has 00 24 hour clock base. Time switch shall indicate actual time and shall permit accurate time setting. Time switch shall be provided with Ni-Cd gel battery.

- 2.4.4. AC Lighting panel** shall be provided with 415 V AC, 63 Amp, TPN MCB with ELCB as incomer, required nos. of 20 A, 240 V AC, single pole MCBs for outgoing circuits, Separate neutral at terminal block for each outgoing circuit.
- 2.4.5. Street lighting panel** shall be provided with 415 V AC, 63 Amp, TPN MCB isolator as incomer, 63 Amp Three pole AC Contactor, 00 -24 hours timer and a photo-electric switch for automatic switching of contactor, a by-pass switch for timer/photo switch, 6 Nos. 20 A, 415 V AC, TPN MCBs for outgoing circuits, Separate neutral at terminal block for each outgoing circuit. One number light sensor in weatherproof enclosure having IP: 55 degree of protection shall be installed separately with necessary interconnecting cable for each street lighting panel. Additionally, 100% sensors shall be supplied for future use.
- 2.4.6. DC lighting panel** shall be provided with 220 V DC, 32 Amp, DP MCB isolator as incomer, required nos. of 16/20 A, 220 V DC, double pole MCBs for outgoing circuits.

2.5 Three Phase Industrial Receptacles

The receptacle shall be of 63 A, industrial heavy duty insulated type with 5 pin (with earth connection) suitable for 415 V, 3 phase, 50 Hz supply. The receptacle shall be switched and interlocked type with MCB and shall be housed in a thermoplastic enclosure of IP-55 protection class. Socket shall be provided with safety cover. Terminal blocks of adequate rating shall be provided for incoming/loop-in-loop out connection.

2.6 Single Phase Industrial Receptacles

The receptacles shall be heavy duty type rated for 20A, 240 V AC supply. The receptacle shall be switched and interlocked type with MCB and shall be housed in a thermoplastic enclosure of IP-55 protection class. Socket shall be provided with safety cover. Terminal blocks of adequate rating shall be provided for incoming/loop-in-loop out connection.

20A, 3-Pin, 230V AC industrial type receptacles with switch will be provided at suitable location in GIS building. The receptacles shall be provided at interval of 50m or part thereof. All receptacles will be controlled with a switch.

2.7 Flush type indoor receptacles

Flush type 3 pin, 6/16 A, 240 V AC sockets shall be provided for office rooms and control rooms. The receptacle shall be complete with 16 A modular type switch & safety shutter. It shall be housed in suitable thermoplastic enclosure.

2.8 Lighting mast

- 2.8.1.** Each Lighting Mast shall be 25 meter high, complete with the following accessories.
- High mast shaft in two/three section, hot dip galvanised
 - Head frame, steel wire rope & double drum winch.
 - Galvanised Lantern carriage arrangement
 - Integral power tool installed inside base compartment for its operation.
 - Foundation bolts
 - Luminaires
 - Aviation obstruction light with 2 nos. LED lamps.

- Control panel
 - Power & control cables and cabling accessories required for the installation.
 - Special tools & tackles
- 2.8.2.** The High mast shall be of continuously tapered, polygonal cross section, at least 20 sided, presenting a good and pleasing appearance and shall be based on proven design to give an assured performance, and reliable service. The entire fabricated mast shall be hot dip galvanized, internally and externally, having a uniform average thickness of at least 85 microns.
- 2.8.3.** An adequate door opening shall be provided at the base of the mast and the opening shall permit clear access to equipment like winches, cables, plug and socket, etc. and facilitate easy removal of the winch.
- 2.8.4.** A fabricated Lantern Carriage shall be provided for fixing and holding the flood light fittings and control gearboxes. The lantern carriage shall be of steel tube construction, the tubes acting as conduits for wires, with holes fully protected by grommets.
- 2.8.5.** The winch shall be completely self-sustaining type, without the need for brake shoe, springs or clutches. Each driving spindle of the winch shall be positively locked when not in use, gravity activated PAWLS. Individual drum also shall be operated for fine adjustment of lantern carriage. The minimum-working load shall be not less than 750 kg. The winch shall be self-lubricating type by means of an oil bath and the oil shall be readily available grades of reputed producers.
- 2.8.6.** The suspension system shall essentially be without any intermediate joint and to consist of only non-corrodible stainless steel of AISI 316 grade. The breaking load of each rope shall not be less than 2350 kg, giving a factor of safety of over 5 for the system at full load. The thimbles shall be secured on ropes by compression splices.
- 2.8.7.** A suitable, high-powered, electrically driven, internally mounted power tool with motor, with manual override shall be supplied for the raising and lowering of the lantern carriage for maintenance purposes. The power tool shall be of single speed, provided with a motor of the required rating. The power tool shall be supplied complete with suitable control.

2.9 Lighting poles

- 2.9.1.** Street Lighting pole shall be octagonal type, galvanized steel, supplied with base plate, foundation bolts, and necessary fixing-bracket for fixing the luminaire. Street lighting pole shall have integral junction box. All poles shall be provided with heavy square nuts on the anchor bolts under the pole base plate and hex nuts on the top. GS conduits shall be embedded in muff for incoming and outgoing cables. Height of poles shall be 10 m. Junction box shall be integral to the pole, supplied along with MCB and neutral link.
- 2.9.2.** Lighting pole for post-top lantern shall be of 4.5m high.

2.10 Wires

PVC insulated wires shall have multi stranded copper conductor. Wires shall be of 1.5 sq.mm/2.5 sq.mm/4 sq.mm sizes. The insulation material shall be resistant to flame, oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling. Wires shall have following colors.

Red for R phase
Yellow for Y phase
Blue for B phase

Black for Neutral
Yellow-Green for Earth wire
Grey & white for positive and negative connections, respectively.

2.11 Earthing material

Equipment	Type of earthing material
Lighting panels	25X6 mm GS flat
Lighting / Control junction boxes	16 SWG GS wire
Lighting poles/masts	20 mm dia, 3 Meter Long mild steel earth electrode

2.12 Rigid Conduits and Fittings

Rigid conduits shall conform to the requirements of IS: 9537 (Part I & Part II). However, conduits above 63 mm diameter shall conform to the requirements of IS: 1239. All conduits and pipes shall be of medium duty. The rigid conduits shall be hot dip galvanized inside and outside. Weight of zinc shall be as per IS: 4759. Conduits shall be thoroughly cleaned and pre-treated, conforming to IS: 6005.

Conduit fittings shall be made from tube or cast to the shape as to match with corresponding conduit sizes. All fittings shall be screwed type and hot dip galvanized inside and outside.

In corrosive areas, epoxy coated conduits shall be provided.

GS conduit shall be of medium duty as per IS: 1239.

Hume pipes shall be of reinforced concrete conforming to class NP3 for road crossings as per IS: 458.

2.13 Flexible Metallic Conduits and Fittings

Flexible metallic conduits shall conform to the requirements of IS: 3480. 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. The strip shall be electro galvanized to a minimum thickness of 25 microns. The surface of the strip shall be thoroughly cleaned before application of protective coating. Pre-treatment, before galvanization, shall conform to IS: 6005. Flexible conduits shall be supplied with suitable end coupler nipple and check nut.

