# BHARAT HEAVY ELECTRICALS LIMITED

## TRANSMISSION BUSINESS ENGINEERING MANAGEMENT



| BHEL Document No. TB-316-381-100C | Rev. 00 | | Prepared by | Checked by | Approved by |
|---|---|---|---|---|---|
| | | Name | SB | VK | AG |
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| Title: OUTDOOR ILLUMINATION SYSTEM | | Date | 02.11.20 | 2/11/20 | 5/11/20 |
| | | Group | TBEM | | |
| | | W.O. No | 83011 | | |

**CUSTOMER** NTPC LTD.

**CONSULTANT** -

**PROJECT** Rammam Stage III HEP (3 X 40 MW)

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| Rev No. | Date | Altered | Checked | Approved | REVISION DETAILS |
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SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0.1 This technical specification covers the requirements of design, manufacture, inspection, testing at works, packing, dispatch, storage, erection, testing & commissioning and handing over of complete Illumination system complete with accessories. No deviation from the requirements specified in various clauses of this specification shall be allowed.

1.0.2 The Contract shall be on Bill of Quantity basis for the package. The Contractor shall be responsible for the design and verification of the Illumination system, demonstration of lux levels and other criteria at site.

1.0.3 After placement of order, the bidder has to design the system as per relevant standard/codes to the satisfaction of BHEL/NTPC.

1.0.4 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 Purchaser/Owner, 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.

1.0.5 The Bidder shall have deemed to have understood completely all the Tender drawings and documents and quoted accordingly.

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

1.0.7 It is the responsibility of the successful Bidder to obtain necessary approval/clearance from statutory organizations wherever applicable for the equipment/systems under the scope specified.

CUSTOMER: NTPC Ltd.
PROJECT: 132kV Switchyard for Rammam HEP (3x40MW)

The specification comprise of following sections:

| | |
|---|---|
| Section-1: | Scope, Specific Technical Requirement & Bill of Quantities. |
| Section-2: | Equipment Specification. |
| Section-3: | Project Details & General technical requirements. |
| Section-4: | Equipment Data Sheet |
| Section-5: | Enclosures to the Specification |

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

1.1 Illumination Areas

The illumination system shall be provided for the following areas:

(i) 132kV Switchyard area at Rammam (3 X 40 MW) HEP – Complete area as marked in the foundation layout drawing (NTPC Drg. No. 5602-003-H230-PVE-F-258 Rev 04) including Street Lighting.

## 1.2 Scope of Supplies & Services

### 1.2.1 Scope of Supply Material & Erection Material

a) Illumination system design engineering is included in bidder's scope, which includes design of complete lighting system for outdoor areas. The aspect of engineering covers preparation of electrical distribution and control schemes, quantity estimation, luminaire layout drawings, wiring schemes up to 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 illumination system complete in all respect.

b) 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. BHEL reserves the right for overall contract value variation up to ±30% due to any reason at the same unit rates, terms & conditions during execution of contract, however, the quantity of individual items may vary up to any extent.

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

d) Further, in case any type of luminaries etc not included below but are required to meet the technical specification shall be specifically brought out in the offer/shall be supplied.

e) 415V ACDB, MLDB, 220V and 48V DCDB boards are being supplied and erected by the owner. They are kept on the ground floor of the Auxiliary Control Room Building adjacent to the 132kV Switchyard. Illumination contractor will terminate the cables in these panels.

f) Review and approval of bidder's engineering documents shall not relieve the bidder from the responsibility of correctness for design & supply.

g) All associated items, though not specifically mentioned herewith but required for safe and satisfactory operation of equipment/ system shall also be deemed included and the same shall be supplied at NO EXTRA COST to BHEL/ Customer. Further, in case any type of luminaire/ panels etc. not included but are required to meet the technical specification shall be specifically brought out in the offer/ shall be deemed to be included in offer.

h) Bidder shall supply junction boxes/ lighting panels complete with terminals, fixing arrangement and its associated accessories as required and hence, the supports, brackets, bolts, nuts, screws, conduits etc. required for erection are also included in scope of the bidder.

i) Bidder shall indicate in his offer, make and catalogue nos. of all equipment offered in line with approved make list.

1.2.2 Free Issue Items from Purchaser

Cables: Following are the various cable sizes that may be used for project execution. Bidder shall estimate the cables required for successful completion of the full scope of works and furnish the break up of quantity as an annexure to the un-priced schedule. The quantity of the cables shall be free issued to the successful bidder as per this annexure. The laying and termination of the estimated quantities of cables shall be in the scope of the bidder. No variation shall be admissible to the contractor so far the input remains unchanged.

1) 2core x 2.5 sq.mm (PVC/ Cu.)
2) 2core x 6 sq.mm (PVC/ Al.)
3) 4 core x 6 sq.mm (PVC/ Al.)
4) 2core x 16 sq.mm (PVC/ Al.)
5) 4 core x 16 sq.mm (PVC/ Al.)
6) 3.5 core x 35 sq.mm (PVC/ Al.)
7) 3.5 core x 70 sq.mm (PVC/ Al.)

Earthing Flats:

Galvanised Earthing Flat shall be available with the purchaser. Bidder shall estimate the GI Flats for successful completion of the full scope of works and furnish the quantity as an annexure to the un-priced schedule. The quantity of the GI Flat shall be free issued to the successful bidder as per this annexure. The installation of the estimated quantities of GI flats shall be in the scope of the bidder. No variation shall be admissible to the Contractor so far the input remains unchanged. Sizes available are 75x12mm and 50x6mm GI Flats. However, any other special material required shall be in bidder scope. Also installation of all earthing material will be in bidder scope. Bidders shall quote the same inclusive in the BOQ items.

GI Conduits: Galvanised conduits of 50mm & 100mm dia shall be available with the purchaser. The installation of the estimated quantities of GI conduits shall be in the scope of the bidder.

1.2.3 Scope of Services

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

1.2.3.1 Erection, Commissioning & Testing

The Bidder shall include Erection, Testing and Commissioning of the Illumination Equipment at Site.

The scope of ETC shall include receipt of material at site, safe storage of material, handling of equipment/ material at site, erection of equipment / material at site including fabrication, equipment and system testing, commissioning and handing over of the entire system.

Conduction of lux level measurement as per approved designs to the satisfaction of BHEL/ Customer shall be under bidder's scope including any other performance guarantee test. It will be bidder's responsibility

to demonstrate performance of system fulfilling design / operational requirement. Bidder to arrange testing instrument on returnable basis.

Laying and termination of power and control cables for the equipment under the scope of this specification.

All material and consumables required for erection work shall be in Contractor's scope. Erection material shall cover, but not be limited to, Clamps etc for Luminaries, Connections between Junction Boxes and Luminaries in outdoor area, All cable glands, lugs and ferrules require for cabling/ wiring. Any other material required for erection shall deemed to be in Contractor's scope. Holes shall not be drilled on the Galvanised substation gantry and LM structures.

Earthing of all electrical equipment.

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

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, which shall be brought to the site, however, the unused commissioning spares shall be returnable to the bidder.

#### 1.2.3.2 Civil Works

Civil works such as foundation for Outdoor Panels, Lighting Poles etc. shall be done by the contractor. The rates for these civil works shall be included in the erection rates of respective items. Civil design for foundations of pole/ lighting panels and other outdoor panels is included in bidder’s scope including construction of the same at site.

### 1.3 Type Tests

The type test reports shall not be more than ten years prior to the original scheduled date of bid opening. If any or all test reports are more than ten years old or are not valid then type tests shall be conducted free of charge.

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 on any/all additional type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.

All type tests as per relevant standards shall be submitted for each type rating of lighting fixtures and lamps with adequate details/drawings to establish equivalence with the offered type.

### 1.4 Quality Plan

Manufacturer shall follow the Approved Manufacturing & Field Quality Plan of BHEL/ NTPC.

### 1.5 Handing and Taking Over

It is the responsibility of the Contractor to run and maintain the system supplied by them for a period of 3

months and subsequently hand over the same to BHEL/owner. Contractor shall assist BHEL to hand over the system supplied by them to owner.

### 1.6 Utilities Available

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

### 1.7 Drawings / Documents required for Engineering Manufacturing Clearance

The following drawings/ documents but not limited to shall be used for providing engineering manufacturing clearance of illumination system.

| | |
|---|---|
| 1 | Outdoor Illumination System- Lighting Design of Switchyard |
| 2 | Outdoor Illumination System- Lighting Layout of Switchyard |
| 3 | Outdoor Illumination System- Drawings/ Technical details for Lighting Fixtures, Lighting Panels and Lighting Poles |
| 4 | Illumination System- Type Test Reports |
| 5 | Illumination System- Cable Schedule |
| 6 | Illumination System- Quality Assurance Plan & Inspection Test Schedule |

The successful bidder shall have to extend all possible supports like timely submission/ re-submission 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.

### 1.8 Packing and Despatch

1. The items/ materials of illumination system shall be properly packed for selected mode of transportation i.e. sea, rail and road in such a manner that it is protected against the climatic conditions and for any damage during transportation, transit and storage. The panels shall be wrapped in polyethylene sheets before being placed in wooden crates/cases to prevent damage to the finish. Crates/cases shall have skid bottoms for handling. Special notations such as 'Fragile', 'This side up', 'Weight', 'Owner's particulars\ 'PO nos.' etc., shall be clearly marked on the package together with other details as per purchase order.
2. The item/ materials may be stored outdoors for long periods before installation. The packing should also be suitable for outdoor storage areas with heavy rains/ high ambient temperature unless otherwise agreed and hence, Packing shall be suitable for long storage (minimum 2 years).

Annexure-BOQ

| BOQ for Scope of Supply and Services for Outdoor Illumination for 132 kV Switchyard for Rammam HEP (3X40 MW) | | | |
|---|---|---|---|
| | | | |
| **Sr No** | **Item Description** | **Unit** | **Quantity** |
| | **SUPPLY** | | |
| 1 | SUPPLY- ILLUMINATION EQUIPMENT : OUTDOOR LIGHTING PANEL | Nos | 3 |
| 2 | SUPPLY- ILLUMINATION EQUIPMENT : OUTDOOR JUNCTION BOX (FOR LIGHTING MAST) | Nos | 15 |
| 3 | SUPPLY- ILLUMINATION EQUIPMENT : STREET LIGHTING PANEL | Nos | 1 |
| 4 | SUPPLY- ILLUMINATION EQUIPMENT : 63A, 415V : INTERLOCKED SWITCH SOCKET OUTDOOR RECEPTACLE (TYPE RP) | Nos | 3 |
| 5 | SUPPLY- ILLUMINATION EQUIPMENT : 1 X 400W FLOOD LIGHT TYPE LIGHTING FIXTURES | Nos | 41 |
| 6 | SUPPLY- ILLUMINATION EQUIPMENT : STREET LIGHTING FIXTURES | Nos | 21 |
| 7 | SUPPLY- ILLUMINATION EQUIPMENT : STREET LIGHTING POLE & ACCESSORIES (A1 TYPE) | Nos | 21 |
| 8 | SUPPLY- ILLUMINATION EQUIPMENT : OUTDOOR JUNCTION BOXES -TYPE JB-S | Nos | 21 |
| 9 | SUPPLY- ILLUMINATION EQUIPMENT : OUTDOOR POWER RECEPTACLE FOR OIL FILTRATION UNIT (100A) | Nos | 1 |
| 10 | SPARES- ILLUMINATION EQUIPMENT : LIGHTING PANELS-EACH RATING OF ISOLATOR/SWITCH | Nos | 2 |
| 11 | SPARES- ILLUMINATION EQUIPMENT : LIGHTING PANELS-EACH RATING OF FUSE | Nos | 5 |
| 12 | SPARES- ILLUMINATION EQUIPMENT : LIGHTING PANELS-EACH RATING OF MCB | Nos | 10 |
| 13 | SPARES- ILLUMINATION EQUIPMENT : LIGHTING PANELS-EACH RATING OF CONTACTOR | Nos | 3 |
| 14 | SPARES- ILLUMINATION EQUIPMENT : LIGHTING PANELS-EACH RATING OF PUSH BUTTON | Nos | 3 |
| 15 | SPARES- ILLUMINATION EQUIPMENT : LIGHTING FIXTURES- EACH TYPE OF FIXTURES COMPLETE WITH ACCESSORIES WITHOUT LAMPS (10% OF TOTAL QUANTITY (FIXTURES SHOULD BE COMPATIBLE WITH INDIAN MAKE) | Lot | 1 |
| 16 | SPARES- ILLUMINATION EQUIPMENT : LIGHTING FIXTURES- LAMPS (20% OF EACH TYPE AND RATING) | Lot | 1 |
| 17 | SPARES- ILLUMINATION EQUIPMENT : RECEPTACLES - EACH TYPE OF RECEPTACLES (5% OF TOTAL QUANTITY) | Lot | 1 |
| 18 | SPARES- ILLUMINATION EQUIPMENT : JUNCTION BOXES (EACH TYPE) (2% OF TOTAL QUANTITY) | Lot | 1 |
| | | | |
| | **SERVICES** | | |
| 1 | ETC- ILLUMINATION EQUIPMENT : OUTDOOR LIGHTING PANEL | Nos | 3 |
| 2 | ETC- ILLUMINATION EQUIPMENT : OUTDOOR JUNCTION BOX | Nos | 15 |
| 3 | ETC- ILLUMINATION EQUIPMENT : STREET LIGHTING PANEL | Nos | 1 |
| 4 | ETC- ILLUMINATION EQUIPMENT : 63A, 415V : INTERLOCKED SWITCH SOCKET OUTDOOR RECEPTACLE (TYPE RP) | Nos | 3 |
| 5 | ETC- ILLUMINATION EQUIPMENT : 1 X 400W FLOOD LIGHT TYPE LIGHTING FIXTURES | Nos | 41 |
| 6 | ETC- ILLUMINATION EQUIPMENT : STREET LIGHTING FIXTURES | Nos | 21 |
| 7 | ETC- ILLUMINATION EQUIPMENT : STREET LIGHTING POLE & ACCESSORIES (A1 TYPE) | Nos | 21 |
| 8 | ETC- ILLUMINATION EQUIPMENT : OUTDOOR JUNCTION BOXES -TYPE JB-S | Nos | 21 |
| 9 | ETC- ILLUMINATION EQUIPMENT : OUTDOOR POWER RECEPTACLE FOR OIL FILTRATION UNIT (100A) | Nos | 1 |
| 10 | LAYING, TESTING AND COMMISSIONING OF 2 CORE 2.5 SQ MM PVC INSULATED, ARMOURED CU CABLE (INCLUDES SUPPLY AND ERECTION OF CABLE GLANDS/ LUGS) | m | 1500 |
| 11 | LAYING, TESTING AND COMMISSIONING OF 2 CORE 6 SQ MM PVC INSULATED, ARMOURED AL CABLE (INCLUDES SUPPLY AND ERECTION OF CABLE GLANDS/ LUGS) | m | 300 |
| 12 | LAYING, TESTING AND COMMISSIONING OF 4 CORE 6 SQ MM PVC INSULATED, ARMOURED AL CABLE (INCLUDES SUPPLY AND ERECTION OF CABLE GLANDS/ LUGS) | m | 200 |
| 13 | LAYING, TESTING AND COMMISSIONING OF 2 CORE 16 SQ MM PVC INSULATED, ARMOURED AL CABLE (INCLUDES SUPPLY AND ERECTION OF CABLE GLANDS/ LUGS) | m | 500 |
| 14 | LAYING, TESTING AND COMMISSIONING OF 4 CORE 16 SQ MM PVC INSULATED, ARMOURED AL CABLE (INCLUDES SUPPLY AND ERECTION OF CABLE GLANDS/ LUGS) | m | 600 |
| 15 | LAYING, TESTING AND COMMISSIONING OF 3.5 CORE 35 SQ MM PVC INSULATED, ARMOURED AL CABLE (INCLUDES SUPPLY AND ERECTION OF CABLE GLANDS/ LUGS) | m | 100 |
| 16 | LAYING, TESTING AND COMMISSIONING OF 3.5 CORE 70 SQ MM PVC INSULATED, ARMOURED AL CABLE (INCLUDES SUPPLY AND ERECTION OF CABLE GLANDS/ LUGS) | m | 300 |
| 17 | LUX MEASUREMENT AT SITE | Lot | 1 |

Annexure A to Section 1_Illumination Color Code



| | | GROUND COLOUR | | IDENTIFICATION TAG/BAND | | | |
|---|---|---|---|---|---|---|---|
| ***Sl. No.*** | ***Equipment*** | ***Colour*** | ***RAL*** | ***Colour*** | ***ISC No.*** | ***Equi-valent RAL No.*** | ***Remarks*** |
| 18. | Doors industrial type | Blue | 5012 | | | | |
| 19. | Hydraulic power unit | Golden Yellow | 1004 | Signal Red | 537 | 3001 | |
| 20. | Fencing | Black | | | | | |
| 21. | Lighting poles | Aluminium | | | | | |
| | **ELECTRICAL COMPONENTS** | | | | | | |
| 22. | **MAIN GENERATOR** | | | | | | |
| | - Lub oil system<br>- Seal Oil System | Grey | 9002 | White | | 9010 | Legend in Black Letters |
| | - Stator Water Sys. | Grey | 9002 | White | | 9010 | Legend in Black Letters |
| 23. | **DIESEL GENERATOR SET** | | | | | | |
| | - Diesel Engine | Grey | 9002 | White | | 9010 | |
| | - Generator | Grey | 9002 | White | | 9010 | |
| 24. | **L.T. TRANSFORMERS** | | | | | | |
| | - Indoor | Blue | 5012 | | | | Legend in Black Letters |

Annexure A to Section 1_Illumination Color Code



| | | GROUND COLOUR | | IDENTIFICATION TAG/BAND | | | |
|---|---|---|---|---|---|---|---|
| ***Sl. No.*** | ***Equipment*** | ***Colour*** | ***RAL*** | ***Colour*** | ***ISC No.*** | ***Equi-valent RAL No.*** | ***Remarks*** |
| 31. | **33 KV SWGR cubicle** | Grey & Blue | 9002 5012 | | | | Front & Rear Panels in Grey (RAL 9002). End Panels sides in Blue (RAL 5012) |
| | - CR Panels | Grey | 9002 | | | | |
| | - Surge protection cubicle | Grey | 9002 | | | | |
| 32. | DDCMIS/PLC system cabinets, computer system cabinets, Termination, Marshalling, Relay Panels etc. | Blue & Grey | 5012& 9002 | | | | Front & Rear Panels in Grey (RAL 9002). End Panels sides in Blue (RAL 5012) |
| 33. | All locally mounted C&I systems panel/ cabinets | Blue & Grey | 5012& 9002 | | | | Front & Rear Panels in Grey (RAL 9002). End Panels sides in Blue (RAL 5012) |
| 34 | Junction boxes | Grey | 9002 | | | | |
| 35 | LIE/LIR | Grey | 9002 | | | | |

Annexure A to Section 1_Illumination Color Code



| | | GROUND COLOUR | | IDENTIFICATION TAG/BAND | | | |
|---|---|---|---|---|---|---|---|
| ***Sl. No.*** | ***Equipment*** | ***Colour*** | ***RAL*** | ***Colour*** | ***ISC No.*** | ***Equi-valent RAL No.*** | ***Remarks*** |
| 36 | Remote I/O cabinets | Grey | 9002 | | | | |
| 37 | Intercom | Equipment | | | | | |
| | - Hand sets unit | Grey | 9002 | | | | |
| | - Hand sets plant | Grey | 9002 | | | | |
| 38 | - Metal containers/ cable junction boxes | Grey | 9002 | White | | 9010 | - |
| 39. | **LIGHTING EQUIPMENT/PANELS** | | | | | | |
| | - Exterior | Grey | 9002 | | | | |
| 40. | **INSULATING OIL TREATMENT PLANT** | | | | | | |
| | - Tanks and the equipment | Grey | 9002 | White | | 9010 | Legend in Black Letters |
| 41. | **IDENTIFICATIONS PLATES** | | | | | | |
| | Mechanical equipment's and piping | | | | | | |
| | - Background | White | 9010 | | | | |
| | - Border | Black | 9011 | | | | |
| | - Lettering | Black | 9011 | | | | |

| | | |
|---|---|---|
| | iii) Cable box - outdoor area | - IP 55 |
| | iv) Indoor kiosks and marshalling boxes | - IP 52 |
| | v) Outdoor kiosks and marshalling boxes | - IP 55 |
| 9.07.00 | Push button stations / Marshalling kiosk / box / panel / cabinet / enclosure / industrial receptacle | |
| | i) Indoor | - IP 55 |
| | ii) Outdoor | - IP 55 |
| 9.08.00 | Junction boxes/Terminal boxes for cables/wires | - IP 55 |
| 9.09.00 | Outdoor lighting fixtures/fixtures | - IP 55 |
| 9.10.00 | Gen. Neutral grounding resistor | - IP 22 |
| 9.11.00 | Battery charger | - IP 42 |

**10.00.00 CONTROL PHILOSOPHY**

SCADA system covered under "Control & Instrumentation" shall provide all control, including synchronisation, monitoring, indication, annunciation and metering for the entire electrical system covered under Bidder's scope. Refer Technical specification Part –B, Section-VI, Sub-Section – IIC, C& I for details.

The SCADA control location of entire electrical plant including out door yard switchgear shall be at the main plant CCR. To maintain uniformity, it shall be ensured that different components of SCADA namely OWS (operator's work station), LVS (large video screen) associated with power house control, out door yard switchgear control ,station auxiliaries control, DC system etc along with requisite furniture shall be similar in appearance and shade and shall be supplied by the same supplier.

**11.00.00 TESTS**

11.01.00 **Test Requirement for Service Transformers, LT Motors (above 50 KW), Air Insulated Switchyard Equipments (Isolators, 132 kV Circuit Breaker, Current Transformers, Capacitive Voltage Transformers, Surge Arrestors, Post Insulators, clamps, connectors, insulator strings, etc.), Protection Equipment, Battery, Battery Chargers (above 60 Amps), LT Power and Control Cables, DG Sets, Cable Joints and Termination Kits, Cable Tray Support System and Fire Proof Cable Penetration Sealing System, 33 KV, 11 KV & 415 V Switchgear.**

11.01.01 All equipment to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for the Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the

CLAUSE NO.

## QUALITY ASSURANCE AND INSPECTION

### STATION LIGHTING (E-6)

| Item Components / Sub System / Assembly — Attributes / Characteristics | Make, Type , Rating/ TC | Dimension | Pre-Treatment of sheat | Paint Shade Thickness Adhesion & Finish | Galvanise Test | IP Test | Bought Out Items/ Bill of Material | HV & IR | Functional Check as per spec. | Constructional Feature as per NTPC spec. | Routine Test as per relevant std aad spec | Acceptance Test as per relevant std and spec | Item to conform to relevant standard |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Luminaries (IS-10322 Part-5 Sec.1) | Y | | | | | Y | | Y | | | Y | Y | |
| Electronic Ballast | Y | | | | | | | | | | Y | Y | Y |
| Lighting Wire (IS-694) | Y | | | | | | | | | | Y | | |
| Fans (IS-374) | Y | | | | | | | | | | Y | | |
| Pole (IS-2713) | Y | | | Y | | | | | | Y | Y | Y | |
| Lamps (IS-9800, IS-9974) | Y | | | | | | | | | | Y | Y | |
| Lighting Mast (with raise & lower lantern type) | Y | Y | | | Y | | | | | Y | Y | Y | |
| Wall Mounted Lighting Panel (IS-513, IS-5) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | |
| Switch Box/ Junction Box/Receptacles/ Local Push Button Station, Lighting Panel (IS-513, 2629, 2633, 4759, 6745) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | |
| Cable Gland (BS-6121) | Y | Y | | | | | | | | | Y | | |
| Cable Lug (IS-8309) | Y | Y | | | | | | | | | Y | | |
| Flexible Conduit | Y | | | | | | | | | | Y | | |
| Lighting Transformer (IS-1117) | Y | | | | | | | | | Y | Y | | |
| Epoxy & Galvanised Conduit (IS-9537, 2629, 2633, 4759, 6745) | Y | Y | | | | | | | | | Y | | Y |

Notes:

1 This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2. Make of all major Bought Out Items will be subject to NTPC approval.

**SECTION 2**

# EQUIPMENT SPECIFICATION

| CLAUSE NO. | 132 KV SWITCHYARD EQUIPMENTS (E17) | |
|---|---|---|
| **7.03.00** | **145 kV class Bus Post Insulator** | |
| a) | Type | Solid core type |
| b) | Voltage class (kV) | 145 |
| c) | Wet one minute power frequency withstand voltage (kV) | 275 |
| d) | Dry impulse withstand positive and negative (kVp) | 650 |
| e) | Max. radio interference voltage (μ V) for any frequency between 0.5 MHz to 2 MHz at voltage of 92 kV (rms) between phase to ground. | 500 |
| f) | Total min. cantilever strength (Kg) | 600 |
| g) | Min. torsional moment (Kg m) | 500 |
| h) | Total height of insulator (mm) | 1500 |
| | i) Top p.c.d. (mm) | 127 |
| | ii) Bottom p.c.d. (mm) | 225 |
| i) | No. of bolts : Top | 4 |
| | Bottom | 4 |
| j) | Diameter of bolt holes (mm) | |
| | Top | M16 |
| | Bottom | dia 18 |
| k) | Pollution level as per IEC – 815 | Class III, Heavy |
| l) | Creepage distance | 3625 mm (minimum) |
| **8.00.00** | **ILLUMINATION** | |
| 8.00.01 | The lighting system and its accessories shall conform in general to the relevant standards except to the extent explicitly modified in the specification and shall be in accordance with the requirement specified elsewhere. The switchyard lighting shall be carried out by fixtures mounted on the switchyard structures/masts to be provided at appropriate locations. | |
| 8.00.02 | Supply, storage and installation of various lighting fixtures complete with lamps and accessories on the gantries and switchyard structures. | |

| CLAUSE NO. | 132 KV SWITCHYARD EQUIPMENTS (E17) |
|---|---|
| 8.00.03 | Supply, storage and installation of lighting panels, including their cable terminations from switchyard MCC/switchgear. |
| 8.00.04 | Supply, storage and installation of fixture supports, complete with all accessories including junction boxes. |
| 8.00.05 | All the civil works like fixing of anchor bolts, erection of lighting panels etc. shall be carried out by the contractor. Hardwares for fixing of fixtures etc. are also included in the erection component of the items. |
| 8.00.06 | Laying and termination of 415 V PVC armoured power cables of 2Cx6 mm2 Al. from lighting panel to the junction box at the bottom of the gantry/ structures for the lighting fixture and looping from one gantry/structures to the other shall be carried out by the contractor. |
| 8.00.07 | Laying and termination of 415 V PVC armoured power cables of 3 ½ Cx 35 mm2 Al. from MCC to the marshalling box and looping from one box to the other shall be carried out by the contractor. |
| 8.00.08 | Power supply shall be fed from 415/240V normal AC power supply through suitable number of conveniently located lighting panels (LPs). |
| 8.00.09 | Lighting panels, fixtures, masts, distribution boards, switchboxes, conduits, junction boxes, etc. shall be properly installed and earthed as per relevant IE rules. |
| 8.00.10 | All outdoor fixtures shall be weather proof type (IP 55 as per IS 2147). Fluorescent fixtures shall be provided with electronic ballasts. |
| 8.00.11 | All luminaries and their accessories and components shall be of the type readily replaceable by the available Indian makes. All fixtures and accessories shall of reputed make and non-corrosive type. Acrylic covers/louvers shall be of non-yellowing type. |
| 8.00.12 | The constructional features of lighting distribution boards shall be similar to AC/DC distribution boards described elsewhere. Outgoing circuits in LPs shall be provided with MCBs of adequate ratings. |
| 8.00.13 | Wiring shall be by multi-stranded PVC insulated colour coded wires laid in GI conduits. Minimum size of the wire shall not be less than 1.5 sq.mm. copper or 4 sq.mm. aluminium. Wires shall conform to IS:694 and wiring installation shall be as per IS:732. |
| 8.00.14 | Conduits shall be of heavy duty type, hot dip galvanised steel conforming to IS:9537. In corrosive areas, conduits shall have additional suitable epoxy coating. |
| 8.00.15 | All outdoor lighting systems shall be automatically controlled by synchronous timer or photocell. Arrangement shall be provided in the panel to bypass the timer/photocell for manual control. |
| 8.00.16 | All outdoor lighting systems shall be automatically controlled by synchronous timer or photocell. Arrangement shall be provided in the panel to bypass the timer/photocell for manual control. |

| CLAUSE NO. | 132 KV SWITCHYARD EQUIPMENTS (E17) |
|---|---|

**8.01.00 LIGHTING FIXTURES AND ACCESSORIES**

**8.01.01 General**

a) All lighting fixtures and accessories shall be designed for continuos operation under atmospheric conditions existing at site, without reduction in the life or without deterioration of materials and wiring etc.

b) Lighting fixtures shall be as given below:

1x400W weather proof miniature flood lighting with aluminium housing polished inside and stove enameled grey outside suitable to Bajaj type BHEF 21-S or Crompton type FBD-14 or Philips type SVF -12.

c) All the fixtures shall be supplied with matching lamps.

**8.02.00 Lighting fixtures**

8.02.01 The lighting fixtures and accessories shall be designed to operate at 240V AC 50Hz with supply voltage variation of ± 10%, frequency variation of ± 5%and combined voltage and frequency variation of ± 10%.

8.02.02 All fixtures shall be complete with accessories like ballasts, igniters, power factor improvement capacitors etc. These shall be mounted inside the fixtures as far as possible. If these cannot be accommodated inside, then a separate metal enclosed weather proof box shall be included to accommodate these. The starting time of these lamps to attain full light output shall be minimum. Each fixture shall have terminals suitable for 2.5 sq.mm stranded flexible copper conductor.

8.02.03 The mounting facility and conduit knockouts for the fixtures shall be as required and shall be suitable for cable/conduit entry.

8.02.04 On completion of the manufacture, all surfaces of the fixtures shall be thoroughly cleaned and degreased. The fixtures shall be free from scale, rust, sharp edges and burns.

8.02.05 All enamel finishing shall have a minimum thickness of 2 mils for outside surface and 1.5 mils for inside surface. The finish shall be non porous and free from blemishes, blisters and fading.

8.02.06 The housing shall be stove enamelled or vitreous enamelled or anodised aluminium as relevant for the type of fixtures.

**8.03.00 Lamps**

8.03.01 Sodium vapour lamps shall be color corrected type with screw caps.

8.03.02 The contractor shall furnish typical wiring diagram for HPSV fitting including all accessories. The diagram shall include all technical details of accessories i.e. starters, chokes, capacitors and igniters etc.

**8.04.00 LIGHTING PANELS**

8.04.01 Each panel shall be provided with one incoming triple pole switchfuse unit with neutral link and outgoing MCB's as specified.

8.04.02 The panel shall have degree of protection of IP55 as per IS 2147. The panel shall be single front construction, front hinged and front connected, suitable for floor mounting.

8.04.03 The panel shall be provided with a circuit directory plate (of anodised aluminium with the inscriptions indelibly etched on the plate) which is fitted on the inside of the door.

8.04.04 Each panel shall be provided with one no. ON indicating lamp for each phase.

8.04.05 The main busbars of the panel shall be of aluminium alloy with adequate cross section to carry rated and short circuit currents. The maximum temperature of the busbars shall not exceed 85 degree C. The busbars shall be able to withstand a fault level of 20KA for 1 sec.

8.04.06 Switches shall be hand operated air break type, heavy duty confirming to IS 4064. The fuses shall be of class 3 type (20KA prospective breaking current).

8.04.07 The MCB's shall in general conform to IS 8828. The rating shall be well coordinated with the corresponding circuits and shall be 'Morarajee Dorman' or 'Standard' make or its equivalent.

8.04.08 The contactors shall be of full voltage, direct on line air break, single throw, electromagnetic type. They shall be provided with atleast 2 NO and 2 NC type auxiliary contacts.

8.04.09 The panels shall be provided with proper identification labels for the panel, incoming and outgoing circuits etc.