2.14 Switch Boxes

The switch boxes shall be of surface/flush mounting type with steel construction. Switch boxes shall have conduit knock out on the sides. The switches shall be of quick make and quick break type and shall be of modular type. Where required, 3 pin 240 V type receptacles shall be provided with safety shutter and modular switch in the switch box. The switch box shall be flush mounted in places such as control rooms and office rooms.

Switches furnished shall be 6/16 Amps, 240 Volt totally enclosed modular type with side connected screw type terminals, phenolic compound housing and operating levers, and single mounting yoke design.

Switches used for switching direct current shall be 10 amperes, 240 Volt T-rated AC/DC switches.

2.15 Lighting Junction Box

The junction boxes shall be of FRP weatherproof type. 650 Volt grade multiday terminal blocks complete with screws, nuts, washers and marking strips shall be furnished for connection of incoming/outgoing wires in the junction boxes. The Junction box shall be suitable for mounting on wall/column/poles/masts.

2.16 Fans

Ceiling fans shall be of reputed make, BIS approved, 1200 mm sweep complete with copper wound, class E insulated motor, and three nos. balanced blades, suspension rod, canopy and other accessories conforming to applicable IS. Ceiling fans shall be supplied with a wall mounted controller to turn the fan on and off and to vary the fan speed from 0 to 100%. Controller shall be Electronic type free from humming noise.

Pedestal fans shall be of reputed make, BIS approved, 500 mm sweep, complete with aluminium blades, cast iron base, copper wound, class E insulated motor, support column, control switch and other accessories conforming to applicable IS.

Wall mounted fans, 400 mm sweep, shall be provided for all cubicles of admin building, service building, laboratories, and other non-plant buildings.

Exhaust fans, 300 mm sweep, shall be provided in toilet, pantry, battery room area, any other room as per requirement of Building architectural drawing.

2.17 Installation

2.17.1. The bottom of wiring devices shall be mounted the following distances above the finished floor.

Wiring Devices	Location	Distance above Floor (minimum)
Receptacles	Offices and finished areas	500 mm
Receptacles	All other locations	900 mm
Switches	All locations	1500 mm
Ceiling fan control	All locations	1500 mm
Ceiling fans	All locations	2500 to 3000 mm

2.17.2. The location of the light fittings, receptacles, switches, etc. shall be such as to avoid interference with piping / ventilation ducts / busduct or other equipment and to avoid objectionable shadows and glare.

2.17.3. In false ceiling areas the switchgear and the conduits shall be recess mounted.

2.17.4. In all Office rooms & Control rooms conduit shall be concealed type. In admin building, canteen, dispensary, concealed conduit wiring shall be adopted.

2.17.5. Wooden plugs in walls and ceilings for fixing of lighting fixtures and accessories are not acceptable. Nylon rawl plug shall be offered.

- 2.17.6.** In the rooms where false ceilings are provided, the lighting fixtures shall be supported separately by false ceiling grid over false ceiling if it is of steel structural or from ceiling or from cable trough / channel and not by the false ceiling board. The arrangement shall be to the approval of Owner.
- 2.17.7.** A four (4) way terminal junction box shall be provided near each lighting fixture, for loop-in, loop-out and off connection of lighting wires or as required.
- 2.17.8.** Conduit shall be routed at least 150 mm from the insulated surfaces of hot water, steam pipes and other hot surfaces. Where conduit must be routed parallel to hot surfaces, special high temperature cable shall be used.
- 2.17.9.** Conduits supports shall be provided at an interval of 750 mm for horizontal runs and 1000 mm vertical runs.
- 2.17.10.** Conduit shall be clamped on to approved type spacer plates or brackets by saddles or U-bolts. The spacer plates or brackets in turn, shall be securely fixed to the building steel by welding and to concrete or brick work by grouting or by nylon rawl plugs.
- 2.17.11.** Wiring for indoor Lighting installation shall be carried with insulated wire following sizes laid in Galvanised steel conduit of
- Lighting Panel to lighting Fixtures: 2.5 sq.mm copper
 - Lighting Panel to Switch box: 2.5 sq.mm copper
 - Switch box to lighting Fixtures: 1.5 sq.mm copper
 - Lighting Panel to Sockets: 4 sq.mm copper
- 2.17.12.** Voltage drop in the cable shall be limited as follows,
- Lighting panel to lighting fixtures: 3%
 - Switchbox to lighting fixtures: 1.5%
 - Lighting panel to socket: 3%
 - Lighting panel to switch box: 1.5%
- 2.17.13.** For outdoor lighting & road lighting, XLPE insulated, PVC inner sheathed, armoured, FRLS PVC outer sheathed cables shall be provided.
- 2.17.14.** Wiring for lighting circuits of Normal AC system, Emergency AC System and DC system shall run in separate conduits.
- 2.17.15.** Wiring for lighting fixtures and receptacle units shall be fed from different circuits and shall run in separate conduits.
- 2.17.16.** Two different phase circuits shall not be laid in the same conduit.
- 2.17.17.** Ceiling fans with variable speed electronic regulators shall be installed in the non-airconditioned areas as specified.
- 2.17.18.** Ceiling Fans & pedestal fans for of required size and quantity to be provided in individual rooms / areas like Workshop, Stores, Office building / areas, Service building, etc.
- 2.17.19.** Receptacles and lighting circuits shall be fed from different circuits. The switch controlling these circuits shall be on the live side (phase wire) of the circuits.
- 2.17.20.** Wiring shall be spliced only at junction boxes. Maximum two wires shall be connected at each terminal.
- 2.17.21.** Lighting branch circuits, telephone circuits, and intercommunication circuits shall be routed in conduit. Lighting circuits shall be routed in electrical metallic tubing (EMT) for indoor areas, rigid conduit for hazardous and outdoor areas.
- 2.17.22.** All conduit system shall be sized considering fill criteria specified in IS: 732.

- 2.17.23.** Each lighting poles and lighting / lightning mast junction box shall be earthed by 25 x 6 mm GS flat bonded to one (1) 20 mm dia MS earth electrode of 3 meter length driven vertically in the ground.
- 2.17.24.** The lights shall not be fixed at gantry. In buildings it shall be fixed with suitable fixtures and not directly on the walls.
- 2.17.25.** For the maintenance of lighting fixtures within the high bay areas, 1 no. free standing adjustable aluminium ladder, adjustable from 5 m to 10 m shall be provided.
- 2.17.26.** 2 no. Portable Aluminium Ladders of **3m height** suitable for switchyard control room shall be provided.

2.18 Codes and standards

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the relevant Indian Standards, IEC publications and other standards as listed, except where modified and / or supplemented by this specification. The design and testing shall follow the following standards.

- a) IS: 1777 Industrial luminaire with metal reflectors.
- b) IS: 1913 General and safety requirements for Luminaires.
- c) IS: 10322-5-5 Luminaires-Flood lights
- d) IS/IEC 60079 -1 Equipment Protection by Flameproof Enclosures "d"
- e) IS: 2149 Luminaires for street lighting.
- f) IS: 2206 Flame proof electric lighting fittings
- g) IS: 4013 Dust-light electric lighting fittings.
- h) IS: 8224 Electric Lighting fittings for Div. 2 areas.
- i) IS: 9583 Emergency lighting units.
- j) IS: 9974 High Pressure sodium vapour lamps.
- k) IS: 10322 Specification for Luminaires
- l) IS: 732 Electrical wiring installation (system voltage not exceeding 650 V).
- m) IS:5216 Guide for safety procedures and practices in electrical works.
- n) IS: 12640 Residual Circuit operated Circuit breakers.
- o) IS/IEC: 60947-1 low-voltage switchgear and control gear.
- p) IS/IEC:60898-1 Miniature circuit breakers
- q) IS/IEC 60715 Dimensions of low-voltage switchgear and control gear.
- r) IEC: 60309-1 Plugs, socket-outlets and couplers for industrial purposes
- s) IS/IEC 60529 Degrees of protection provided by enclosures (IP code)
- t) IS: 694 PVC insulated cables for working voltages up to and including 1.1 kV.
- u) IS: 9537 Conduits for electrical installation.
- v) IS: 3480 Flexible steel conduits for electrical wiring.
- w) IS: 1239 Mild steel tubes, tubular and other wrought steel fittings. (For size above 63 mm dia of rigid conduits)
- x) IS: 14768 Fittings for rigid steel conduits for electrical wiring.
- y) IS: 3837 Accessories for rigid steel conduits for electrical wiring.
- z) IS: 14772 Boxes for enclosures of electrical accessories.
- aa) CIE-173 Tubular day light guidance system

2.19 Information to be furnished after contract

The following drawings and documents shall be submitted for approval during detail engineering stage.

- Design basis report
- Illumination design calculation
- GA drawing and single line diagram of lighting panel & receptacle panels
- GA drawing of poles and masts
- GA drawing of receptacles
- General arrangement drawings of lighting fixtures
- Technical data sheet/Catalogues
- Test reports
- Illumination layout for GIS building
- Illumination layout for switchyard control building
- Illumination layout for Switchyard with roads
- Manufacturing quality plan

Any additional document not mentioned above but is required as per specification for customer approval shall also be submitted by bidder after award of contract.

2.20 Reference Documents

Sl.No	DOCUMENT NO.	DOCUMENT DESCRIPTION	REV NO.
1	TB-0-400-316-002	GIS and Pothead yard Plan & Section Layout	6
2	TB-2-400-316-010	Trench layout for 400kv switchyard	1
3	TB-1-400-607-620-1	Architectural drawing Control Room Building (Plans)	1
4	TB-1-400-607-620-2	Architectural drawing Control Room Building (Elevations)	1
5	TB-1-400-607-620-3	Architectural drawing Control Room Building (Sections)	1
6	TB-1-400-607-640-1	Architectural dwgs. GIS Building (Plans)	1
7	TB-1-400-607-640-2	Architectural dwgs. GIS Building (Elevations)	1
8	TB-1-400-607-640-3	Architectural dwgs. GIS Building (Sections)	1
9	TB-400-558-127-14	Design memorandum for lighting system (400KV switchyard)	0
10	PE-DC-435-602-C001	Geotechnical investigation report-2x660MW Udangudi STPP	1

3 General Technical Requirements

Please refer TB-400-316-000-REV 01: 'General Technical Requirements- Section 3'

BILL OF QUANTITY-ILLUMINATION SYSTEM-SUPPLY AND SPARE

S. NO.	ITEM DESCRIPTION	QUANTITY	UNIT	REMARKS
SUPPLY				
1	SUPPLY- ILLUMINATION EQUIPMENT : OUTDOOR LIGHTING PANEL	4	No.	
2	SUPPLY- ILLUMINATION EQUIPMENT : INDOOR LIGHTING PANEL	6	No.	
3	SUPPLY- ILLUMINATION EQUIPMENT : STREET LIGHTING PANEL	2	No.	
4	SUPPLY- ILLUMINATION EQUIPMENT : EMERGENCY OUTDOOR LIGHTING PANEL	2	No.	
5	SUPPLY- ILLUMINATION EQUIPMENT : INDOOR EMERGENCY LIGHTING PANEL	2	No.	
6	SUPPLY- ILLUMINATION EQUIPMENT : DC EMERGENCY LIGHTING PANEL INDOOR	2	No.	
7	SUPPLY- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - SURFACE MOUNTED LED	146	No.	
8	SUPPLY- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - RECESSED MOUNTED LED	103	No.	
9	SUPPLY- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - SURFACE MOUNTED LED CORROSION RESISTANT	10	No.	
10	SUPPLY- ILLUMINATION EQUIPMENT : LED INDOOR HIGH BAY FITTINGS TYPE IHB	49	No.	
11	SUPPLY- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - AC LED DOWNLIGHTER	27	No.	
12	SUPPLY- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - DC LED BULKHEAD	38	No.	
13	SUPPLY- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - DC LED DOWNLIGHTER	31	No.	
14	SUPPLY- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - LED FLOOD LIGHT TYPE 1	18	No.	
15	SUPPLY- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - LED FLOOD LIGHT TYPE 2	117	No.	
16	SUPPLY- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - LED STREET LIGHT	21	No.	
17	SUPPLY- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - LED POST TOP LANTERN	9	No.	
18	SUPPLY- ILLUMINATION EQUIPMENT : PORTABLE EMERGENCY LIGHTS	2	No.	
19	SUPPLY- ILLUMINATION EQUIPMENT : SWITCHBOARDS WITH 8 NO. SWITCH, 2 NO. 3 PIN 240V TYPE RECEPTACLE AS PER TECHNICAL SPECIFICATION	10	No.	
20	SUPPLY- ILLUMINATION EQUIPMENT : SWITCHBOARDS WITH 6 NO. SWITCH, 1 NO. 3 PIN 240V TYPE RECEPTACLE AS PER TECHNICAL SPECIFICATION	24	No.	
21	SUPPLY- ILLUMINATION EQUIPMENT : SWITCHBOARDS WITH 4 NO. SWITCH, 1 NO. 3 PIN 240V TYPE RECEPTACLE AS PER TECHNICAL SPECIFICATION	15	No.	
22	SUPPLY- ILLUMINATION EQUIPMENT : MODULAR TYPE FAN REGULATOR	25	No.	
23	SUPPLY- ILLUMINATION EQUIPMENT : SWITCHBOARDS WITH 3 NO. DC SWITCH AS PER TECHNICAL SPECIFICATION	10	No.	
24	SUPPLY- ILLUMINATION EQUIPMENT : JUNCTION BOXES FOR OUTDOOR	15	No.	
25	SUPPLY- ILLUMINATION EQUIPMENT : MCB BOX	3	No.	
26	SUPPLY- ILLUMINATION EQUIPMENT : TELEPHONE JB	1	No.	Telephone junction box suitable for 20 pair. Indoor type
27	SUPPLY- ILLUMINATION EQUIPMENT : TELEPHONE POINTS- SINGLE OUTLET TELEPHONE SOCKET INCLUDING CABLE/WIRE AND ACCESSORIES	10	No.	