**8.05.00 ILLUMINATION LEVELS AND TYPE OF FIXTURES AND LUMINAIRES**

| Location | Average Illumination level (lux) | Type of Fixture |
|---|---|---|
| Switchyard | 20 (general) | HPSV flood light, weather proof |
| | 50 (on strategic equipment) | HPSV flood light, weather proof |

**9.00.00 LT SWITCHGEAR AND DBs**

**9.01.00 CODES AND STANDARDS**

9.01.01 All equipments shall, generally, comply with the updated issues of :

I) IEC-947, IS-13947

# PART-B

# SUB-SECTION- E6

# ILLUMINATION SYSTEM

| | |
|---|---|
| **RAMMAM STAGE-III HYDRO ELECTRIC PROJECT**<br>**(3 X 40 MW)**<br>**ELECTRO MECHANICAL WORKS**<br>**EPC CONTRACT PACKAGE**<br>**BIDDING DOC NO.: CS-5602-003-9** | **TECHNICAL SPECIFICATION**<br>**SECTION-VI** |

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| CLAUSE NO. | ILLUMINATION SYSTEM (E 6) | एनटीपीसी NTPC लाइको hydro |
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## 1.00.00 CODES AND STANDARDS

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

## 1.01.00 Lighting Fixtures and Accessories

| | |
|---|---|
| IS:1913 | General and safety requirements for luminaries. |
| IS:2148 | Flame proof enclosures of electrical apparatus. |
| IS:418 | Tungsten filament general service electric lamps. |
| IS:1258 | Bayonet lamp holders. |
| IS:1534 | Ballast for fluorescent lamps. |
| IS:1569 | Capacitors for use in tubular fluorescent, high pressure mercury vapour and low pressure sodium vapour discharge lamp circuit. |
| IS:1777 | Industrial luminaries with metal reflectors. |
| IS:2149 | Luminaries for Street lighting. |
| IS:2215 | Starters for fluorescent lamps. |
| IS:2418 | Tubular fluorescent lamps for general lighting services. |
| IS:3323 | Bi-pin lamp holders for tubular fluorescent lamps. |
| IS:3324 | Holders for starters for tubular fluorescent lamps. |
| IS:3646 | Code of practice for interior illumination. |
| IS:4013 | Dust-tight electric lighting fittings. |
| IS:6616 | Ballasts for high pressure mercury vapour lamps. |
| IS:8224 | Electric Lighting fittings for Division 2 areas. |
| IS:9900 | High-pressure mercury vapour lamps. |
| IS:9974 | High pressure Sodium vapour lamps. |
| IS:10276 | Edison screw lamp holders |
| IS:10322 | Luminaires. |
| IS:13021 | AC Supplied Electronic Ballasts for tubular fluorescent lamps. |

**1.02.00 Lighting Panels, Switch-Boxes, Receptacles and Junction Boxes**

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

**1.03.00 Conduits, Pipes and Accessories**

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

**1.04.00 LIGHTING WIRES/CABLES**

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

**1.05.00 Electrical Installation Practices & Miscellaneous**

| | |
|---|---|
| IS:1944 | Code of practice for lighting of public thorough fare |
| IS:3646 | Code of practice for interior illumination. |
| IS:5572 | Classification of Hazardous areas (other than Mines)having flammable gases and Vapours for electrical installation |
| IS:6665 | Code of practice for industrial lighting. |

| | | |
|---|---|---|
| | | National Electrical Code |
| | | Indian Electricity Rules. |
| | | Indian Electricity Act |
| | IS:5 | Colour for ready mixed paints & enamels. |
| | IS:280 | Mild steel wires for general engineering purposes. |
| | IS:374 | Electric ceiling type fans & regulators. |
| | IS:732 | Code of practice for electrical wiring installations. |
| | IS:1255 | Code of practice for installation and maintenance of power cables upto and including 33KV rating. |
| | IS:2062 | Steel for general structural purposes |
| | IS:2629 | Recommended practice for hot dip galvanizing of iron and steel. |
| | IS:2633 | Methods for testing uniformity of coating of zinc coated articles. |
| | IS:2713 | Tubular steel poles for overhead power lines. |
| | IS:3043 | Code of practice for earthing |
| | IS:5216 | Guide for safety procedures and practices in electrical work. |
| | IS:5571 | Guide for selection of electrical equipments for hazardous areas. |
| | IS:802 | Code of practice for use of structural steel in overhead transmission line towers-Fabrication Galvanising, inspection & packing. |
| | BS:6121 | Mechanical cable glands |

**1.06.00** The equipment offered shall be of standard make and of best design. Equipments conforming to any other authoritative standards, which ensure same or better performance, shall also be acceptable. Wherever the equipments conform to any other standards, the deviations from the standard adopted and standard specified above, shall be clearly brought out in the tender. Copies of the standards adopted shall be supplied by the Contractors.

**1.07.00** All the material and equipment shall be installed in strict accordance with the best engineering practice and in accordance with the applicable regulations in the Indian Standards. In no instance shall the material, equipment and installation methods be inferior than the approved standards, unless departures from these standards are expressly specified and authorised by the Employer.

**2.00.00 VOLTAGE AND FREQUENCY**

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All current consuming devices shall be suitable for the 415V/240V AC, 50 Hz supply and 220V DC supply to which these are to be connected.

**3.00.00 ILLUMINATION SYSTEM DESCRIPTION**

The Illumination System shall cover the illumination of all indoor and outdoor areas of the Project like Barrage & Intake area, Butterfly valve house & Surge tank area, Power house area, Tailrace area, Approaches, Street Lighting along approach roads etc, as per actual requirement, complying with the specifications.

The lighting system of various areas shall comprise of the following systems:

a) Normal AC Lighting System

b) Emergency AC Lighting System

c) DC Lighting System

**85% lighting for various areas and 50% lighting in staircases shall be fed from normal AC source. 15% lighting for various areas and 50% lighting in staircases shall be fed from emergency AC source/DC source.**

**3.01.00 Normal AC Lighting System**

Normal AC lighting system shall be fed from lighting panels (LPs) which in turn shall be fed from the Lighting distribution boards (LDBs). The incoming supply to the Lighting distribution boards (LDBs) shall be 415V, 3 phase, 4 wire, 50Hz.

**3.02.00 Emergency AC Lighting System**

The lighting fixtures connected to this system shall be normally “ON” along with the normal AC system and shall be fed from AC source. These fixtures shall be fed from Emergency lighting panels (ELPs) which in turn shall be fed by 3-phase, 4-wire supply from the Emergency Lighting distribution boards (ELDBs). These fixtures shall go off for a few seconds in case of normal AC supply failure , but shall be automatically restored when ELDBs /ELPs are energised by Diesel generator set.

**3.03.00 DC Lighting System**

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

The supply to the DC lighting panels shall be automatically switched ON in case of loss of AC supply and DG set supply at Station Service Boards. The DC supply shall

be automatically switched OFF after about 3 minutes following the restoration of supply to normal AC or emergency AC lighting system.

In all areas other than Power House, like Barrage and Intake area, Butterfly valve house and Surge shaft area, approaches etc., emergency DC lighting is to be provided through self contained DC lighting fixtures at strategic locations. These fixtures shall be normally OFF and get switched ON in case of failure of AC supply.

**3.04.00** **Portable Lighting Units**

Total 18 Nos. (i.e. 10 Nos. for Power House, 4 Nos. for Barrage/Intake and 2 Nos. each Butterfly valve house & Tailrace area) Portable type self charging lighting units shall be supplied.

**4.00.00** **DESIGN PHILOSOPHY**

1. A comprehensive Illumination system shall be provided for the entire project

2. All outdoor lighting system shall be automatically controlled by synchronous timer or photocell. Provision to bypass the timer or photocell shall be provided in the panel.

3. Self contained DC lighting fixtures shall be provided by self-contained 4 hours duration Emergency lighting fixtures. Each shall be provided with Ni-Cd Battery, Battery Charger & 2x10 W flourescent lamps

4. The system shall include Normal/Emergency AC/DC Lighting Distribution boards and lighting panels, lighting fixtures, junction boxes, receptacles, switchboards, lighting poles/masts, conduits, cables and wires, etc. The system shall cover all interior and exterior lighting such as Area lighting, Street lighting, security lighting, etc. The Lighting Distribution Boards (LDBs) shall be located in LT Swgr. room. The Lighting Panels(LPs) shall be wall/floor mounted type with incomers as Switch fuse units/Isolators/MCCBs. Outgoing circuits in Lighting Panels shall be provided with MCBs of adequate ratings.

5. The Illumination system shall be designed on the basis of best engineering practices and shall ensure uniform, reliable, aesthetically pleasing and glare free illumination. The lighting fixtures shall be designed for minimum glare. The design shall prevent glare/luminous patch seen on VDU/ Large video screens, when viewed from an angle. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection. The diffusers/ louvers used in fluorescent fixtures shall be made of impact resistant polystyrene sheet and shall have no yellowing property over a prolonged period. **The Lux levels to be adopted for various area are indicated at Annexure - A.**

6. Apart from maintenance factor as given below, temperature correction factor and suitable correction factor for high altitude shall be considered in the lighting design for all light fixtures in all the areas.

a.) Area airconditioned : 0.8

b.) Area non airconditioned and other indoor area : 0.7

c.) Dust prone and outdoor area : 0.6

7. Power supply shall be 415/240 V normal AC , emergency AC and 220V DC through suitable number of conveniently located Lighting distribution boards (LDBs) and/or Lighting panels (LP). AC lighting supply shall be isolated from main supply by isolation transformers of max. rating of 100KVA and fault level restricted to 3 KA at Lighting Panels.

8. Adequate nos.(minimum two nos.) of 5/15A, 240V AC universal socket outlet with switch shall be provided in each office, cabin, room etc.
20A, 240V AC industrial receptacle with switch shall be provided strategically in all industrial areas. Suitable number of 63A, 3phase, 415V AC industrial receptacles shall be provided in all areas for welding purposes, particularly near all major equipment and at an average distance of 50m. Atleast one 63A, 3phase, 415V AC receptacle shall be provided in each building /area, other than Power house area.

9. In all the hazardous areas the lighting equipment /fixtures shall be flame proof.

10. All flourescent fixtures, shall have energy efficient 'T5' type flourescent lamps except the flourescent fixtures used for division 2 hazardous area. The louvers of these fixtures shall be designed for 'T5' type flourescent lamps. All flourescent lamps shall be have "Cool day light" colour designation. The mirror optics type flourescent fixtures shall have no irridescence effect.

## 5.00.00 TECHNICAL REQUIREMENTS OF VARIOUS EQUIPMENTS

### 5.01.00 Lighting Distribution Boards (AC LDBs/DC LDBs)

The technical requirements about Lighting distribution boards shall be as per Sub-section E-07 (HT & LT Switchgear).

### 5.02.00 Lighting Transformers

Lighting transformers shall be dry type, natural air cooled with class B insulation or better. Impedance of lighting transformer shall be so selected that the fault level of lighting system shall be reduced to 3KA. Lighting Transformers shall be tested as per IS:2026. Off-circuit tap changer with +/-5% tapping with a step of +/-2.5% shall be provided. In case, the transformer is not mounted inside the LDB, the same shall be housed in a separate 2mm thick CR sheet steel enclosure with IP-42 degree of protection as per IS:2147. However, the transformer terminal box shall have IP-52 degree of protection.

### 5.03.00 Lighting Panels (LPs)

a) Lighting panels shall be constructed out of 2 mm thick CRCA sheet steel. The door shall be hinged and the panel shall be gasketted to achieve

specified degree of protection. The panel shall be provided with terminal blocks for incoming and outgoing circuits, earthing terminals, M.S. mounting brackets suitable for surface mounting on wall/column/structure, allen keys with bolts as locking arrangements, circuit directory plate & circuit diagram fitted on the inside of the door etc. Removable gland plates shall be provided for entry of cables/conduits. Canopy shall be provided slope towards the rear side of the panel.

b) Wiring inside the panel shall be carried out with 1100V grade PVC insulated stranded copper conductors of adequate size. On both ends of each wire, engraved identification ferrules shall be provided.

c) Busbars shall be of aluminium alloy/ copper conforming to the details indicated for LDBs above.

d) All MCBs / Isolators shall be mounted inside the panel and a fibre glass sheet shall be provided inside such that operating knobs project out of it for safe operation against accidental contact. Operating handle of incoming MCCB/isolator shall project out of door.

e) Equipment mounted inside the panel shall be provided with individual labels with equipment designation/rating. Front of the panel shall be provided with label engraved with designation of the panel as furnished by the Owner. Labels shall be made of 3 ply lamicoid/engraved PVC having white letters on black background.

f) Miniature circuit breakers (MCBs)/Isolators shall be current limiting type with magnetic and thermal release suitable for manual closing and automatic tripping under fault condition. MCBs shall have interrupting capacity of 9 kA rms. MCB knob shall be marked with ON/OFF indication. A trip free release shall be provided to ensure tripping on fault even if the knob is held ON position. MCB terminals shall be shrouded to avoid accidental contact.

g) Isolators of AC lighting panels shall be of TPN, 63 A, continuous duty, load make-break type suitable for 415 V, 3 phase 4 wire system. Isolator knob shall be marked with ON/OFF indication. Terminals shall be shrouded to avoid accidental contact. The isolator shall be suitable for withstanding let through energy of 125 A HRC fuse.

h) DC switches shall be rotary type, 2 pole, continuous duty, load break type, quick make quick break, suitable for 220 V DC, 2 wire system. Switch knob shall be provided with ON/OFF indication.

i) Fuses shall be of HRC plug in type complete with fuse fittings. Fuse fittings shall incorporate fully insulated shrouded contacts. Visible indication of operation of fuse shall be provided.

j) Synchronous timers shall be quartz controlled electronic type, complete with rechargeable nickel cadmium cell, 24 hours range day dial, NO/NC contacts etc. and suitable for operation on 240V AC supply.

k) Each panel shall be provided with prominent, engraved identification plates for all front mounted equipment. Panel identification name plates shall be provided at front and rear. All name plates shall be of non-rusting metal or 3-ply lamicoid, with white engraved lettering on black back ground. Inscription and lettering sizes shall be subject to Owner's approval. Labels for fuses shall also clearly indicate the current ratings of the respective fuses. These labels shall be positioned so as to be clearly visible and shall give the device number, as mentioned in the wiring drawings.

l) All internal control wiring shall be carried out with 1100 V grade, single core, 1.5 sq.mm or higher size, stranded copper wires having colour coded PVC insulation. Space heater/power circuits shall have wires having adequate current carrying capacity but of size not less than 2.5 sq.mm copper. Internal terminals of stranded conductors shall be made with solderless crimping type tinned copper lugs, Insulating sleeves shall be provided over the exposed part of lugs. Engraved core identification ferrules, marked to correspond with panel wiring diagrams, shall be fitted at both ends of each wire. Jumper wires between two terminal blocks shall also be ferruled at both ends.

m) A continuous galvanised steel grounding bus of adequate size shall be provided along the bottom of the panel structure. It shall run continuously through out the length of the panel and shall have provision at both ends for connection to the grounding grid. Metallic parts of all components shall be effectively earthed using green coloured insulated copper wire or other approved means. Electrical continuity of the whole enclosure/frame work shall be maintained even after painting . All hinged doors shall be earthed through flexible earthing braids of copper.

n) The exterior side of Lighting panel shall be powder coated with color shade RAL 9002. The inside of the panel shall be glossy white.

o) Terminal blocks shall be 1100 V grade, stud type, moulded in melamine, suitable for terminating incoming cable and outgoing circuits of specified sizes. All the terminals shall be shrouded, numbered and provided with identification strip for the feeders.

**5.04.00 Lighting Fixtures, Lamps & Accessories**

a) All lighting fixtures and accessories shall be designed for continuous operation for its life under atmospheric conditions existing at site.

b) AC lighting fixtures and accessories shall be suitable for operation on 240 V AC, 50 Hz supply with supply voltage variation of +/-10%, frequency variation of +/- 5% and combined voltage & frequency variation (absolute sum ) of 10%. DC lighting fixtures and accessories shall be suitable for operation on 220 V, with variation between 190 V & 240 V.

c) Power factor of fluorescent lamp fixtures shall be not less than 0.90 for flame proof type fixtures & shall be not less than 0.95 with electronic ballast for other fluorescent fixtures. For High Pressure Sodium Vapour and Mercury Vapour (HPSV & HPMV) lamp fixtures, the power factor shall not be less than 0.85. Suitable power factor improvement capacitors shall be provided

for this purpose. Capacitors shall be hermetically sealed to prevent seepage of moisture.

d) All lighting fixtures shall be complete with lamps, lamp holders, terminal blocks, clamps, locking arrangements, fixing brackets etc. Control gears shall be provided as applicable/specified. The fixtures shall be fully wired upto terminal block. The internal wiring of the fixtures shall be done with suitable thermo-plastic or silicon rubber insulated copper conductor wires of suitable size and type. However, the normal cross section of conductor shall be not less than 0.5 Sq.mm and minimum thickness of insulation shall be 0.6mm. The wiring shall be capable of withstanding the maximum temperature to which it shall be subjected under specified service conditions without deterioration and affecting the safety of the luminaire when installed and connected to the supply. All fixing /locking screws, washers, nuts, brackets, studs etc, shall be zinc plated and passivated.

e) All fluorescent fixtures shall be provided with terminal blocks of ELMEX-EP or Equivalent make inside the fixture, for loop in loop out at fixture. The terminal block shall be suitable for 4 sq. mm. wire termination.

f) All lighting fixtures shall be provided with an external, brass/GI earthing terminal suitable for connecting 14 SWG, GI earthing wire. All metal or metal enclosed parts of the housing and accessories shall be bonded and connected to the earthing terminal as so to ensure satisfactory earthing continuity through out the fixture.

g) 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.

h) Generally all lighting fixtures (except for street light & post top lantern type fixture) shall be provided with 20mm dia. conduit knock-out for connection to the incoming supply.

i) Twin fluorescent lamp fixtures shall be wired in lead lag circuit to minimise stroboscopic effect.

j) High bay fixtures shall be suitable for pendant mounting and provided with safety chain. Flood light fixtures shall have suitable base plate/frame/ mounting brackets for mounting on structural steel members.

k) The reflectors shall be manufactured from CRCA sheet steel or aluminium as specified. The aluminium reflectors shall be made of high purity aluminium sheet, polished electrochemically brightened and anodized or proven alternate arrangement of anodizing.

l) Lamp holders for fluorescent tubes shall be of spring loaded, low contact resistance, bi-pin rotor type, resistant to wear and suitable for holding in normal position under condition of shock and vibration. Live parts of the lamp holder shall not be exposed during insertion or removal of the lamp or after the lamp has been taken out. Lamp holders for incandescent, HPMV & HPSV lamps shall be of porcelain screwed type.

m) Starters shall have bi-metal electrodes and high mechanical strength. Starters shall be replaceable without disturbing the reflector or lamps and without use of any tool. Starter shall have brass contacts and radio interference suppressing capacitor.

**I) Lamps**

a) Incandescent, HPMV & HPSV lamps shall be provided with screwed type caps.