BILL OF QUANTITY-ILLUMINATION SYSTEM-SUPPLY AND SPARE

S. NO.	ITEM DESCRIPTION	QUANTITY	UNIT	REMARKS
28	SUPPLY- ILLUMINATION EQUIPMENT : RECEPTACLE - 5/15A (DECORATIVE) RA TYPE	54	No.	
29	SUPPLY- ILLUMINATION EQUIPMENT : 15A/240V RECEPTACLE TYPE RO (INDUSTRIAL TYPE)	27	No.	
30	SUPPLY- ILLUMINATION EQUIPMENT : 32A DP RECEPTACLES WITH MCB FOR AC UNIT	16	No.	
31	SUPPLY- ILLUMINATION EQUIPMENT : 63A, 415V, 3 PHASE WELDING RECEPTACLE (INDOOR/OUTDOOR)	4	No.	
32	SUPPLY- ILLUMINATION EQUIPMENT : OUTDOOR POWER RECEPTACLE FOR OIL FILTRATION UNIT (63A)	2	No.	
33	SUPPLY- ILLUMINATION EQUIPMENT : OUTDOOR POWER RECEPTACLE FOR OIL FILTRATION UNIT (250A)	2	No.	optional
34	SUPPLY- ILLUMINATION EQUIPMENT : RECEPTACLE - 5/15A (FLAMEPROOF)	4	No.	optional
35	SUPPLY- ILLUMINATION EQUIPMENT : 20A/240V RECEPTACLE TYPE RO (INDUSTRIAL TYPE)	5	No.	optional
36	SUPPLY- ILLUMINATION EQUIPMENT : CEILING FAN, 240V, 1200/1400MM SWEEP WITH SUSPENSION ROD CANOPY AND COMPLETE ACCESSORIES.	25	No.	
37	SUPPLY- ILLUMINATION EQUIPMENT : 400MM SWEEP WALL MOUNTED FAN	32	No.	
38	SUPPLY- ILLUMINATION EQUIPMENT : 300 MM SWEEP EXHAUST FANS	14	No.	
39	SUPPLY- ILLUMINATION EQUIPMENT : 500 MM SWEEP PEDASTAL FANS	5	No.	
40	SUPPLY- ILLUMINATION EQUIPMENT : EXIT BOARDS	34	No.	
41	SUPPLY- ILLUMINATION EQUIPMENT : OCTAGONAL LIGHTING POLE	21	No.	
42	SUPPLY- ILLUMINATION EQUIPMENT : HIGH MAST WITH FEEDER PILLAR	3	No.	
43	SUPPLY- ILLUMINATION EQUIPMENT : 4.5M HIGH LIGHTING POLE FOR POST-TOP LANTERN	5	No.	
44	SUPPLY- ILLUMINATION EQUIPMENT : SELF SUPPORTED ALUMINIUM LADDER AS PER TECHNICAL SPECIFICATION.	1	No.	height adjustable (from 5m to 10m height) aluminum ladder
45	SUPPLY- ILLUMINATION EQUIPMENT : PORTABLE ALUMINIUM LADDERS OF VARIOUS SIZES	2	No.	
46	SUPPLY- ILLUMINATION EQUIPMENT : EARTHING MATERIAL - 25X6MM GS FLAT	2000	KG	
47	SUPPLY- ILLUMINATION EQUIPMENT : EARTHING MATERIAL - 3M , 20MM DIA MS ROD ELECTRODE	33	No.	
48	SUPPLY- ILLUMINATION EQUIPMENT : EARTHING MATERIAL - GS WIRE FOR EARTHING OF SIZE 16 SWG	200	KG	
49	SUPPLY- ILLUMINATION EQUIPMENT : 2 WIRE TELEPHONE CABLE (ISI MARKED).	500	m	
50	SUPPLY- ILLUMINATION EQUIPMENT : 1C, 1.5 SQMM PVC INSULATED STRANDED CU. WIRE RED/YELLOW/BLUE/BLACK/GREY (ISI MARKED WITH VALID CML NUMBER). COLOUR CODED.	6000	m	
51	SUPPLY- ILLUMINATION EQUIPMENT : 1C, 2.5 SQMM PVC INSULATED STRANDED CU. WIRE RED/YELLOW/BLUE/BLACK/GREY (ISI MARKED WITH VALID CML NUMBER). COLOUR CODED.	12000	m	
52	SUPPLY- ILLUMINATION EQUIPMENT : 1C, 4 SQMM PVC INSULATED STRANDED CU. WIRE RED/YELLOW/BLUE/BLACK/GREY (ISI MARKED WITH VALID CML NUMBER). COLOUR CODED.	8000	m	
53	SUPPLY- ILLUMINATION EQUIPMENT : GALVANIZED STEEL RIGID CONDUIT OF 20MM SIZE	4000	m	

BILL OF QUANTITY-ILLUMINATION SYSTEM-SUPPLY AND SPARE

S. NO.	ITEM DESCRIPTION	QUANTITY	UNIT	REMARKS
54	SUPPLY- ILLUMINATION EQUIPMENT : GALVANIZED STEEL RIGID CONDUIT OF 25MM SIZE	5000	m	
55	SUPPLY- ILLUMINATION EQUIPMENT : GALVANIZED STEEL FLEXIBLE CONDUIT OF 20MM SIZE	500	m	
56	SUPPLY- ILLUMINATION EQUIPMENT : GALVANIZED STEEL FLEXIBLE CONDUIT OF 25MM SIZE	500	m	
57	SUPPLY- ILLUMINATION EQUIPMENT : GALVANIZED STEEL RIGID CONDUIT OF 25MM SIZE WITH ADDITIONAL EPOXY COATING FOR CORROSIVE AREAS	800	m	
SPARE				
58	SPARE- ILLUMINATION EQUIPMENT : RECEPTACLE - 5/15A (DECORATIVE) RA TYPE	6	No.	
59	SPARE- ILLUMINATION EQUIPMENT : 15A/240V RECEPTACLE TYPE RO (INDUSTRIAL TYPE)	3	No.	
60	SPARE- ILLUMINATION EQUIPMENT : 32A DP RECEPTACLES WITH MCB FOR AC UNIT	2	No.	
61	SPARE- ILLUMINATION EQUIPMENT : 63A, 415V, 3 PHASE WELDING RECEPTACLE (INDOOR/OUTDOOR)	1	No.	
62	SPARE- ILLUMINATION EQUIPMENT : OUTDOOR POWER RECEPTACLE FOR OIL FILTRATION UNIT (63A)	1	No.	
63	SPARE- ILLUMINATION EQUIPMENT : OUTDOOR POWER RECEPTACLE FOR OIL FILTRATION UNIT (250A)	1	No.	
64	SPARE- ILLUMINATION EQUIPMENT : RECEPTACLE - 5/15A (FLAMEPROOF)	1	No.	
65	SPARE- ILLUMINATION EQUIPMENT : 20A/240V RECEPTACLE TYPE RO (INDUSTRIAL TYPE)	1	No.	
66	SPARE- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - SURFACE MOUNTED LED	15	No.	
67	SPARE- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - RECESSED MOUNTED LED	11	No.	
68	SPARE- ILLUMINATION EQUIPMENT : LED INDOOR HIGH BAY FITTINGS TYPE IHB	5	No.	
69	SPARE- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - AC LED DOWNLIGHTER	3	No.	
70	SPARE- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - DC LED BULKHEAD	4	No.	
71	SPARE- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - DC LED DOWNLIGHTER	3	No.	
72	SPARE- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - LED FLOOD LIGHT TYPE 1	2	No.	
73	SPARE- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - LED FLOOD LIGHT TYPE 2	12	No.	
74	SPARE- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - LED STREET LIGHT	3	No.	
75	SPARE- ILLUMINATION EQUIPMENT : LIGHTING FIXTURE - LED POST TOP LANTERN	1	No.	
76	SPARE- ILLUMINATION EQUIPMENT : LIGHTING SWITCH	38	No.	
77	SPARE- ILLUMINATION EQUIPMENT : JUNCTION BOX	10	No.	
78	SPARE- ILLUMINATION EQUIPMENT : PHOTO VOLTAIC SENSOR WITH ELECTRONIC CIRCUIT	2	No.	
79	SPARE- ILLUMINATION EQUIPMENT : HRC FUSE	10	No.	

BILL OF QUANTITY-ILLUMINATION SYSTEM- ERECTION, TESTING & COMMISSIONING

S. NO.	ITEM DESCRIPTION	QUANTITY	UNIT	REMARKS
1	OUTDOOR LIGHTING PANEL	4	No.	
2	INDOOR LIGHTING PANEL	6	No.	
3	STREET LIGHTING PANEL	2	No.	
4	EMERGENCY OUTDOOR LIGHTING PANEL	2	No.	
5	INDOOR EMERGENCY LIGHTING PANEL	2	No.	
6	DC EMERGENCY LIGHTING PANEL INDOOR	2	No.	
7	LIGHTING FIXTURE - SURFACE MOUNTED LED	146	No.	
8	LIGHTING FIXTURE - RECESSED MOUNTED LED	103	No.	
9	LIGHTING FIXTURE - SURFACE MOUNTED LED CORROSION RESISTANT	10	No.	
10	LED INDOOR HIGH BAY FITTINGS TYPE IHB	49	No.	
11	LIGHTING FIXTURE - AC LED DOWNLIGHTER	27	No.	
12	LIGHTING FIXTURE - DC LED BULKHEAD	38	No.	
13	LIGHTING FIXTURE - DC LED DOWNLIGHTER	31	No.	
14	LIGHTING FIXTURE - LED FLOOD LIGHT TYPE 1	18	No.	
15	LIGHTING FIXTURE - LED FLOOD LIGHT TYPE 2	117	No.	
16	LIGHTING FIXTURE - LED STREET LIGHT	21	No.	
17	LIGHTING FIXTURE - LED POST TOP LANTERN	9	No.	
18	SWITCHBOARDS WITH 8 NO. SWITCH, 2 NO. 3 PIN 240V TYPE RECEPTACLE AS PER TECHNICAL SPECIFICATION	10	No.	
19	SWITCHBOARDS WITH 6 NO. SWITCH, 1 NO. 3 PIN 240V TYPE RECEPTACLE AS PER TECHNICAL SPECIFICATION	24	No.	
20	SWITCHBOARDS WITH 4 NO. SWITCH, 1 NO. 3 PIN 240V TYPE RECEPTACLE AS PER TECHNICAL SPECIFICATION	15	No.	
21	MODULAR TYPE FAN REGULATOR	25	No.	
22	SWITCHBOARDS WITH 3 NO. DC SWITCH AS PER TECHNICAL SPECIFICATION	10	No.	
23	JUNCTION BOXES FOR OUTDOOR	15	No.	
24	MCB BOX	3	No.	
25	TELEPHONE JB	1	No.	
26	TELEPHONE POINTS- SINGLE OUTLET TELEPHONE SOCKET INCLUDING CABLE/WIRE AND ACCESSORIES	10	No.	
27	RECEPTACLE - 5/15A (DECORATIVE) RA TYPE	54	No.	
28	15A/240V RECEPTACLE TYPE RO (INDUSTRIAL TYPE)	27	No.	
29	32A DP RECEPTACLES WITH MCB FOR AC UNIT	16	No.	
30	63A, 415V, 3 PHASE WELDING RECEPTACLE (INDOOR/OUTDOOR)	4	No.	
31	OUTDOOR POWER RECEPTACLE FOR OIL FILTRATION UNIT (63A)	2	No.	
32	OUTDOOR POWER RECEPTACLE FOR OIL FILTRATION UNIT (250A)	2	No.	
33	RECEPTACLE - 5/15A (FLAMEPROOF)	4	No.	
34	20A/240V RECEPTACLE TYPE RO (INDUSTRIAL TYPE)	5	No.	
35	CEILING FAN, 240V, 1200/1400MM SWEEP WITH SUSPENSION ROD CANOPY AND COMPLETE ACCESSORIES.	25	No.	
36	400MM SWEEP WALL MOUNTED FAN	32	No.	
37	300 MM SWEEP EXHAUST FANS	14	No.	
38	EXIT BOARDS	34	No.	
39	OCTAGONAL LIGHTING POLE	21	No.	
40	HIGH MAST WITH FEEDER PILLAR	3	No.	
41	4.5M HIGH LIGHTING POLE FOR POST-TOP LANTERN	5	No.	
42	EARTHING MATERIAL - 25X6MM GS FLAT	2000	KG	
43	EARTHING MATERIAL - 3M , 20MM DIA MS ROD ELECTRODE	33	No.	
44	EARTHING MATERIAL - GS WIRE FOR EARTHING OF SIZE 16 SWG	200	KG	
45	2 WIRE TELEPHONE CABLE (ISI MARKED).	500	m	
46	1C, 1.5 SQMM PVC INSULATED STRANDED CU. WIRE RED/YELLOW/BLUE/BLACK/GREY (ISI MARKED WITH VALID CML NUMBER). COLOUR CODED.	6000	m	
47	1C, 2.5 SQMM PVC INSULATED STRANDED CU. WIRE RED/YELLOW/BLUE/BLACK/GREY (ISI MARKED WITH VALID CML NUMBER). COLOUR CODED.	12000	m	
48	1C, 4 SQMM PVC INSULATED STRANDED CU. WIRE RED/YELLOW/BLUE/BLACK/GREY (ISI MARKED WITH VALID CML NUMBER). COLOUR CODED.	8000	m	

BILL OF QUANTITY-ILLUMINATION SYSTEM- ERECTION, TESTING & COMMISSIONING

S. NO.	ITEM DESCRIPTION	QUANTITY	UNIT	REMARKS
49	GALVANIZED STEEL RIGID CONDUIT OF 20MM SIZE	4000	m	
50	GALVANIZED STEEL RIGID CONDUIT OF 25MM SIZE	5000	m	
51	GALVANIZED STEEL FLEXIBLE CONDUIT OF 20MM SIZE	500	m	
52	GALVANIZED STEEL FLEXIBLE CONDUIT OF 25MM SIZE	500	m	
53	GALVANIZED STEEL RIGID CONDUIT OF 25MM SIZE WITH ADDITIONAL EPOXY COATING FOR CORROSIVE AREAS	800	m	
54	EARTHING MATERIAL - 50X6MM GS FLAT	200	KG	MATERIAL WILL BE FREE ISSUE FROM BHEL, IF REQUIRED FOR ILLUMINATION WORK.
55	EARTHING MATERIAL - 75X8MM GS FLAT	200	KG	
56	LAYING AND TERMINATION OF 2 C X 6 SQ MM PVC/ALUMINIUM, FRLS, ARMOURED AUXILIARY POWER CABLE	500	m	
57	LAYING AND TERMINATION OF 4 C X 6 SQ MM PVC/ALUMINIUM, FRLS, ARMOURED AUXILIARY POWER CABLE	500	m	
58	LAYING AND TERMINATION OF 4 C X 16 SQ MM PVC/ALUMINIUM, FRLS, ARMOURED AUXILIARY POWER CABLE	500	m	
59	LAYING AND TERMINATION OF 3.5 C X 35 SQ MM PVC/ALUMINIUM, FRLS, ARMOURED AUXILIARY POWER CABLE	500	m	
60	LAYING AND TERMINATION OF 3.5 C X 70 SQ MM PVC/ALUMINIUM, FRLS, ARMOURED AUXILIARY POWER CABLE	500	m	
61	LAYING AND TERMINATION OF 1 C X 150 SQ MM PVC/ALUMINIUM, FRLS, ARMOURED AUXILIARY POWER CABLE	200	m	
62	LAYING AND TERMINATION OF 3.5 C X 150 SQ MM PVC/ALUMINIUM, FRLS, ARMOURED AUXILIARY POWER CABLE	200	m	
63	LAYING AND TERMINATION OF 1C X 150 SQ MM EPR/COPPER, FIRE SURVIVAL, ARMOURED POWER CABLE	200	m	