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

c) Incandescent (GLS) lamps shall be of 'clear' type unless otherwise specified.

d) All fluorescent fixtures shall have 'T5' type fluorescent lamps except for flame proof fixture. The louvers of these fixtures shall be designed for 'T5' type fluorescent lamps. All fluorescent lamps shall have 'cool day light' color designation. The mirror optics type fluorescent fixtures shall have no irridescence effect. The life of T5 fluorescent fixture shall be rated for 18,000 burning hours.

e) High pressure mercury vapour (HPMV) lamps shall be of elliptical shape, colour corrected type with special fluorescent coating to increase lumen out put and improve colour rendition.

f) High pressure sodium vapour (HPSV) lamps shall be of elliptical / tubular shape and shall be provided with integral /external ignitor for rapid restart facility as per requirement. Halogen lamps shall be of tungsten filament, quartz glass type with ceramic base.

**II) Ballasts**

a) All HPSV and HPMV lamp fixtures shall be provided with wire-wound ballasts. All fluorescent fixtures except for Class-I, Div-II fittings/ increased safety fittings (Div-II/Hazardous Area) shall be provided with electronic ballasts.

b) Wire-wound Ballasts shall have annealed copper wire wound coil, electrical grade silicon sheet steel laminations and hermetically sealed with suitable insulating compound housed in sheet steel enclosure finished stove enameled grey outside. Class of insulation shall be suitable for temp. rise of winding. End connections and taps shall be brought out in a suitable terminal block rigidly fixed to the ballast enclosure. Ballast shall be suitable for use on nominal voltage of 240 V +/- 10%, 50 Hz supply. Ballast for HPSV and HPMV lamps shall be provided with tap settings of 220 & 240 V. Separate ballast shall be provided for each lamp in case of multi-lamp fixtures. Ballasts shall be free from hum.

c) Electronic ballasts shall be capable of satisfactory performance in adverse environment like that of power station. Electronic ballasts shall consist of AC/DC Convertor, high frequency power oscillator and low pass filter. The ballast shall be suitable for use on nominal voltage of 240 V ± 10%, 50 Hz supply. The filter circuit shall suppress the feed back of high frequency signals to the mains. The ballasts shall be rated for the rated lamp wattage of respective fluorescent fixtures.

d) Ignitors for HPSV lamps shall be of solid state electronic type

e) Controlgear box compartment for HPSV & HPMV fixtures shall be complete with ballast, capacitor, electronic ignitor (for HPSV lamps only) etc. fully wired upto terminal block, housed in cast aluminium or CRCA sheet steel enclosures as specified, finished powder coated grey shade RLA9002. The box shall be provided with hinged door and neoprene/synthetic rubber gasket to achieve IP-54 degree of protection & shall have loop in loop out facility suitable for 20 mm conduit entry.

5.04.01 Lighting fixtures of Philips/Bajaj/Crompton Greaves make shall be acceptable. Fixtures of any other make shall be subject to Employer's approval.

5.04.02 Neoprene/EPOM/synthetic rubber gasket shall be provided to achieve specified degree of protection.

5.04.03 Flood light fixtures shall be provided with graduated disc facilities for aiming angle of luminaries.

**5.05.00** Self Contained DC Emergency lighting fixtures shall be automatic, totally enclosed single unit suitable to receive 240 V +/- 10% AC, 50 Hz supply. The fixtures shall switch 'ON' automatically in the event of failure of AC supply. The unit shall comprise of 1.6 mm thick CRCA M.S. sheet enclosure, finished stove enameled grey outside, accommodating 6 Volt Nickel Cadmium batteries, battery charger, 2 x 10W fluorescent lamps, reflector etc. The unit shall be complete with mounting brackets suitable for mounting on wall/column. Nickel-Cadmium Battery shall be rated for operation of 2 x 10W fluorescent lamps continuously for 4 hours.

**5.06.00 Fans & Regulators**

Ceiling Fans, to be provided in non air conditioned office/control room area, shall be suitable for operation on 240 V, 50 Hz, AC supply comprising of class 'B' insulated copper wound single phase motor, 1200mm sweep, aerodynamically designed well balanced Aluminium blades (3 Nos.), down rod, die cast aluminium housing, capacitor, suspension hook, canopies etc. finished in stove enameled white. Power factor of fans shall not be less than 0.9.

Fan regulators shall be stepped electronic type suitable for operation on 240V AC supply.

**5.07.00 Switchboards / Switch Boxes / Socket outlets**

Switch boxes shall be made of 1.6 mm thick, MS sheet with 3 mm. thick decorative, Perspex cover. Switchbox shall be hot dip galvanized.

All the switch boards, 3/6 pin socket outlets alongwith switches (5 A & 15A) shall be decorative, modular type and flushed with the walls/columns.

The switch boards with the required number of piano type modular switches, fan regulators, socket etc. shall not be less than 75mm deep.

**5.08.00 Junction boxes**

5.08.01 Junction box (JB) shall be made of fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. The box shall be provided with the terminal blocks, mounting bracket and screws etc. The cable entry shall be through galvanized steel conduits of 20mm diameter. The JB shall have suitable knockouts on four sides of conduits or drilled during execution. The JB shall be suitable for surface mounting on ceiling/structures. The JB cover shall be either hinged or chain supported. The JB shall be of grey color RAL 7035. All the metal parts shall be corrosion protected. Terminal block shall be stud type suitable for loop-in loop-out of up to 2 numbers of 10 sq.mm aluminium conductors and tap off of 1.5 sq. mm copper conductors. The JB shall have internal provision to maintain earth continuity of connected metal conduits and shall have provision for lighting fixture earthing. Junction box surface should be such that it is free from crazings, blisterings, wrinkling, colour blots/striations. There should not be any mending or repair of surface. JBs will be provided with captive screws so that screws don't fall off when cover is opened. JB's mounting brackets should be of powder coated MS. Type test reports shall be furnished for the following Type tests.

(a) Impact resistance for impact energy of 2 Joules (IK07) as per BS EN50102

(b) Thermal ageing at 70deg C for 96 hours as per IEC60068-2-2Bb.

(c) Class of protection shall be IP 55.

(d) HV test.

5.08.02 Junction boxes for street lighting poles and lighting masts shall be made of 1.6 mm. thick CRCA sheet steel. The door shall be hinged and the box shall be gasketed to achieve IP: 55 degree of protection. The box shall be hot dip galvanised provided with HRC fuse units, terminal block for loop in loop out, earthing terminals, mounting brackets, allen keys with bolts as locking arrangement, cable gland plate at bottom etc. Wiring shall be carried out with 1100 V grade PVC insulated flexible copper wire of adequate size. Top of the box shall be arranged to slope towards rear side of the junction box. The junction box shall be of following types:

| Type No. | Component Description | Terminal Block |
|---|---|---|
| JB-S ( for street lighting poles ) | 1-6 A HRC fuse &1-netural Link | 1-4 way, stud type suitable for loop-in loop out |

| | | |
|---|---|---|
| | | 4CX16Sq.mm.Al. Cable & tap off 2Cx2.5Sq.mm.cu. cable |
| JB-M1 ( to be provided as part of lighting mast ) | | 1-4 way stud type suitable for loop-in loop out of 4C x 16 sq.mm. Al. cable & tap off of 3 nos. 2C x 2.5 Sq.mm cu. Wire |

5.08.03 Fuses shall be HRC, plug in type, complete with bakelite fuse fittings. ON/OFF switch shall be TPN, rotary type, load break suit able for 415V AC system.

5.08.04 Terminal blocks shall be of 750 V grade clip-on, stud type moulded in polyamide 6.6 grade or better. The terminals shall be shrouded and numbered.

**5.09.00 Industrial type Receptacles**

Industrial type Receptacles of required number of 63A, 415V AC, TPN, 5-pin and 20A, 240V AC, SPN 3-pin metal clad type shall be provided for all the areas. The receptacles shall be complete with suitable switch and plug with interlocking. The receptacles shall be designed for degree of protection of IP-55.
Receptacle boxes shall be fabricated out of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, and gasket to achieve degree of protection, terminal block for loop-in loop-out, of wire/cable of specified size, mounting brackets suitable for surface mounting on wall/column/structure, conduit entry/gland plate etc.

The On/OFF switches shall be rotary type, heavy duty, double break, AC 23 category, suitable for AC supply.

Plug & socket shall be of shrouded die-cast aluminium. Socket shall be provided with lid safety cover.

Robust mechanical interlock shall be provided for receptacles such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in off position.
Wiring inside the box shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wires of adequate sizes.

Terminal block shall be of 750 V grade, clip on stud type, moulded in Melamine, suitable for terminating specified cable size. All the terminals shall be shrouded.

**5.10.00 Conduits, Fittings & Accessories**

Galvanised heavy duty steel conduits for normal area and galvanised heavy duty steel conduits with an additional epoxy coating for corrosive area shall be provided. Alternatively glass reinforced epoxy conduits with comparable compressive and impact strength with that of heavy duty steel conduits may be offered.

**5.10.01 Rigid Steel Conduits**

Rigid steel conduits shall be heavy duty type, hot dip galvanised conforming to IS: 9537 Part-I & II shall be suitable for heavy mechanical stresses, threaded on both sides and threaded length shall be protected by zinc rich paint. Conduits shall be smooth from inside and outside. It shall be possible to pass wooden ball in a straight length of conduit. Diameter of ball shall be 2mm less than the internal dia. of conduit. Conduit shall be plugged by PVC caps for storage and transportation. Outside and inside surfaces of conduits shall be hot dip galvanized and shall have high protection against corrosive and polluting substances.

Fittings and accessories for conduits shall also be hot dip galvanised. However, for corrosive areas accessories & fittings shall have additional epoxy coating.

**5.10.02 Flexible Steel Conduits**

Flexible conduit shall be water proof and rust proof made of heat resistant lead coated steel. Conduit diameter shall be uniform throughout its length. Internal surface of the conduit shall be free form burrs and sharp edges. Conduit shall be complete with necessary accessories for proper termination of the conduit with junction boxes and lighting fixtures.

**5.11.00 Pull-out Boxes**

Pull out boxes shall be provided at approximately 6 (six) metre interval in a conduit run. Boxes shall be suitable for mounting on Walls, Columns, Structures, etc. Pull-out boxes shall have cover with screw and shall be provided with good quality gasket lining. Pull out boxes used outdoor shall be weather proof type suitable for IP:55 degree of protection and those used indoor shall be suitable for IP:52 degree of protection.

**5.12.00 Cables and Wires**

The cable sizes shall be so chosen that the voltage drop between the current consuming device and Lighting Distribution board shall not exceed 3% of supply voltage. Lighting wires shall be 1100 V grade, light duty PVC insulated unsheathed, stranded copper/aluminium wire for fixed wiring installation. Colour of the PVC insulation of wires shall be Red, Yellow, Blue and Black for R,Y,B phases & neutral, respectively and white & grey for DC positive & DC negative circuits, respectively. Minimum size of wire shall be 1.5 sq.mm for copper and 4 sq. mm for aluminium.

**5.13.00 Lighting Poles**

The poles shall be of ERW tubes of specified lengths, stepped tubular or swaged tubular and joined together. Lighting poles shall be painted with two coats of red Oxide and Zinc chromate in Synthetic compound primer on the exposed outside surface and with Bituminous paint all along the inside of the pole and outside portion which shall be embedded in foundation at manufacturing stage.

Poles shall be smooth cylindrical and swan neck or straight as per requirement. Poles shall be complete with base plates & taper plugs and necessary pipe reducer/fixing brackets for fixing the light fixture as per requirement.
Lighting poles shall be of following types:

| Overall Pole Height | Overhang projection | Application |
|---|---|---|
| 11m | 1.2m | For single street Light fixture. |
| 13m | 1.8m | For single street Light fixture. |
| 13m | 1.8m | With double arm for two street Light fixtures. |
| 11m / 13m | - | For flood light fixture |
| 4m | - | For post top lanterns. |

A1 Type

**5.14.00 Lighting Masts**

Lighting Masts shall be of continuously tapered polygonal cross section and hot dip galvanised. The Mast shall be of 30 Mtrs. height with lantern carriage to enable raising/lowering for ease of maintenance, including the Head Frame, Double Drum Winch, continuous stainless steel wire rope, in built power tool, luminaires, suitable aviation warning light, lightning protection alongwith 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.

a) The Mast together with the fixtures shall be capable of withstanding the appropriate wind loads as per IS:875. The Mast shall be fabricated from special steel plates conforming to BS-EN10-025 and folded to form a polygonal section.

b) Lantern Carriage shall be fabricated suitably and hot dip galvanised for fixing and holding flood light fixtures and their control gear boxes. Lantern carriage shall be provided with suitable no. and rating of light fixtures.

c) Carriage shall be provided with JB type M1 to facilitate interconnection to lighting fixtures.

d) 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.

e) Lighting mast shall be complete in all respect and shall be provided with feeder piller complete with power/control circuit alongwith 32A TPN MCB, contactors, timers, MCB's, motor protections (O/L & single phase), start/stop PB with indication lamps. Feeder piller shall have provision of receiving 4Cx16 sq mm. cable. Feeder piller shall be made up of 1.6 mm CRCA sheet steel with IP 55 degree of protection & shall be powder coated. All necessary cables between feeder piller & JBMI & between JBMI & fixtures shall be provided and same shall be of proven design.

f) A finial (heavy duty, hot dip galvanized) with a height of 1.2M shall be

provided at the centre of the head frame for providing lightning protection. It shall be solidly bolted with the mast body to provide a conducting path. Earthing terminals shall be provided for earthing the mast.

g) Lighting Mast shall also be provided with suitable aviation warning lights.

**5.15.00 Painting**

I. All sheet steel work for lighting panels, lighting fixtures etc. shall be treated in tanks in accordance with IS 6005. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling, the parts shall be washed in running water and rinsed in slightly alkaline hot water and dried. After phosphating the surfaces shall be rinsed and passivated. Treatment as per IS:6005 shall be provided followed by powder painting with final shade of RAL9002 shall be done.

II. All welds, bolt holders, conduit/cable entry holes etc. made during installation shall be wire brushed and touched up with metal primer of lead oxide and zinc chromate in synthetic medium.

**5.16.00 Galvanising**

I. Galvanizing of switch boxes, junction boxes, conduits, other steel components and accessories shall conform to IS: 2629 and IS: 2633. Galvanizing shall be uniform, clean, smooth, continuous and free from acid spots. Should the galvanizing of the samples be found defective, the entire batch of steel shall have to be regalvanised at Contractor's cost after pickling.

II. The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS: 1367 (Part-13). 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.

## 6.00.00 INSTALLATION

**6.01.00 Lighting Fixture Installation**

1. Lighting fixture of appropriate type as per lighting layout drawings shall be installed by the Contractor. Contractor shall submit & obtain approval for the typical mounting arrangements for different light fixtures. The type of mounting will generally be indicated on the layout drawings. The exact mounting will be decided at site depending upon the actual space/other facilities available at site. Lighting fixtures shall not be suspended directly from the junction box in the main conduit run.

2. Wooden plugs in walls and ceilings for fixing of lighting fixtures and accessories are not acceptable. A suitable fool-proof method preferably using nylon rawl plug for fixing these shall be offered and this shall be subject to the Employer's approval.

3. Flood lights shall be mounted on steel base of structures/walls

/columns/masts/poles. Fixing slots shall be provided to turn the fixture by about 5 deg. on both sides. Bolts shall be tightened with spring washers. Terminal connection to the flood lights shall be made through flexible-conduits.

4. In the rooms where false ceiling is provided the lighting fixtures shall be supported separately by false ceiling grid or roof over false ceiling and not by the ceiling board.

5. The installation of lighting fixtures shall include the supply of all steel brackets, channels, angles, supporting, & anchoring material and hardware, steel brackets/hangers for bridging the gap above false ceiling and other accessories.

6. To distinguish emergency AC fixtures from normal AC fixtures, red painted circular mark of 1cm. Dia. shall be provided on emergency fixtures.

7. The self contained DC emergency lighting fixtures shall generally be installed in different areas on walls/columns/structure as required at site.

8. Fan clamps shall be rigid enough and shall be made to suit the position suitable for reinforced concrete roofs or steel structures as required. Suspension rod shall be of adequate strength to withstand the dead and impact forces imposed on it.

9. Ballasts which, produce humming sound after commissioning at site shall be replaced at free of cost by the contractor.

10. All steel installation accessories shall be brushed-up and shall be painted with red lead primer followed by two coats of aluminium paint/enamel paint to the satisfaction of Project manager.

**6.02.00 Lighting Panel Installation**

Lighting panel shall be mounted at a height of 1200 mm from floor level unless otherwise specifically mentioned) on walls/columns/steel structures as indicated in the drawings by fastening to suitable studs.

**6.03.00 Installation of Switch Boxes, Receptacles and Junction Boxes**

I. Switch boxes, Receptacles and Junction boxes shall be adequately supported/mounted on wall/column by means of anchor fasteners/expandable bolts or shall be mounted on angle/plate or other structural supports fixed to floor/wall/ceiling.

II. In office areas and control rooms, switch boxes shall be flush mounted in wall and junction boxes shall be recess mounted.

III. Mounting height of switch boxes and receptacles from floor level shall be as follows :

| | Item | Mounting Height | Location |
|---|---|---|---|
| (a) | Light control switch box | 1500 mm | |
| (b) | 20 A Receptacles | 500 mm | Indoor location |
| (c) | 6/16 A Receptacles | 500 mm | Indoor location |
| (d) | 20 A Receptacles | 900 mm | Outdoor location |

IV. Necessary conduit /cable entry shall be made by drilling/punching during installation depending on the requirement. No gas cutting shall be used.