NOTE:

- The Erection & commissioning materials (all necessary interconnecting/ terminating/ fixing accessories & fixing hardware such as double compression cable glands, conduit fittings viz. couplers, elbows, bends, tees, circular boxes etc., conduit accessories viz. clips, saddles, spacing plates, entry bushes, lock nuts, plugs, heavy duty lugs, ferrules, expansion fastners, covers for power outlets in wash rooms and showers, ball & sockets, earth clips, fan boxes, clamps, screws, ceiling rose, casing and capings etc. form part of erection activities) including commissioning & operational spares up to system handing over to customer has to be worked out for complete and successful erection & commissioning. The price of Erection & commissioning material shall be inclusive in the individual Erection & commissioning item as per Annexure-BOQ-ETC.
- Fabrication & painting charges of structural steel shall be part of erection charges of those equipment for which the same is being used.
- All measuring and testing instruments required during erection, testing, commissioning and performance testing shall be arranged by the bidder and taken back.

SECTION 3**PROJECT DETAILS AND GENERAL SPECIFICATIONS****3.0 GENERAL**

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

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

3.1 SITE INFORMATION

SL.NO.	DESCRIPTION	
3.1	PROJECT INFORMATION	
	a) Customer	Tamil Nadu Generation and Distribution Corporation (TANGEDCO)
	b) Project	400kV GIS at 2 x 660 MW Udangudi STPP (Stage-I)
	c) Project location	
	i) Country	India
	ii) State	Tamil Nadu
	iii) Administrative district	Thoothukudi
	iv) Next Big cities to site	Thoothukudi (approx.. 45 kms from site)
	v) Road access	East Coast Road- State high way (176)
	vi) Nearest Railway Station	Thiruchendur (approx.. 12 kms from site)
	vii) Nearest Airport	Vaigai (approx.. 60 kms from site)
	viii) Nearest Harbour	Tuticorin (approx.. 45 kms from site)
3.2	SITE CONDITIONS	
3.2.1	Ambient Air Temp.	

	a) Maximum dry bulb temp. (max.) °C	41 ⁰ C
	b) Minimum dry bulb temp. (min.) °C	17 ⁰ C
	Design ambient temperature	50 ⁰ C
3.2.2	Relative humidity	
	Mean Maximum humidity (Summer)	84 %
	Mean Minimum humidity (Summer)	62 %
	Maximum humidity (Monsoon)	97%
	Minimum humidity (Monsoon)	45%
3.2.3	Rain fall	
	Annual rainfall (Maximum)	718.2 mm
	Annual rainfall (Minimum)	384.1 mm
	Twenty four (24) Hour max	138.2 mm
3.2.4	High Flood Level	
	High Flood Level for site	RL 2.450 m
3.2.5	Wind	
	Mean Wind Speed (max)	39 m/sec (As per IS: 875)
	Wind direction	North, North east, North west, East
3.3	Seismic intensity	
	Seismic Intensity	As per IS:1893 Latest
	Zone	II

3.2 INSTRUCTION TO BIDDERS

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

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

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

3.3 STANDARDS

The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

The equipment to be furnished under this specification shall conform to latest issue (with all amendments) of specified standards.

In addition to meeting the specific requirement called for in Sections 1 and 2 of the Technical Specification, the equipment shall also conform to the general requirement of the applicable standards, which shall form an integral part of the specification.

The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to complement each other.

When the specific requirements stipulated in the specifications exceed or differ from those required by the applicable standards, the stipulation of the specification shall take precedence.

Other internationally accepted standards, which ensure equivalent or better performance than that specified in the standards referred, shall also be accepted. The bidder shall submit copies of such standards.

In case governing standard for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in the offer along with English language version of standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Purchaser's / owner's approval.

The bidder shall clearly indicate in his bid the specific standards in accordance with which the works will be carried out.

3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

All equipment shall also perform satisfactorily under various other electrical, electro mechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all external and internal mechanical, thermal and electro mechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc for the equipment.

3.5 ENGINEERING DATA

3.5.1 Drawings

The Supplier shall necessarily submit all the drawings/ documents unless anything is waived. The Supplier shall submit drawings/ design documents/ data/ test reports/manuals as may be required for the approval of the purchaser. All drawings submitted by the Manufacturer including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required. The dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the Manufacturer shall be clearly marked with the name of the Purchaser, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

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

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

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

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

The title block of drawings shall contain the following information incorporated in all contract drawings

Title block for project:

1. Customer : Tamil Nadu Generation and Distribution Corporation (TANGEDCO)
2. Consultant : TATA CONSULTING ENGINEERS LIMITED, BENGALURU
3. Project : 400kV GIS at 2 x 660 MW Udangudi STPP (Stage-I)
4. Contract No./LOA No. : Lr.No.CE/Proj.II/SE/C/UTPP/EE/E/LOI/D.179/2017, dt.07.12.2017
5. Main Contractor : Bharat Heavy Electricals Limited
6. BHEL Order No. & Date :

3.5.2 Documentation

Document Distribution Schedule - After Placement of Order:

S. No.	Stage	No. of copies	
i)	Submission of Data sheets Datasheet, drawings, documents, write-ups, calculation, test reports, Preliminary	13	As per agreed schedule
ii)	Resubmission of above, if required	13	As per agreed schedule
iii)	Final approved documents	13	As per agreed schedule
iv)	Instruction manuals for erection and O&M	6	As per agreed schedule
v)	As built drawings including O &M manual -Hard copy -Soft copy in CD/Pendrive	13 6	As per agreed schedule

NOTES:

- a) The manufacturer may note that all re-submissions must incorporate all comments given in the prior submission by the Purchaser. Adequate justification for not incorporating the same must be submitted, failing which the submitted documents may be returned.

3.5.3 Format of Documentation

- a) All engineering documents and drawings shall be of international "A" series sizes, that is, A0, A1, A2, A3 and A4.
- b) Two set of CD/ pendrive containing all the drawings in Auto CAD shall also be supplied in addition to hard copies. Soft copy of all documents shall be supplied in a CD/pendrive in PDF format.
- c) Grouped documents shall be provided by size A4, with the inclusion of bigger size drawings which, however, have to be folded as Size A4.

3.5.4 Instruction manuals and operating manuals

The Supplier shall provide Instruction & Maintenance Manuals for each part of the Plant and Equipment included in the Works and Operating Manuals for each Station.