**6.04.00 Conduit Installation**

1. In corrosive areas like Battery room, water treatment plant, etc. only epoxy coated GI conduit and accessories shall be installed for wiring purpose.
2. All accessories/fittings required for making the installation complete shall include tees, tees, elbows, check nuts, brass or galvanised steel end caps, pull boxes, saddles, spacers and required supporting steel work.
3. Exposed conduits shall run in straight lines parallel to building columns/beams and walls. Conduits shall be fixed by using metallic saddles/clamp secured to suitable nylon rawl plugs with screws or secured to the building steel at an interval of not more than 1 metre, but either side of couplers or bends or similar fittings. Saddles/clamps shall be fixed at a distance of 30 cm from the centre of such fittings.
4. In rooms with false ceiling, conduits shall be embedded in the wall. Embedded conduits shall be securely fixed in position to preclude any movement. For embedded conduits fixing of standard bends or elbows shall be avoided and all curves shall be made bending the conduits itself. Spacing of embedded conduit shall be such as to permit flow of mortar between them and in no case shall be less than 40 mm. Embedded conduits shall have a minimum mortar cover of 50 mm. Positioning and ensuring proper alignment during concreting by other agencies shall be the responsibility of the contractor.
5. All openings in the floor/wall/ceiling etc, made for conduit installation shall be sealed and made water proof.
6. Size of conduit shall be selected considering no. of wires drawn in line with IS : 732 and as indicated below:

| a) Size of the Wire | Size of the Conduit (in mm) 20 | 25 | 40 |
|---|---|---|---|
| | Maximum Number of Wire | | |

| | | | | |
|---|---|---|---|---|
| b) | 1.5 Sq.mm. | 5 | 10 | 21 |
| c) | 2.5 Sq.mm. | 5 | 8 | 19 |
| d) | 4 Sq.mm. | 3 | 6 | 16 |
| e) | 6 Sq.mm. | 2 | 5 | 12 |
| f) | 10 Sq.mm. | - | 4 | 8 |

7. For long conduit runs pull out boxes shall be provided at suitable intervals not exceeding 6 m to faciliate wiring. However, pull out boxes need not to be provided wherever junction box exists in circuit.

8. Conduits shall be securely terminated at lighting panels, switch boxes, junction boxes/lighting fixtures by proper fastening with a lock nut on inside and outside. The number of conduits terminating at lighting panel shall not exceed the permissible number considering the glanding area of lighting panel. Conduit termination shall be made water and vermin proof.

9. Conduit lengths shall be jointed by screwed couplers. Running thread equal to twice the length of coupling shall be provided on any one length to facilitate easy dismantling. The contractor shall have at site die for threading conduit. All field threaded ends shall be reamed after threading and anti-corrosive paint applied. Conduits shall be cleanly cut. The cut ends shall be within three (3) degree of square with a conduit axis. Cut ends shall be reamed and all burrs and sharp edges removed. Conduit joints and connections shall be made thoroughly water-tight and rust-proof by application of the thread compound which will not insulate the joints.

10. Conduits shall be kept, wherever possible, at least 300 mm away from hot pipes, heating device etc.

11. The entire metallic conduit system whether embedded or exposed shall be electrically continuous and thoroughly grounded. G.I. Pull wire of adequate size shall be laid in all conduits before installation.

12. All conduits installed outdoor shall be sloped towards pull boxes, hand holes/manholes for drainage. Low points of conduits not terminating in pull boxes, hand holes/manholes shall be provided with weep holes for drainage. Care shall be taken to see that no rough edge is left around the weep holes. Where no provision for drainage can be made, both ends of conduit shall be sealed after cable is laid through. Minimum slope of 1 in 400 shall be provided.

13. Each conduit run shall be marked with its designation as indicated on the drawings. Identifications shall be by means of painting so located that each run of conduit is readily identified at each end. Where conduits terminate at panels, switch boxes, junction boxes, or other enclosures, the designations shall also be painted on the inside of the enclosure adjacent to the conduits.

**6.05.00 Lighting Pole/Mast Installation**

1. Installation of poles and masts shall include construction of required foundation.
2. For lighting Poles M 15 PCC foundation shall be made for planting depth of minimum 1/6TH of the pole height.
3. Junction box type 'JB-S' shall be fixed to the pole with 'U' clamps for wiring lighting terminating the cables. 25 mm dia holes shall be made on poles for wiring of lighting fixtures from junction box.
4. Junction box type 'M1' Shall be fixed on mast platform for fixtures.
5. Flood light fixtures shall be mounted on galvanised M.S base making use of shop drilled holes or by suitable clamps. No cutting or drilling of galvanised structure is permitted. For mounting flood light fixtures on poles, required supporting frame work shall be made.
6. For loop-in loop out of the cables, 50 mm dia G.I. conduits with minimum 500 mm radius shall be laid along pole mast embedding in PCC foundation.
7. G.S. Earthing bolt (Size M6) shall be welded to pole/mast for earthing pole/mast. Fixture and junction box shall be inter connected by earthing wire to pole/mast earthing bolt. Earth connection between pole/mast and earth electrode shall be made by 25x3 mm GS flat. Welding between GS flat and electrode shall be provided with protective coating.
8. Lighting poles shall be painted with two coats of aluminum paint after completion of installation.

**6.06.00 Wiring Installation**

Wiring installation of various areas between lighting panels, switch boxes, junction boxes, fixtures, fans, receptacles etc. shall be done in G.I. conduits.

Lighting fixtures shall generally be group controlled directly from lighting panel. However, in office areas, control shall be provided through switch boxes.

A.C. normal, AC emergency and DC system wiring shall run throughout in separate conduits. Wires of different phase shall run in different conduits. However wires of same phase but of different circuit shall run in same conduit.

A junction box with two way terminal block of suitable size shall be provided near the fixture except the fluorescent fixtures and last fixture in a circuit for loop -in-loop-out and T-off connection.

All wires in a conduit shall be drawn simultaneously. No subsequent drawing is permissible. Call bell wiring in office area shall also be done by the Contractor.
Wires shall not be pulled through more than two equivalent 90 degree bends in a single circuit run. Wherever required, suitable conduit junction boxes/pull boxes shall be provided.

Receptacles and lighting circuit shall be fed from different circuits. The switch controlling these circuits shall be on the phase wire of the circuits.

Wiring shall be spliced only at junction boxes/terminal blocks. Maximum two wires shall be connected at each terminal. In vertical run of conduit the wires shall be suitably supported by means of wooden/hard rubber plugs at each pull/junction box.

For group controlled lighting fixtures, single phase receptacles and switch boxes, aluminium wire of 4/6/10 sq.mm shall be used from lighting panel as circuit wiring, as applicable. However, T-off connection to the lighting fixture shall be done by 1.5 sq.mm. copper.

The wiring between switch box and lighting fixtures and fans shall be done by 1.5 sq.mm. copper wire.

All lighting wires shall be crimped using solderless crimping type tinned copper lugs suitable for the specified type of terminal block.
Ceiling Fans and Regulators

1. The contractor shall install the ceiling fans and regulators as per requirement.

2. The fan regulator shall be mounted on the lighting control switch box provided in that area.

3. Hook along with rubber bush shall be supplied and grouted in ceiling for mounting the fan. All necessary, material and hardware for installation shall be supplied by the Contractor.

**6.07.00 Foundation & Civil Works**

1. Foundations, for Street lighting Poles/Flood Lighting Poles, lighting masts, panel foundation and other civil works, as per relevant drawings and specification clauses, shall be provided by the contractor.

2. All foundation drawings shall be subject to the Employer's approval. However, it shall be the responsibility of the Contractor to check these foundations before commencement of installation to ensure their suitability.

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

4. Any cutting of masonary/concrete work, which is necessary, shall be done by the contractor at his own cost and shall be made good to match the original work. The contractor shall obtain approval of the Project manager before proceeding with any cutting of masonary/concrete work.

5. The Contractor shall perform all excavation and backfilling as required for ground connections and casting foundations.

6. Excavation shall be performed upto the required depth. Such sheeting and shorting shall be done as may be necessary for protection of the wall.

7. The contractor shall make use of his own arrangement for pumping out any water that may be accumulated in the excavation.

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

**6.08.00 Steel Fabrication**

1. The steel structures supplied and fabricated by the contractor shall be made from standard quality steel sections/flats/plates. The steel structures fabricated shall be free from defects, cleaned of rust, grease, oil etc., and sharp edges shall be removed.

2. The welds shall be wire brushed or cleaned otherwise. The holes shall be touched up with metal primer.

3. All steel fabrications shall be painted with two coats of metals primer (lead oxide and zinc chromate in synthetic medium) followed by the two coats of aluminium paint.

## 7.00.00 EARTHING OF LIGHTING SYSTEM

Lighting panels shall be earthed by two separate and distinct connections with main earthing system. Switch boxes, junction boxes, lighting fixtures, fans, single phase receptacles etc. shall be earthed by means of separate earth continuity conductor. The earth continuity conductor 14 SWG GI wire shall be run alongwith each conduit run. Cable armours shall be connected to earthing system at both the ends.

Earthing conductors shall be free from pitting laminations, rust scale and other mechanical defects. The various sizes of earthing conductor for various electrical items shall be as follows :

| Sl. No. | Item | Earth conductor size | Earth Electrode size |
|---|---|---|---|
| a) | Lighting panel | 25 x 3 mm G.S. flat | |
| b) | Lighting pole& masts s | 25 x 3 mm G.S. flat | 20 mm dia MS rod, |

| | | | |
|---|---|---|---|
| | c) | Lighting fixtures fans, switch boxes, junction boxes, single phase receptacles | 14 SWG G.S. wire - |

Connection between earth leads and equipment shall normally be bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti-corrosive paint/compound.

Earthing conductors along their run on column, walls, etc. shall be supported by suitable welding/cleating at an interval of 1000 mm.

20 mm dia M.S. electrode of 3 meter long shall be embedded below permanent moisture level for earthing every mast and every fourth lighting pole.

On completion of installation, continuity of earth conductors shall be checked.

**8.00.00 TESTS**

**8.01.00** All Acceptance and Routine tests as per the specification and relevant standards shall be carried out.

**8.02.00** Selection of samples for Acceptance tests & Routine tests and acceptance criteria for all the materials/equipment shall be as per relevant IS.

**8.03.00** The Lighting Distribution boards and Lighting Panels(including the components) shall be assembled at the manufacturers works with complete equipments & accessories and shall be tested in accordance with the requirements of relevant Indian Standards/Indian Electricity rules etc.

**8.04.00 Acceptance Tests and Routine Tests**

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

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

**8.05.00 Galvanising Tests**

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

In addition following tests shall be conducted as Acceptance tests:

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

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

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

**9.00.00 COMMISSIONING CHECKS**

1. On completion of installation work, the Contractor shall request the Project manager for inspection and tests with minimum of fourteen (14) days advance notice.

2. The Project manager 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.

3. The installation shall be then tested and commissioned in presence of the Project manager.

4. The contractor shall provide all, men, material and equipment required to carry out the tests.

5. All rectifications, repair or adjustment work found necessary during inspection, testing and commissioning shall be carried out by the Contractor without any extra cost. The handing over of the lighting installation shall be affected only after the receipt of written instruction from the Employer/his authorized representative.

6. The testing shall be done in accordance with the applicable Indian Standards and Codes of practices. The following tests shall be specifically carried out for all lighting installation:

   (a) Insulation Resistance.

   (b) Testing of earth continuity path.

   (c) Polarity test of single phase switches.

   (d) Functional checks.

7. The lighting circuits shall be tested in the following manner :

   (a) All switches ON and consuming devices in circuit, both poles connected together to obtain resistance to earth.

   (b) Insulation resistance between poles with lamps and other consuming devices removed and switches ON.

| CLAUSE NO. | ILLUMINATION SYSTEM (E 6) | एनटीपीसी NTPC लाइको hydro |
|---|---|---|

**ANNEXURE-A**

| Sl No. | Area/Location | Average Illumination Level(Lux) | Type of Fixture |
|---|---|---|---|
| 1 | Machine Hall, Service Bay, | 200 | HPSV High/Medium bay |
| 2 | Generator floor, Turbine floor, Transformer cavern, MIV floor, Busduct Tunnels, GIS Hall, Switchgear rooms/ areas, Butterfly Valve House, Tail Water Collection Chamber, Blower rooms etc. | 150 | HPSV Medium bay/Industrial trough type fluorescent |
| 3 | Control room, Computer room, Control Equipment room | 300 | Mirror optics with anti-glare feature |
| 4 | Offices, Conference rooms etc. | 300 | Decorative Mirror optics type |
| 5 | Battery rooms | 100 | Totally enclosed corrosion proof |
| 6 | Diesel Generating room, Compressor room, AC/ Ventilation plant room, Water treatment plantm, Escape tunnels etc. | 150 | HPSV Medium bay/Industrial trough type fluorescent |
| 7 | Workshop general | 150 | Industrial trough type fluorescent |
| 8 | Laboratory Area<br>- General<br>-Analysis area | <br>150<br>300 | Mirror optics fluorescent |
| 9 | Entrance, staircases, cloak rooms | 100 | Industrial trough type fluorescent |

| Sl No. | Area/Location | Average Illumination Level(Lux) | Type of Fixture |
|---|---|---|---|
| 10 | Ventilation/cable tunnel, Access tunnels, construction tunnels, Adits etc. | 50 | Industrial trough type fluorescent |
| 11 | Stores | 100 | Industrial trough type |
| 12 | Canteen, Facility areas | 150 | Industrial trough type fluorescent |
| 13 | Street lighting<br><br>Permanent Roads | 20 | HPSV street lights<br>Degree of Protection IP54 |
| 14 | Outdoor storage handling and unloading area | 20 | HPSV flood light |
| 15 | Area around barrage/intake areas Including intake regulator, intake channels, intake pool, trash rack/power intake areas | 20 | HPSV flood light |
| 16 | Area around Surge shaft top( if open to atmosphere) | 20 | HPSV flood light |
| 17 | Area around tail water outfall | 20 | HPSV flood light |
| 18 | Area around Portal to Main Access Tunnel | 50 | HPSV flood light |
| 19 | Area around B.F.Valve Cavern Access Tunnel | 20 | HPSV Flood light |

Note: 1. For details of area to be illuminated in Power House Complex, Barrage, and Intake etc, please refer relevant Tender Drawings, Section-VI, Part-E.

2. For Illumination System of Surface Pothead yard, please refer Sub-Section, E-17 of the Technical Specification, Section-VI, Part-B.

## SECTION- 3

## PROJECT DETAILS AND GENERAL SPECIFICATIONS

### 3.0 GENERAL

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

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

In following clauses contractors stands for supplier/ vendor/ bidder and employer stands for purchaser/ NTPC/ BHEL.

### 3.1 PROJECT DETAILS

| | Particular | Details |
|---|---|---|
| **a)** | Customer | NTPC HYDRO LIMITED. |
| **b)** | Engineer/Consultant/ Inspector | NTPC HYDRO LIMITED. |
| **c)** | Project Title | NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3X40MW): 132kV Switchyard |
| **d)** | Project Location | The project can be accessed from Silliguri via Ghoom in Darjeling district of West Bengal or from Jorthang in Sikkim by road.<br>Bagdogra is nearest airport.<br>New Jalpaiguri is the nearest broad gauge railway station.<br>The proposed project site is connected by all-weather metalled road from Siliguri. |
| **e)** | Latitude & Longitude | North: 27°6'00", 27°9'00" and East: 88°8'00", 88°14'00" |
| **f)** | Nearest Railway Station | New Jalpaiguri |
| **g)** | Distance of project location from the Railway station | 75kms (approx.) |
| **h)** | Nearest Major Town | Siliguri |
| **i)** | Distance of the town from the project site | 140km. |
| **j)** | Nearest commercial airport | Bagdogra |
| **k)** | Distance of airport from the project site | - |
| | **SITE CONDITIONS** (for design purposes) | |
| **a)** | Design ambient temperature | 40°C |
| **b)** | Maximum Relative humidity | Max. <95% &^Min. >35% |

| | | |
|---|---|---|
| **c)** | Height above mean sea level | Less than 910meter |
| **d)** | Pollution Severity | Class-III, Heavy (25mm/kV) |
| **e)** | Criteria for Wind Resistant design of structures and equipment | Standard Applicable - IS 875 (Part 3) 1987 |
| **f)** | Basic Wind speed "Vb" at ten meters above the mean ground level. | 47 m/ sec |
| **g)** | Category of terrain | Cat –2 |
| **h)** | Risk Coefficient "K1" | 1.07 |

3.1.1 **SYSTEM PARAMETERS:**

| Sl.No. | Parameters | 132 kV |
|---|---|---|
| 1 | Highest system voltage | 145 kVrms |
| 2 | Lightning Impulse voltage | |
| | Phase to earth and between phases | 650kVp |
| | Across isolating distance | 750kVp |
| 3 | Switching impulse voltage | -- |
| 4 | Power frequency withstand for 1 min (rms) | |
| | Phase to earth and between phases | 275 kV(rms) |
| | Across isolating distance | 315 kV(rms) |
| 5 | Max. fault level (1 sec.) | 31.5kA |
| 6 | Minimum creep age distance | 3625mm |
| 7 | Radio Interference Voltage at level 92kV | Not more than 1000µV |

3.1.2 **AUXILIARY POWER:**

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

Combined variation of voltage and frequency shall be + 10%. Fault level of 415V system shall not be less than 20kA.