The Instruction Manuals and Operating Manuals shall be arranged in an organized library adequately cross referenced to facilitate issuing clauses of the manuals as required by the work i.e. erection instructions shall be required before operating & maintenance instructions.

All Manuals provided by the Supplier shall be fully detailed and specifically prepared for the Works and equipment provided. General manuals not specifically required for the work shall not be acceptable.

The instruction manuals shall at least contain:

- a) A general description of all components
- b) Storage instructions
- c) Erection instructions
- d) Pre-commissioning Instruction:
- e) Material and part list.
- f) Design clearances and settings
- g) Complete sets of drawings as finally issued
- h) Operating Instructions:
- i) Routine and Preventive Maintenance instructions with material requirement for each site
- j) Preventive Maintenance Schedule.
- k) Replacement instruction for all equipment

The operation manuals shall at least contain:

- a) Operator oriented functional descriptions of the equipment.
- b) Operator oriented description of the protection and control systems
- c) Description of the equipment auxiliary systems
- d) Fault finding and diagnostic tools
- e) User software interface tools for modification/augmentation etc.

Notes:

The supplier may please note that all resubmissions must incorporate all comments given in the earlier submission by the Owner/Purchaser or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/ additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Supplier to the Owner/Purchaser.

The Supplier shall furnish to the Owner/Purchaser, catalogues of spare parts also.

3.6 QUALITY ASSURANCE PROGRAMME

This section contains general requirements for inspection of material, parts, equipment and workmanship during manufacture, assembling to demonstrate compliance with specification, codes and standards to ensure overall reliability of product operation and performance.

The Owner and/or authorized Representatives shall, at any time, be allowed free and ready access to the Contractor's premises and those of his suppliers as well as to the site installation and the Contractor has to make the items available for the purpose of inspection of the specified equipment components and obtaining information as to the progress of the work. Failure on the part of the Owner, at this or any other time, to discover or reject materials or work which do not meet specified requirements shall not be deemed an acceptance thereof nor a waiver of defects therein.

The approval of the Owner shall not prejudice the right to reject equipment if it does not give complete satisfaction in service.

To ensure that the equipment and services under the scope of this Contract, whether manufactured or performed within the Manufacturer's Works or at his Sub-manufacturer's premises or at the Purchaser's site or at any other place of Work, are in accordance with the specifications, the Manufacturer shall adopt a suitable quality assurance programme to control such activities at all points, as necessary.

Before manufacture commences and not later than 45 days after award of contract, the Contractor shall submit an outline of his proposed inspection program, which shall include all major stages during manufacturing. The inspection and test program shall include for the various items the designation No., name of equipment, part of equipment, the kind of test, test standard, company which carries out the test, place, date and witnesses by the Contractor, third party or Owner's Representative. The detailed manufacturer's quality assurance plan shall be subject to approval after award of contract.

The Owner will return a copy of the Contractor's proposed inspection program indicating those inspection stages for which notification is required. Notification shall be by Fax or email in a format to be agreed and shall be sent prior to the intended test. If the Owner intends to be represented at the test he will provide at least 24 hours' notice and if his representative does not attend on the notified date, an alternative date has to be informed by the Owner.

A quality assurance programme of the manufacturer shall generally cover the following:

- (a) Manufacturer's organisation structure for the management and implementation of the proposed quality assurance programme;
- (b) Documentation control system;
- (c) Qualification data of bidder's key personnel;
- (d) The procedure for purchases of materials, parts components and selection of sub-Manufacturer's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
- (e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;
- (f) Control of non-conforming items and system for corrective actions;
- (g) Inspection and test procedure both for manufacture and field activities;
- (h) Control of calibration and testing of measuring instruments and field activities;
- (i) System for indication and appraisal of inspection status;
- (j) System for quality audits;
- (k) System for authorising release of manufactured product to the Purchaser
- (l) System for maintenance of records;
- (m) System for handling storage and delivery; and
- (n) A quality plan detailing out the specific quality control measures and Procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered. The Purchaser or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and Procedure of the Manufacturer/his vendors quality management and control activities.

3.7 Quality Assurance Documents

The Manufacturer shall be required to submit all Quality Assurance Documents as stipulated in the quality plan at the time of purchaser's inspection of equipment/material.

3.8 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

All equipment being supplied shall conform to type tests and shall be subject to routine and acceptance tests in accordance with requirements stipulated under respective sections. Purchaser reserves the right to witness any or all the tests. The

Manufacturer shall intimate the Purchaser the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies. The Manufacturer shall also submit type test procedure for approval of the Purchaser.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the technical specification or any/all additional type tests not carried out, Such test shall be conducted fresh without any additional cost implication to the Purchaser.

The price of conducting all tests and additional type tests is deemed to be included in Bid price. In case any bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected.

Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

The Purchaser or Inspector shall, within fifteen (15) days from the date of inspection as defined herein, give notice in writing to the Manufacturer, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Manufacturer shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Purchaser/ inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

When the factory tests have been completed at the Manufacturer's works, the Purchaser/inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Purchaser/inspector, the certificate shall be issued within fifteen (15) days of receipt of the Manufacturer's Test certificate by the Engineer/ Inspector. Failure of the Purchaser/inspector to issue such a certificate shall not prevent the Manufacturer from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Purchaser to accept the equipment should it, on further tests/ after erection, be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of MICC by the Purchaser.

In all cases where the Contract provides for tests whether at the premises or at the works of the Manufacturer or of any Sub-Contractor, the Manufacturer except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Purchaser /Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give

facilities to the Purchaser Inspector or to his authorised representative to accomplish testing.

The inspection by Purchaser and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Manufacturer in respect of the agreed quality assurance programme forming a part of the Contract.

The Purchaser reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Purchaser.

3.9 MATERIALS AND WORKMANSHIP

Equipment materials and components shall be new, of high grade and good quality and be to the latest engineering practice. The material and workmanship throughout shall be in accordance with the purpose for which they are intended. Each component shall be designed to be consistent with its duty.

All the information concerning materials or components to be used in manufacturing, machinery, equipment, materials and components supplied, installed or used shall be submitted for approval. Without such approval the supplier shall run risk of subsequent rejection. The cost as well as time delay associated with such rejection shall be borne by the supplier.

3.10 COLOUR SCHEME

The Supplier shall propose a colour scheme for the equipment for the approval of the Employer. The decision of the Employer shall be final. However, the finishing colour shall be RAL 7035 for all Control panels/ MCC/ Switchgear panels. The scheme shall include:

- Finishing colour of Indoor equipment
- Finishing colour of Outdoor equipment
- Finishing colour of various auxiliary system equipment including piping
- Finishing colour of various building items.
- Finishing colour of all cubicles.

All steel structures, plates etc shall be painted with non-corrosive paint on a suitable primer. The galvanised structures in the switchyard shall not be painted. However galvanised structures in other areas may require painting for aesthetic reasons.

3.11 PACKING AND STORAGE

Packing specification shall be submitted for BHEL/customer approval after award of contract.

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. On request of the purchaser, the manufacturer shall also submit packing details/associated drawing for any equipment/ material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The manufacturer shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharf age and other such charges claimed by the transporters, railways etc shall be to the account of the manufacturer. Purchaser takes no responsibility of the availability of the wagons.

All coated surfaces shall be protected against abrasions, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device.