3.1.3 **CLEARANCES:**

| Sl.No. | Nominal Voltage | Phase to Phase (mm) | Phase to Earth (mm) | Section Clearance (mm) | Ground Clearance (mm) |
|---|---|---|---|---|---|
| 1 | 132kV | 1300 | 1300 | 4000 | 5000 |

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

| Voltage | Equipment /1st Level | 2nd Level | 3rd Level |
|---|---|---|---|
| 132kV | 5000mm | 11500mm | 14000mm/18000mm |

The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or support insulators to the bottom of the equipment structure, where it rests on the foundation pad shall be 2250mm.

**3.2 INSTRUCTION TO BIDDERS:**

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

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

It is recognized that the bidders may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.

Except for lighting fixtures, wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition. For lighting fixtures, makes shall be as defined in Section-Lighting System.

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

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

## 3.3 CODES AND STANDARDS

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

The equipment to be furnished under this specification shall conform to latest issue with all amendments of standards and/ or codes specified under respective section heads. The standards mentioned in the specification are not mutually exclusive or complete in them, but intended to complement each other. The supplier shall also note that list of standards presented in this specification is not complete. Whenever necessary the list standards shall be considered in conjunction with specific IS/IEC. When the specified requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

Other internationally accepted standards which ensure equivalent or better performance that specified in the standards referred under section shall also be acceptable.

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

The full names of the codes and standards mentioned in abbreviations under various equipment heads are as follows:

| | |
|---|---|
| BS | British Standards |
| IEC/ CISPR | International Electro-technical Commission |
| IS | Bureau of Indian Standards |
| ISO | International Organization for Standards |
| NEMA | National Electric Manufacturers Association |

## 3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

All the equipment/materials covered in this specification shall perform all its function satisfactorily without undue strain; restrike etc. under such over voltage conditions. All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (not applicable for this project) short circuit etc for the equipment.

The equipment shall also comply with the following:

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

## 3.5 ENGINEERING DATA

### 3.5.1 Drawings

All drawings submitted by the supplier including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required. The dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor 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 Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Purchaser, if so required.

The review of these data by the purchaser will cover only general conformance of the data to the specification and documents, interfaces with the equipment provided under specification, external connections and of the dimensions which might affect substation layout.. This review

by the purchaser may not indicate a thorough review of the dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the purchaser shall not be considered by the contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

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

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

### 3.5.2 Approval Procedure

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

a. All data/information furnished by Vendor in the form of drawings, documents, Catalogues or in any other form for NTPC's information/interface and/or review and approval are referred by the general term "drawings".

b. The 'Master drawings list' shall be submitted for review and approval of Employer before award of contract. The Contractor shall have to prepare and submit any other drawings and reference documents in addition to the drawings contained in the list, if so required during engineering stage as felt necessary by the Employer. Number of copies of the list for the distribution shall be as mutually agreed between Contractor and Employer.

c. All drawings (including those of sub vendors') shall bear at the right hand bottom corner the 'title block' with all relevant information duly filled in. The Contractor shall give this format to his sub vendor along with his purchase order for sub vendor's compliance. The size of title block basic format and its contents shall not be changed. All drawings shall be in English language. All dimensions shall be in metric units.

d. Contractor shall submit all the drawings in five (5) copies for review of Employer. Employer shall forward their comments within four (4) weeks of receipt of drawings.

e. Upon review of each drawings, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

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

f. Contractor shall resubmit the drawings approved under Category II and III within one (1) week of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.)

g. In case Contractor does not agree with any specific comment, he shall furnish the explanation for the same to Employer consideration. In all such cases Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

h. It is the responsibility of the Contractor to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

i. Contractor shall not make any changes in the portion of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawings identifying the changes (along with reasons for changes) for Employer's review and approval.

j. Approval of drawings will not in any way relieve the Contractor of his obligations of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if such equipment is later found to be defective.

k. The drawing approval progress report shall be submitted in at least three (3) copies within one (1) week from the last date of the every month.

**3.5.3 Erection Drawings.**

a. Contractor shall furnish erection drawings for the guidance or commencement of erection or the first shipment, whichever is earlier. These shall generally comprise of fabrication/assembly drawings, various component/part details drawing, assembly, clearance data requirements, etc. The drawings shall contain details of components/ equipment with identification number, match marks, bill of materials, assembly procedures etc.

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

**3.5.4 Instruction Manual**

a. The Contractor shall submit to the Employer preliminary instruction manuals for all the equipment for review. The final instructions manuals incorporating Employer's comments and complete in all respect shall be submitted at least thirty (30) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipment, the transportation, storage, installation, testing, operation and maintenance procedures, etc. separately for each component/equipment along with log record format. These instruction manuals shall be submitted in five (5) copies for approval.

b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall being corporate and the updated final instruction manuals shall be submitted.

c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Employer to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment, including erection, testing, commissioning, operation, maintenance dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be considered completed for purpose of taking over until such instructions and drawings have been supplied to the Employer.

d. A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together will all relevant pamphlets, drawings and list of parts with procedures for ordering spares. Maintenance instructions shall include charts showing lubrication, checking, and testing and replacement procedure to be carried out daily, weekly, and monthly and at longer intervals to ensure trouble free operation. Where applicable, fault location charts shall be included to facilitate finding the cause of mal-operation or breakdown. A collection of the manufacturer'' standard leaflets will not accepted to be taken as a compliance of this clause. The manual shall be specifically compiled for the concerned project.

**3.5.5 Final Submission of drawings and documents:**

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

a. List of drawings bearing the Employer's and Contractor's drawing number.
b. Ten (10) bound sets along with 4 CD-ROMs of all drawing.
c. All documents/designs in five (5) copies as noted above.
d. Contractor shall also furnish nine (9) bound sets of all as-built drawings including the list of all as-built drawings bearing drawing numbers. The Contractor shall also furnish four (4) sets of film reproducible or CD-ROMs of all as-built drawings as decided by the Employer.
e. The Contractor shall also furnish eleven (11) copies of instruction manuals (after approval) for all the equipment.

**3.5.6 TEST REPORTS**

Five (5) copies of all test reports shall be supplied for approval before shipment of Equipment. The report shall indicate clearly the standard value specified for each test to facilitate checking of the reports. After final approval seven bound copies of all type and routine test reports shall be submitted to Employer.

**3.6 MATERIAL /WORKMANSHIP**

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended and shall ensure satisfactory performance throughout the service life.

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard the purchaser shall decide upon the question of similarity. When required by the specification or when required by the purchaser the contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such

approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

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

Whenever possible, all similar part of the works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the equipment supplied under the specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.
The equipment offered in the bid only shall be accepted for supply, with the minimum modifications as agreed/accepted.

### 3.7 LIMIT OF CONTRACT

All the equipment, materials and services furnished by the manufacturer shall be complete in every respect with all mountings, fitting, fixtures and standard accessories normally provided with such equipment, and needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in technical specification and unless included in the list of exclusions. The manufacturer shall supply at no extra cost to Employer any additional material/service not covered specifically but which are found to be required for fulfillment of the scope of work under specification.

### 3.8 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

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

**SPACE HEATERS**

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

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

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a

value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

**FUNGI STATIC VARNISH**

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

**Ventilation opening**

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

**Degree of Protection**

The enclosure of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

a. Installed out door: IP- 55
b. Installed indoor in air conditioned area: IP-31
c. Installed in covered area: IP-52
d. Installed indoor in non air-conditioned area where possibility of entry of water is limited: IP-41.
e. 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.

**3.9 RATING PLATES, NAME PLATES AND LABELS**

3.9.1 The equipment nameplate should preferably be of stainless steel. In case of aluminium, it should be at least 2mm thick.. The inscription on the nameplate shall be engraved and no punching shall be accepted except for equipment serial number and year of manufacture. These nameplates shall be black with white engraved lettering.

3.9.2 The rated current, extended current rating and rated thermal current shall be clearly indicated in the name plate in case of current transformer.

3.9.3 Rated voltage, voltage factor and intermediate voltage shall be clearly indicated on the nameplate in case of capacitor voltage transformer.

3.9.4 Name plates of cubicles and panels may be made of non-rusting metal or 3 ply lamicoid.

3.9.5 Each switch shall a clear inscription identifying its function. Switches shall also have a clear inscription of each position indication.

**3.10 GALVANISING :**

3.10.1 The galvanised surface shall consist of a continuous film adhering to the steel. The finished surface shall be clean and smooth, and shall be free from defects like dissolved patches, base, spot, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits,

blistered surfaces, flaking or peeling off, etc. The presence of any of these defects shall render the material liable to rejection.

3.10.2 All exposed ferrous parts shall be hot dip galvanised as per IS:2629 & IS:2633, Galvanising shall be uniform, smooth continuous and free from acid spots. Should the galvanising of the sample be found defective, the entire batch of steel shall have to be re-galvanised at Contractor's cost. The amount of zinc deposit shall be not less than 610 gms. per sq.m. of surface area and in addition, the thickness of zinc at any spot shall not be less than 85 microns and foundation bolts shall have heavier zinc coating at least 800 gram/m2.

3.10.3 . The Employer reserves the right to measure the thickness of zinc deposit by Elko meter or any other instrument acceptable to Employer and reject any component which shows thickness of zinc at any location less than 85 microns. The testing on the galvanised materials shall be carried out as per IS:2633.

3.10.4 The amount of zinc deposit over threaded portion of the bolts, nuts and screws shall not be less than 300 gms. per sq. meter of surface area. The amount of zinc deposit on washers shall not be less than 340 gms. per sq. meter of surface area. The threads having extra deposit of zinc shall be removed by die cutting after the completion of galvanising. The removal of extra zinc shall be carefully done so that threads shall have minimum deposits of zinc on them as specified.

**3.11 PAINTING**

The sheet steel to be painted shall be pre-treated in tanks in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "class-C" as specified in IS: 6005. The phosphated surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint on panels shall be applied. Electrostatic paining shall also be acceptable. Finishing paint on outside of the panels shall be as required otherwise by the Employer. The inside of the panels shall be glossy white. Each coat of finishing shall be properly stoved. The paint thickness shall not be less than 50 microns. Finished parts shall be coated by peelable compound by spraying method to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.

**3.12 QUALITY ASSURANCE PROGRAMME**

3.12.1 The Contractor shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his subcontractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS- 14001.

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

i. His organisation structure for the management and implementation of the proposed quality assurance programme
ii. Quality System Manual
iii. Design Control System
iv. Documentation Data Control System
v. Qualification data for Bidder's key Personnel.

vi. The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
vii. System for shop manufacturing and site erection controls including process, fabrication and assembly.
viii. Control of non-conforming items and system for corrective actions and resolution of deviations.
ix. Inspection and test procedure both for manufacture and field activities.
x. Control of calibration and testing of measuring testing equipments.
xi. System for Quality Audits.
xii. System for identification and appraisal of inspection status.
xiii. System for authorising release of manufactured product to the Employer.
xiv. System for handling storage and delivery.
xv. System for maintenance of records, and
xvi. Furnishing quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

### 3.12.2 GENERAL REQUIREMENTS - QUALITY ASSURANCE

3.12.2.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award.

3.12.2.2 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor"s/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. floppy or E-mail in addition to hard copy, for review. Once the same is finalised, hard copies shall be submitted for approval. After approval the same shall be submitted in compiled form on CD ROM.

3.12.2.3 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control Organisation, during various stages of site activities starting from receipt of materials/equipment at site.

3.12.2.4 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed.

These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer/Authorised representative in writing. All deviations to this specification, approved quality plans and

applicable standards must be documented and referred to Employer along with technical justification for approval and dis-positioning.

3.12.2.5 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 Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of MDCC.

3.12.2.6 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.

3.12.2.7 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.

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

3.12.2.8 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.

3.12.2.9 Test results or qualification tests and specimen testing shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.

3.12.2.10 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipments/systems shall also be complied with.

3.12.2.11 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

3.12.2.12 No welding shall be carried out on cast iron components for repair.

3.12.2.13 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.

3.12.2.14 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.

3.12.2.15 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the subcontractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's

quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc.

Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. 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 Employer on the monthly basis by the Contractor.

3.12.2.16 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub vendor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.

3.12.2.17 The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor'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. Contractor shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

3.12.2.18 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

3.12.2.19 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

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

**3.12.2.21 Burn in and Elevated Temperature Test Requirement for Electronics solid State Equipment**

a) 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.

b) 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.

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

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

### 3.12.3 QUALITY ASSURANCE DOCUMENTS

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

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

i) Quality Plan,
ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
iii) Factory test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
iv) Type test report (wherever applicable).
v) 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.
vi) Heat Treatment Certificate/Record (Time- temperature Chart)
vii) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure)Verification sketches, if used and methods used to verify that the inspection and testing points in the Quality Plan were performed satisfactorily
viii) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.
ix) Certificate of Conformance (COC) whoever applicable.
x) MDCC

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

3.12.3.3 Due to the large variety of equipment items, it is always possible to adapt the content of the quality document to better match the particularities of any equipment. This shall be done in agreement with the Supplier and the Inspector.

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

Each quality document 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.

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

i) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory. The Inspector shall stamp the quality document (or applicable section) for release.

ii) If the quality document is unsatisfactory, the Supplier shall endeavour to correct the incompleteness, thus allowing finalizing the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

iii) If a decision is made to ship equipment, whereas all outstanding actions cannot be readily cleared for the release of the quality document by the time as per contract documents ( or finalization of the applicable section of the quality document within one month as per corresponding shipment date).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 final quality document will be compiled and issued at the final assembly place of equipment before shipment.

3.12.3.5 TRANSMISSION OF QUALITY DOCUMENTS

As a general rule, two hard copies of the quality document and Two CD ROMs shall be issued to the Employer not later than 1 month after the delivery date for the corresponding equipment. One set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Site.

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

**3.13 TYPE TESTING , INSPECTION, TESTING & INSPECTION CERTIFICATE**

3.13.1 The word ‘Inspector’ shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.

3.13.2 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

3.13.3 The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.

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

3.13.5 When the factory tests have been completed at the Contractor's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.

3.13.6 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

3.13.7 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.

3.13.8 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 3.03.00, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

3.13.9 All inspection, measuring and test equipments used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipments in the presence of Project Manager / Inspector.

## 3.14 PACKAGING & PROTECTION

3.14.1 Packing, Marking and shipping

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

a) The equipment shall be prepared in such a manner as to protect the equipment from damage or deterioration during shipping or storage. The shipments can be exposed to heavy rains, hot sun, high humidity and sudden extreme changes of temperature. The equipment shall be packed and shipped so as to protect it from all such conditions and any other abnormal conditions, generally expected during shipping & storage.

b) The metallic containers, if any, shall be considered as the property of the Contractor and he will be allowed to remove them from site once the contents are unpacked, inspected, documented and placed in temporary storage or in final position.

c) The equipment shall be shipped in such a manner as to facilitate unloading, handling and storage en-route and at the site. The Contractor shall provide lifting lugs and special lifting devices for proper handling and erection.

d) The Contractor shall be liable for any damage or loss resulting due to careless, improper, poor or insufficient packing and handling.

e) Spare parts and spare equipment shall be packed separately in containers adequate for long term storage, plainly marked “Spare Parts Only”. They shall be crated individually or in kits to be used in one single renewal or overhaul operation. Other spare part kits shall not be disturbed when using one set or kit.

f) The Contractor shall at all times protect and preserve from damage, loss, corrosion and all other forms of damage, all parts of the works.

3.14.2 Transportation

a) The Contractor shall make a careful examination of access rail/roadways to the site in order to confirm the practical maximum transport weight and dimensions as well as a careful examination of the ports of disembarkation particularly with respect to the capacity of the cranes installed and access roads.

b) All instruments and computer/microprocessor based equipment imported into India from overseas for the purpose of this contract shall be air freighted to the nearest possible point and further by rail/road taking due precautions as per manufacturer’s recommendations. Employer shall have the right to decide the items that should be air freighted and Employer’s decision shall be binding on Contractor.

3.14.3 Insurance

a) The Contractor shall insure all shipments and works at his own expense for not less than the full replacement cost plus any additional cost for accelerated manufacturing of the replacement parts.

b) Loss or the damage to equipment during shipping or transportation to the site(s) or

otherwise shall not constitute groups for claims for extension in time or for extra payment.

3.14.4 Storage of Equipment

a) The Contractor shall provide and construct adequate storage sheds for proper storage of equipment. Sensitive equipment shall be stored indoors. All equipment during storage shall be protected against damage due to act of nature or accidents. The storage instructions of the equipment manufacturers shall be strictly adhered to.

b) The necessary transport packing shall be removed as soon as possible after receipt of equipment at the work site(s).

**3.15 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS**

3.15.1 The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS:617 for connecting to equipment terminals and conductors of aluminium. In case the terminals are of copper, the same clamps/connectors shall be used with 2mm thick bimetallic liner.

3.15.2 The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.

3.15.3 Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.

3.15.4 All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.

3.15.5 They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.

3.15.6 Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.

3.15.7 Current rating and size of terminal/conductor for which connector is suitable shall be put on a suitable sticker on each component which should last at least till erection time.

**3.16 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT.**

3.16.1 All types of control cabinets, junction boxes, marshalling boxes, lighting panels, terminal boxes, operating mechanism boxes, Kiosks etc. shall generally conform to IS:5039, IS:8623 and IEC:439 as applicable.

3.16.2 They shall be of painted sheet steel or aluminium. The thickness of sheet steel shall be 2mm cold rolled or 2.5mm hot rolled. The thickness of aluminium shall be 3mm and shall provide rigidity. Top of the boxes shall be sloped towards rear of the box. The paint shall be of grey RAL 9002 on the outside and glossy white inside. However, the junction and switch boxes shall be of hot dip galvanised sheet steel of 1.6mm thickness.

3.16.3 The cabinets/boxes/kiosks/panels shall be free standing or wall mounting or pedestal mounting type. They shall have hinged doors with padlocking arrangement. All doors, removable covers and plates shall be gasketed all around with neoprene gaskets.

3.16.4 The degree of protection of all the outdoor boxes shall not be less than IP 55 as per IS 2147.

3.16.5 The cable entry shall be from bottom, for which removable gasketed cable gland plates shall be provided.

3.16.6 Suitable 240V, single phase, 50Hz ac heaters with thermostats controlled by switch and fuse shall be provided to maintain inside temperature 10deg. above the ambient.

3.16.7 The size of enclosure and the layout of equipment inside shall provide generous clearances. Each cabinet/box/kiosk/panel shall be provided with a 15A, 240V ac, 2 pole, 3 pin industrial grade receptacle with switch. For incoming supply, MCB of suitable rating shall be provided. Illumination of each compartment shall be with door operated incandescent lamp. All control switches shall be of rotary switch type.

3.16.8 Each cabinet/box/kiosk/panel shall be provided with two earthing pads to receive 75mmx12mm GS flat. The connection shall be bolted type with two bolts per pad. The hinged door shall be connected to body using flexible wire. The cabinets/boxes/kiosks/panels shall also be provided with danger plate, and internal wiring diagram pasted on inside of the door. The front label shall be on a 3mm thick plastic plate with white letters engraved on black background

**3.17 TERMINAL BLOCKS**

3.17.1 They shall be non-disconnecting stud type of extensible design equivalent to Elmex type CAT-M4.

3.17.2 The terminal blocks shall be of 1100 V grade, and rated to continuously carry maximum expected current. The conducting part shall be tinned or silver plated.

3.17.3 They shall be of moulded, non-inflammable thermosetting plastic. The material shall not deteriorate with varied conditions of temperature and humidity. The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating plastic material. Insulating barriers shall be provided between the terminal blocks so that the barriers do not hinder the wiring operation without removing the barriers.

3.17.4 The terminals shall be provided with marking tags for wiring identification.

3.17.5 Unless otherwise required (expected current rating) or specified, terminal blocks shall be suitable for connecting the following conductors on each side: All CT & VT circuits - Min. four 2.5 sq.mm. Copper flexible conductor AC & DC power supply -Two 16 sq.mm. Aluminium conductor circuits other control circuits - Min. two 2.5 sq.mm. copper flexible conductor

The terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall also be provided with short circuiting and earthing facilities.

**3.18 Wiring**

3.18.1 All wiring shall be carried out with 1100 V grade stranded copper wires. The minimum size of the stranded conductor used for internal wiring shall be as follows:

a) All circuits except CT circuits 2.5 sq.mm
b) CT circuits 4 sq. mm (minimum number of strands shall be 3 per conductor).

3.18.2 All internal wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals and terminal blocks.

3.18.3 Wire terminations shall be made with solder-less crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with the wiring

diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires shall not fall off when the wires and shall not fall off when the wire is disconnected from terminal blocks.

3.18.4 All wires directly connected to trip circuit breaker shall be distinguished by the addition of a red coloured unlettered ferrule. Number 6 & 9 shall not be included for ferrules purposes.

3.18.5 All terminals including spare terminals of auxiliary equipment shall be wired up to terminal blocks. Each equipment shall have its own central control cabinet in which all contacts including spare contacts from all poles shall be wired out. Inter-pole cabling for all equipment's shall be carried out by the Contractor.

**3.19 CABLE GLANDS AND LUGS**

3.19.1 Cable glands shall be Double compression type, tinned/Nicked plated (coating thickness not less than 20 microns in case of tin and 10 to 15 microns in case of nickel) brass cable glands for all power and control cables. They shall provide dust and weather proof terminations. They shall comprise of heavy duty brass casting, machine finished and tinned to avoid corrosion and oxidation. Rubber components used in cable glands shall be neoprene and off tested quality. Required number of packing glands to close unused openings in gland plates shall also be provided.

3.19.2 The cable glands shall be tested as per BS: 6121. The cable glands shall also be duly tested for dust proof and weather proof termination.

3.19.3 Cables lugs shall be tinned copper solder less crimping type conforming to IS: 8309 and 8394 suitable for aluminium or copper conductor (as applicable). The cable lugs shall suit the type of terminals provided. The cable lugs shall be of Dowell make or equivalent.

**3.20 CONDUITS, PIPES AND ACCESSORIES**

3.20.1 The Contractor shall supply and install all rigid conduits, mild steel pipes, flexible conduits, Hume pipes, etc. including all necessary sundry materials, such as tees, elbows, check nuts, bushing reduces, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes, etc.

3.20.2 Rigid conduits shall be flow-coat metal conduits of Nagarjuna Coated Tubes or equivalent make. The outer surface of the conduits shall be coated with hot-dip zinc and chromate conversion coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanised. All rigid conduits/ pipes shall be of a reputed make.

3.20.3 Flexible conduits shall be heat-resistant lead coated steel, water-leak, fire and rust proof, and be of PLICA make or equivalent.

**3.21 MOTOR CONTROL CENTRE**

3.21.1 The 415 Volt motor control centres (if provided separately) shall conform to the requirements for boxes/cabinets/kiosks. They shall be fixed type, shall be fully sectionalised and shall be equipped with load break switches. Motor feeders shall be provided with isolating switch fuse unit and Contractor with thermal overload relay and single phase protection. The motor Contractor shall have one normally open auxiliary contact for alarm purposes. The motor control circuit shall be independent from all other control circuits.

3.21.2 Isolating Switches

The incoming power supply isolating switch operation handle shall be interlocked with the control cabinet door as to prevent opening of door when main switch is closed. Device for by passing the door interlock shall also be provided. Switch handle shall have provision for locking in both fully open and fully closed positions.

3.21.3 Fuses

All fuses shall be of the HRC cartridge type, conforming to IS: 2208 and suitable to mount on plugin type of fuse bases. Fuses shall be provided with visible operation indicators to show that they have operated. All accessible live connections shall be adequately shrouded, and it shall be possible to change fuses with the circuit alive, without danger of contact with live conductor. Insulated fuse pulling handle shall be supplied with each control cabinet.

**3.22 MOTORS**

3.22.1 Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall conform to type tests and shall be subjected to routine tests as per applicable standards.

3.22.2 Enclosures

a) For motors to be installed outdoor, the motor enclosure shall have degree of protection IP: 55. For motors to be installed indoor, i.e. inside a box, the motor enclosure shall be dust proof equivalent to IP: 44.

b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.

c) Motors shall have drain plugs so located that they will drain water resulting condensation or other causes from all pockets in the motor casing.

d) Motors weighing more than 25 kg shall be provided with eyebolts, lugs or other means or facility for lifting.

3.22.3 Operational Features :

a) Continuous motor ratings (name plate rating) shall be at least suitable for the driven equipment at design duty operating point of driven equipment that will arise in service.

b) Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously in the given system.

3.22.4 Starting Requirements

a) All induction motors shall be suitable for full voltage direct on-line starting. These shall be capable of starting and accelerating to the rated speed along with the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops.

b) Motors shall be capable of withstanding the electro-dynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.

c) The locked rotor current shall not exceed six(6) times the rated full load current for all motors subject to tolerance given in IS:325.

d) Motors when started with driven equipment imposing full staring torque and supply voltage conditions specified shall be capable of withstanding at least two successive starts from cold condition at room temperature and one start from hot

condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.

e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by a least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Contractor shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speeds lower than 20% and open for speeds above 20% of the rated. The speed switch shall be capable of withstanding 120% of the rated speed in either directions of rotation.

3.22.5 The maximum permissible temperature rise over the ambient temperature shall be within the limits specified in IS: 325 (for 3 phase induction motors) after adjustment due to increased ambient temperature specified.

3.22.6 The double amplitude of motor vibration shall be within the limits specified in IS: 729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.

3.22.7 All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes.

**3.23 AUXILIARY SWITCH**

The auxiliary switch shall conform of following type tests:

a) Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/ visual defects/ temperature rise test.

b) Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination

c) Heat run test on contacts

d) IR/HV test, etc.

**3.24 LAMPS AND SOCKETS**

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

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

3.24.3 Hand Lamp:

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

**3.25 Switches and Fuses:**

Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switch-fuse units.

Selection of the main and sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

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

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

**3.26 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS**

3.26.1 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC: 137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS 5284. The support insulators shall be manufactured and tested as per IS: 2544 / IEC 168/IEC 273. The insulators shall also conform to IEC 815 as applicable.

Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

3.26.2 Porcelain used shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture. Hollow porcelain should be in one integral piece in green & fired stage.

3.26.3 Glazing of the porcelain shall be uniform brown in colour, free form blisters, burns and other similar defects.

3.26.4 When operating at normal rated voltage there shall be no electric discharge between conductor and insulators which would cause corrosion or injury to conductors or when operating at normal rated voltage.

3.26.5 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall be lead to deterioration. All ferrous parts shall be hot dip galvanised.

3.26.6 Contractor shall make available data on all the essential features of design including the method of assembly of shells and metal parts, number of shells per insulator, the manner in which mechanical stresses are transmitted through shells to adjacent parts, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.

3.26.7 Post type insulators shall consist of a porcelain part permanently secured in metal base to be mounted on supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand all shocks to which they may be subjected to during operation of the associated equipment.

3.26.8 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps, the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

3.26.9 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued; porcelain parts by grinding and metal parts by machining. Insulator/ bushing design shall be such as to ensure a uniform compressive pressure on the joints.

3.26.10 Bushings, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests and acceptance test/ sample test in accordance with relevant standards.

3.26.11 Insulator shall also meet requirement of IEC - 815 as applicable, having alternate long & short sheds.

**3.27 TYPE, ROUTINE & ACCEPTANCE TESTS:**

All equipment to be supplied shall be of type tested design. During contract stage, bidder shall submit for Owner's approval the reports of all the type tests listed in specification/ IS/ IEC and carried out within last ten years from the date 12.01.2015. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the tests should have been either conducted at an independent laboratory or should have be witnessed by a client.

However if contractor is not able to submit report of the type tests conducted within ten years from the date 12.01.2015 or in the case of type test reports are not found to be meeting the specification requirements, the bidder shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.

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

The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design change". Minor changes if any shall be highlighted on the endorsement sheet.

# SECTION 4

# GUARANTEED AND TECHNICAL PARTICULARS

- NTPC datasheet for Illumination System (3 pages)

Annexure to Section 4_Illumination Data Sheet

| Clause No. | ILLUMINATION SYSTEM (E6) |
|---|---|

Bidder's Name……..

## TECHNICAL PARTICULARS

Technical Information and data to be submitted with proposal.

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

Annexure to Section 4_Illumination Data Sheet

| Clause No. | ILLUMINATION SYSTEM (E6) | |
|---|---|---|
| | | Bidder's Name…….. |
| | b) Type | ..... ..... |
| | c) Applicable standard | ..... ..... |
| 5.00.00 | **Junction Boxes** | |
| | a) Make | ..... ..... |
| | b) Type | ..... ..... |
| | c) Material | ..... ..... |
| | d) Applicable standard | ..... ..... |
| 6.00.00 | **Rigid steel Conduits/Fittings & Accessories** | |
| | a) Make | ..... ..... |
| | b) Material | ..... ..... |
| | c) Applicable standard | ..... ..... |
| 7.00.00 | **Flexible steel conduit standard** | |
| | a) Make | ..... ..... |
| | b) Applicable standard | ..... ..... |
| 8.00.00 | **Lighting poles** | ..... ..... |
| | a) Make | ..... ..... |
| | b) Applicable standard | ..... ..... |
| | c) Type | ..... ..... |
| | d) Pole height | ..... ..... |
| 9.00.00 | **Lighting masts** | |
| | a) Make | ..... ..... |
| | b) Type | ..... ..... |
| | c) Overall height | ..... ..... |
| | d) Applicable standard | ..... ..... |

Annexure to Section 4_Illumination Data Sheet

| Clause No. | ILLUMINATION SYSTEM (E6) |
|---|---|

Bidder's Name……..

| | | | |
|---|---|---|---|
| | e) | Catalogue attached as annexure no. | ..... ..... |
| 10.00.00 | **Lighting Transformers** | | |
| | a) | Make | ..... ..... |
| | b) | Voltage Ratio | ..... ..... |
| | c) | KVA Rating | ..... ..... |

# SECTION 5

## ENCLOSURES TO THE SPECIFICATION

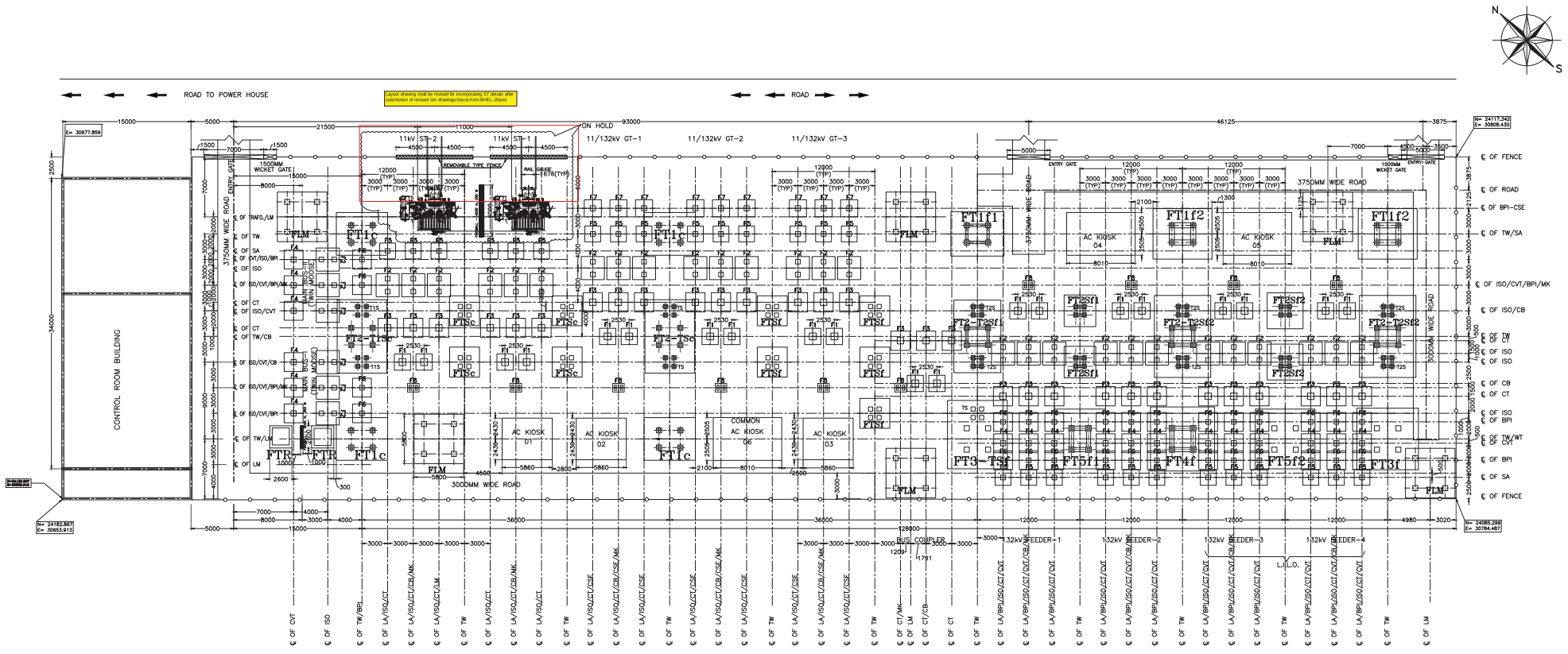
1. Layout of Foundations for Tower and Equipment for 132kV Switchyard 5602-003-H230-PVE-F-258 Rev 04
2. Cable Trench Layout
3. GA of Lighting Mast
4. Annexure BOQ
5. Annexure-A to Section 1: Illumination Colour Code
6. Annexure-B to Section 1: IP Protection
7. Annexure-C to Section 1: Quality Assurance and Inspection
8. Annexure-1 to Section 2: Switchyard Illumination Specification from NTPC
9. Annexure-2 to Section 2: Illumination System Specification E6 from NTPC
10. Annexure to Section 4: Data Sheet Format