Supplier shall ensure that equipment shall be properly packed, blocked, padded, coated and protected so that it is not damaged due to possible mishandling. Storage requirements shall be clearly defined by the supplier. Packing shall be such that if required, long time storage (at least 1 year) at site should not deteriorate the performance of the equipment.

3.12 NAME PLATE

Name plates which are to be firmly fixed on all the equipment, buildings and structures shall be provided. For equipment of small size, these are to be fixed on the piping or structure adjacent to the equipment. The contents of nameplate are to include the designation and principal parameters of the equipment.

The nameplate within the field shall be made of a high temperature - resistant metallic sheets, with designation permanently engraved on them. Indoor installed equipments (e.g., panels, cabinets, switchgear, etc.) shall also be labelled by appropriate name plate.

The form, size, base colour and colour of contents of the name plates and prompting plates will be agreed between the Contractor and the Owner. It shall be possible for these to be readily seen by the operator. The designation of warning tags shall be different from that of other tags.

The Equipment identification shall be finalized by vendor in consultation with BHEL/TANGEDCO and should be included in name plates.

3.13 CLAMPS & CONNECTORS

- i) All power clamps and connectors shall conform to IS: 5561, and/or IEC standard and shall be made of materials listed below:

a)	For connecting ACSR conductors	Aluminium alloy casting, conforming to designation A6 of IS: 617 and shall be tested for all tests as per IS:617
b)	For connecting equipment terminals made of copper with ACSR conductors	Bimetallic connectors made from aluminium alloy casting, conforming to designation A6 of IS 617 with 2 mm thick Bimetallic liner and shall be tested as per IS: 617.
c)	For connecting G.I. Shield wire	Galvanised mild steel
d).1	Bolts, nuts & Plain washers.	Electro galvanized for sizes below M12, for others hot dip galvanised
d).2	Spring washers for items 'a' to 'c'	Electro-galvanised mild steel suitable for at least service condition-3 as per IS: 1573

- ii) Equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The conductor terminations of equipment shall be either expansion, sliding or rigid type. The requirements regarding external corona and RIV as specified for any equipment shall include its terminal fittings and the equipment shall be factory tested with the connectors in position. In case the connector is not available then equivalent connector may be used. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of Work.
- iii) Where copper to aluminium connections are required, bi-metallic clamps shall be used, which have been properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current t shall be furnished to the Employer.
- iv) Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified are also included in the scope of Work.
- v) No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2mm thickness shall be cast integral with aluminium body for Bi-metallic clamps. When copper alloy is not cast integral with aluminium body, a bimetallic washer or strip shall be used to meet the functional requirement.
- vi) All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

- vii) Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of IPS Aluminium tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.
- viii) Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.
- ix) All current carrying parts shall be designed and manufactured to have minimum contact resistance.

x) TESTS

The following is the list of type tests.

- a) Temperature rise test (maximum temperature rise allowed is 35deg C over 50 deg C ambient)
- b) Short time current test
- c) Dry corona and RIV test as per annexure-A
- d) Resistance test and tensile test

3.14 GALVANIZING

Galvanizing works shall conform in all respect to B.S. 729, B.S. 3083 and B.S.C.P. 2008 and to DIN 50976 whatever requires the higher quality and shall be performed by the hot dip process, unless otherwise specified. It is essential that details of steel members and assemblies which are to be hot-dip galvanized should be designed in accordance with B.S 4479.

Vent-holes and drain-holes should be provided to avoid high internal pressures and air-locks during immersion, which may cause explosions, and to ensure that molten zinc is not retained in pockets during withdrawal.

Careful cleaning of welds is necessary before welded assemblies are dipped. The welds and the surrounding metal should be cleaned separately, preferably be blast-cleaning, because the usual preliminary pickling cannot be relied on to remove the welding slag.

All defects of the steel surface including cracks, surface laminations, laps and folds shall be removed in accordance with B.S. 4360. All drilling, cutting, welding, forming and final fabrication of unit members and assemblies shall be completed, where feasible, before the structures are galvanized. The surface of the steelwork to be galvanized shall be free from paint, oil, grease and similar contaminants in

accordance with DIN 55928, part 4 and DIN 50976. The weight of zinc coating per unit area has to be noted in the manufacturing documents in accordance with DIN 50976.

The minimum average coating weight shall be as specified in Table 1 of B.S. 729 or Table 2, DIN 50976, whatever requires higher quality.

Structural steel items shall be initially grit-blasted to B.S. 4232, second quality, (Sa 21/2) or by pickling in a bath and the minimum average coating weight on steel sections 5 mm thick and over shall be 610 g/m² (DFT = 85μ).

On removal from the galvanizing bath, the resultant coating shall be smooth, continuous, free from gross surface imperfections such as bare spots, lumps, blisters and inclusions of flux, ash or dross.

Galvanized contact surfaces to be joined by high-tensile friction-grip bolts shall be roughened before assembly so that the required slip factor (defined in B.S. 3294, part 1 and B.S. 4604,

part 1) is achieved. Care shall be taken to ensure that the roughening is confined to the area of the mating faces.

Bolts, nuts and washers, including general grade high-tensile friction grip bolts (referred to in B.S. 3139, and B.S.4395 part 1) shall be hot dip galvanized and subsequently centrifuged (according to B.S. 729). Nuts shall be tapped up to 0.4 mm oversize after galvanizing and the threads oiled to permit the nuts to be finger-turned on the bolt for the full depth of the nut. No lubricant, applied to the projecting threads of galvanized high-tensile friction-grip bolt after the bolt has been inserted through the steelwork, must be allowed to come into contact with the mating faces of the steelwork,. A local remelting of the galvanized parts to achieve the nuts to be finger turned on the bolt is possible in accordance with DIN 50976.

Protected slings must be used for offloading and erection. Galvanized work which is to be stored at the works or on site shall be stacked so as to provide adequate ventilation to all surfaces to avoid wet storage staining (white rust).

Small areas of the galvanized coating damaged in any way shall be restored in accordance with DIN 55928, part A and DIN 50976 by:

- Cleaning the area of any weld slag rust and other impurities and by thorough wire brushing to give a metallic clean surface.
- Application of suitable number of coats of zinc-rich paint containing more than 90 % w/w of zinc in dried film. The dry film thickness shall exceed at least 50 % the thickness of the desired galvanization. In case of application of a low melting point zinc alloy repair rod, the rods shall be in accordance with DIN1707, the thickness of the alloy shall be at least as of the desired galvanization.

The restored area is not to exceed 1 % of the galvanized surface. Surface restoration of parts in contact with drinking water is not allowed and the quality of the galvanization is to be in accordance with DIN 2444.

After fixing, bolt heads, washers and nuts shall receive two coats of zinc-rich paint.

Connections between galvanized surfaces and copper, copper alloy or aluminum surfaces shall be protected by suitable preferably hydrophobe tape wrappings to the owner's approval.

3.15 DEGREE OF PROTECTION

The enclosures of the control cabinets, Junction boxes and Marshalling boxes, panels etc. to be installed as detailed here under:

The minimum requirements for panels are as follows:

- Installed out door: IP- 55
- Installed indoors in air-conditioned area: IP-32
- Installed in covered area: IP-52
- Installed indoors in non air-conditioned area where possibility of entry of water is limited: IP-41.
- For LT Switchgear (AC & DC distribution Boards): IP-52.

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