LAYOUT OF EQUIPMENT FOUNDATION A TOWER FOUNDATION

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. TB-DG-1-381-607-601




Layout drawing shall be revised for incorporating S/T details after submission of revised GA drawings/inputs from BHEL-Jhansi

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## SCHEUDULE TOWER FDN.

| SL. NO. | TOWER DESCRIPTION | FDN. MKD. | LOCATION | NO. OF FDN | REMARK | DRAWING NO. |
|---|---|---|---|---|---|---|
| 1. | T1 | FT1c | CUTTING | 4 | --- | 5602-003-H230-PVE-C-115 |
| | | FT1f1 | FILLING | 1 | --- | 5602-003-H230-PVE-C-118 |
| | | FT1f2 | FILLING | 2 | --- | 5602-003-H230-PVE-C-120 |
| 2. | T2 | FT2-T1Sc | CUTTING | 1 | COMBINED FDN FOR 1NO. T2 & 2 NOS. T1S TOWERS | 5602-003-H230-PVE-C-116 |
| | | FT2-TSc | CUTTING | 1 | COMBINED FDN FOR 1NO. T2 & 2 NOS. TS TOWERS | 5602-003-H230-PVE-C-116 |
| | | FT2-T2Sf1 | FILLING | 1 | COMBINED FDN FOR 1NO. T2 & 2 NOS. T2S TOWERS | 5602-003-H230-PVE-C-124 |
| | | FT2-T2Sf2 | FILLING | 2 | | 5602-003-H230-PVE-C-126 |
| 3. | T3 | FT3f | FILLING | 1 | --- | 5602-003-H230-PVE-C-136 |
| | | FT3-TSf | FILLING | 1 | COMBINED FDN FOR 1NO. T3 & 1 NO. TS TOWERS | 5602-003-H230-PVE-C-134 |
| 4. | T4 | FT4f | FILLING | 1 | --- | 5602-003-H230-PVE-C-138 |
| 5. | T5 | FT5f1 | FILLING | 1 | --- | 5602-003-H230-PVE-C-132 |
| | | FT5f2 | FILLING | 1 | --- | 5602-003-H230-PVE-C-140 |
| 6. | LM | FLMc | CUTTING | 2 | --- | 5602-003-H230-PVE-C-142 |
| 7. | TS | FTSc | CUTTING | 4 | --- | 5602-003-H230-PVE-C-117 |
| | | FTSf | FILLING | 5 | --- | 5602-003-H230-PVE-C-122 |
| 8. | T2S | FT2Sf1 | FILLING | 2 | --- | 5602-003-H230-PVE-C-128 |
| | | FT2Sf2 | FILLING | 2 | --- | 5602-003-H230-PVE-C-130 |

## SCHEUDULE OF EQUIPMENT FDN.

| SL. NO. | DESCRIPTION | FDN. MKD. | NO. OF FDN. | DRAWING NO. |
|---|---|---|---|---|
| 1. | CB | F1 | 20 | 5602-003-H230-PVE-C-173 |
| 2. | ISOLATOR | F2 | 33 | 5602-003-H230-PVE-C-179 |
| 3. | CT | F3 | 30 | 5602-003-H230-PVE-C-185 |
| 4. | CVT | F4 | 18 | 5602-003-H230-PVE-C-191 |
| 5. | LA | F5 | 27+9* | 5602-003-H230-PVE-C-197 |
| 6. | BPI | F6 | 28+9* | 5602-003-H230-PVE-C-203 |
| 7. | CSE | F7 | 9+9* | 5602-003-H230-PVE-C-209 |
| 8. | MK | F8 | 10 | 5602-003-H230-PVE-C-213 |
| 9. | 250 kVA TRF. | FTR | 2 | 5602-003-H230-PVE-C-602 |
| 10. | AC KIOSK | 1,2,3 | 3 | 5602-003-H230-PVE-C-215 |
| 11. | AC KIOSK | 4,5,6 | 3 | 5602-003-H230-PVE-C-801 |
| 12. | 5 MVA ST | --- | 2 | 5602-003-H230-PVE-C-217 |

*EQUIPMENTS IN GT YARD

**NOTES:-**

1. ALL DIMENSIONS ARE IN MM.
2. THIS DRAWING TO BE READ IN CONJUCTION WITH ELECTRICAL LAYOUT DRAWING NTPC DRG.NO. 5602-003-H230-PVE-F-103.
3. ALL CIVIL EXECUTION SHALL BE DONE AS PER NTPC APPRVD DRGS. PLEASE REFER INDIVIDUAL EQUIPMENT FOUNDATION BEFOR CASTING AT SITE.
4. BEFORE EXCAVATION CHECK WITH ELECTRICAL LAYOUT DRG AND IF ANY DISCREPANCY NOTICED, CLARIFY BEFORE STARTING ANY WORK AT SITE.
5. SAFE BEARING CAPACITY IN SWITCHYARD AREA FOR DESIGN OF ALL CIVIL WORKS INCLUDING SHALLOW FOUNDATION FOR E & M EQUIPMENT HAS BEEN LIMITED TO 20T/SQM UPTO DEPTH OF 2M AND 25 T/SQM FOR DEPTH MORE THAN 2M FROM NGL RESPECTIVELY.
5. TRANSFORMER FOUNDATIONS AND FIREWALLS HAVE BEEN DESIGNED ON THE BASIS OF CAT-II DWG. NO. 5602-003-H201-PVE-B-713.
6. Fire wall of transformers shall be RCC.

**REFRENCE DRAWING:-**

1. 132kV SWITCHYARD LAYOUT - 5602-003-H230-PVE-F-103.
2. STRUCTURE LAYOUT PLAN AND SECTION FOR 132kV SWITCHYARD- 5602-003-H230-PVE-C-065.

| REV. | DATE | ALTERED |
|---|---|---|
| 03 | 14.01.20 | CHECKED |
| | | APPD. |
| ZONE | REVISED AS PER NTPC COMMENTS | |

| REV. | DATE | ALTERED |
|---|---|---|
| 02 | 03.11.17 | CHECKED |
| | | APPD. |
| ZONE | REVISED AS PER NTPC COMMENTS | |

| REV. | DATE | ALTERED |
|---|---|---|
| 01 | 07.04.17 | CHECKED |
| | | APPD. |
| ZONE | REVISED AS PER NTPC COMMENTS | |

CUSTOMER : एनटीपीसी NTPC — एन.टी.पी.सी.लिमिटेड NTPC LIMITED ( A GOVERNMENT OF INDIA ENTERPRISE )

PROJECT: NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3X40MW)

BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP NOIDA

| DEPT. CODE | NAME | SIGN | DATE | NO. OF VAR |
|---|---|---|---|---|
| HSE 415 | DRN | | | |
| | CKD | | | |
| | APPD | | | |

SUB-VENDOR DRG. NO. | PO REF | NO. OF ITEMS

TITLE: LAYOUT OF FOUNDATIONS FOR TOWER & EQUIPMENT FOR 132kV SWITCHYARD

NTPC DRG. NO. 5602-003-H230-PVE-F-258

SUB-VENDOR NAME | WEIGHT (kg) | SCALE

BHEL DRG. NO. TB-DG-1-381-607-601 | REV. 04

SHEET NO.1 | NO. OF SHT.

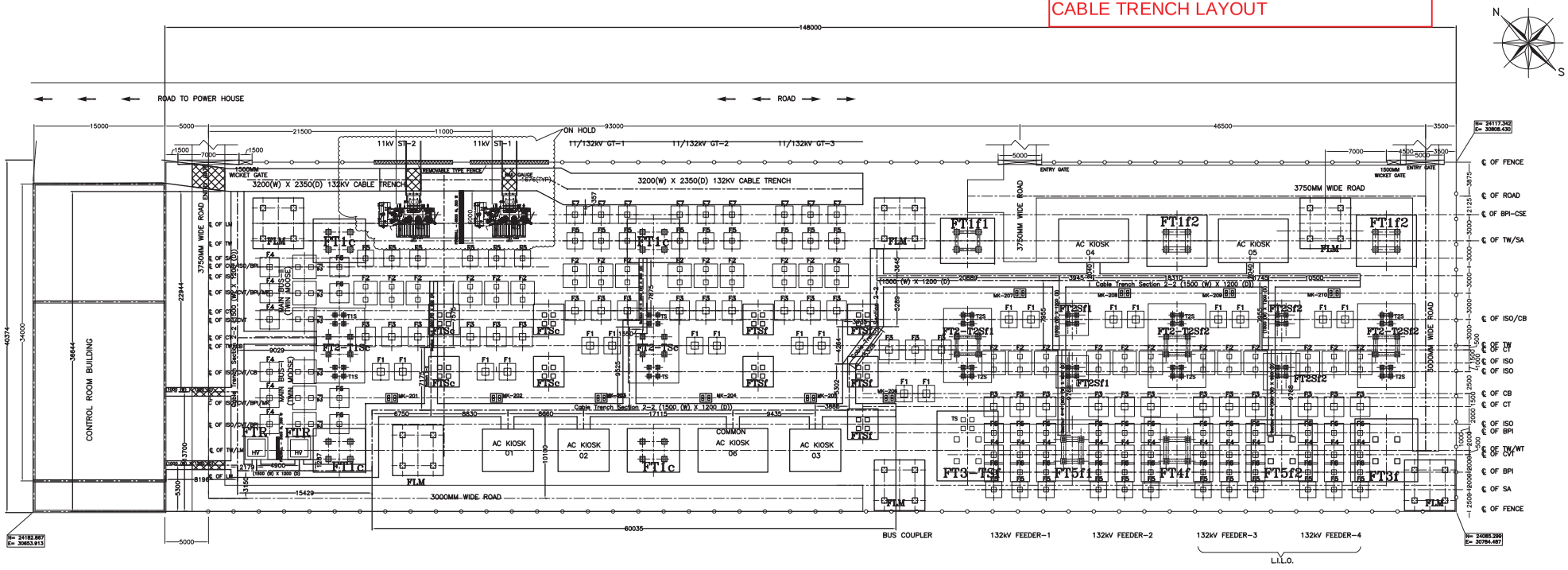
A1 SIZE

FIRST ANGLE PROJECTION

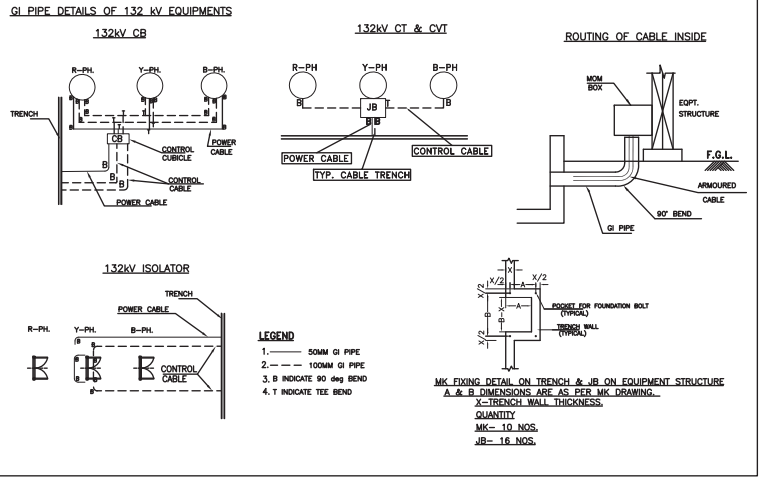
(ALL DIMENSIONS ARE IN mm)

DRG. NO.

# CABLE TRENCH LAYOUT

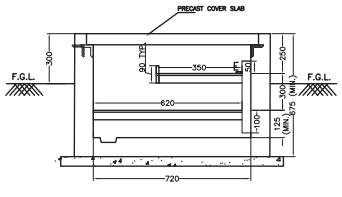



## GI PIPE DETAILS OF 132 kV EQUIPMENTS

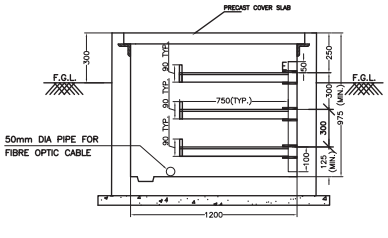



MK FIXING DETAIL ON TRENCH & JB ON EQUIPMENT STRUCTURE
A & B DIMENSIONS ARE AS PER MK DRAWING.
X=TRENCH WALL THICKNESS.

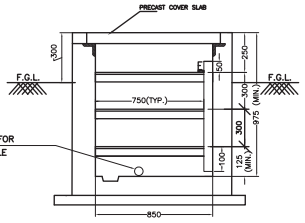
QUANTITY
MK– 10 NOS.
JB– 16 NOS.




OUTER MAXIMUM DIMENSION (900 (W) X 800 (D))




OUTER MAXIMUM DIMENSION(1500 (W) X 1200 (D))




OUTER DIMENSION (1000 (W) X 1200 (D))

REFRENCE DRAWING:–
1. LAYOUT OF FOUNDATION OF TOWER AND EQUIPMENT – DRG. No. 5602–003–H230–PVE–F–258 Rev.04
2. TENDER PLAN & SECTION DRAWING NO. 5602–003–P–E–E–A–108

NOTES :–
1. ALL DIMENSIONS ARE IN mm.
2. THE LOCATION OF CABLE TRENCHES MARKED IN THIS DWG MAY BE SLIGHTLY MODIFIED TO SUIT SITE CONDITIONS.
3. OPENINGS FOR TAKING OUT GI PIPES TO EQUIPMENTS SHALL BE PROVIDED IN CABLE TRENCHES. OPENING OF SIZE SUITABLE TO DIA. 50/100 PIPE SHALL BE PROVIDED BELOW TOP CABLE SUPPORT.
4. MK– INDICATES MARSHALLING KIOSK.
5. MK SHALL BE PLACED IN THE LOCATION SHOWN. EXACT COORDINATES TO BE SUITABLY DECIDED AT SITE. JB TO BE MOUNTED ON CT/CVT STRUCTURE
6. 1.1kV CONTROL CABLE SHALL BE PLACED IN MULTILAYER ON GI CABLE RACK SUPPORT (ANGLE).
7. CABLE SUPPORT SHALL BE PROVIDED AT EVERY 600mm INTERNAL.
8. AUXILIARY POWER CABLES SHALL BE LAID IN TOP TIERS AND CONTROL CABLES IN BOTTOM TIERS.
9. CABLES FOR LIGHTING PURPOSE SHALL BE LAID IN GI PIPE/ TRENCH. SEPARATE DRAWING SHALL BE SUBMITTED FOR LIGHTING SYSTEM.
10. EARTH CONDUCTOR 75X12 GI FLAT TO BE WELDED IN VERTICAL ON THE CABLE SUPPORT BEFORE INSTALLATION OF CABLES.
11. CABLES CROSSING ROAD SHALL BE LAID IN PIPE CULVERT.
12. FOR POWER & CONTROL CABLES, SEPARATE PIPES SHALL BE USED CONSIDERING 60% VOID FOR EACH PIPE I.E., 40% FILLING CRITERIA.
13. ALL OTHER DETAILS PERTAINING TO CIVIL WORKS SHALL BE REFLECTED IN THE RESPECTIVE CIVIL DRAWINGS.
14. GI PIPES SHALL BE SECURELY FIXED AT BOTH ENDS.
15. AFTER LAYING THE CABLES THE ENDS OF GI PIPES SHALL BE FULLY SEALED TO PREVENT INGRESS OF WATER INSIDE THE PIPE.
16. CONTROL CABLES & POWER CABLES MUST BE LAID IN SEPARATE GI PIPES.
17. THE PURPOSE OF TRENCH LAYOUT DRAWING IS FOR USE AS FOLLOWS:
    – TO BE USED AS CIVIL INPUT FOR CABLE TRENCHES.
    – FOR ERECTION OF CABLE RACKS AT SITE.
    – FOR CABLE LAYING AND ROUTING AT SITE.
18. THE CABLE OF CT/CVT BETWEEN SECONDARY TERMINAL BOX AND JUNCTION BOX SHALL BE LAID IN 100/50MM GI PIPE.
19. ▭ INDICATE CULVERT. CABLES CROSSING ROAD SHALL BE LAID IN BOX/PIPE CULVERT.
20. SUMP AND DRAINAGE SHALL BE SHOWN IN SEPARATE CIVIL DRAWING.
21. ———— INDICATES GI PIPE FOR CABLING.
22. CABLE TRECH FROM CSE TO GT YARD IS UNDER HOLD AS INDICATED IN DRAWING AND SHALL BE FURNISHED AFTER CABLE SIZING CALCULATION.
23. INSERTS MUST BE EMBEDDED AT EVERY 600mm INTERVAL FOR FIXING CABLE SUPPORT.
24. FIBER OPTIC CABLE BETWEEN AC KIOSK AND CONTROL ROOM SHALL BE LAID IN 50mm DIA GI PIPE AND SAME SHALL BE ROUTED THROUGH BOTTOM OF CABLE TRENCH. 50mm DIA GI PIPE USED FOR FIBER OPTICS CABLES SHALL BE SUITABLY CLAMPED TO AVOID MOVEMENT.

| REV. | DATE | ALTERED / CHECKED / APPD. | REV. | DATE | ALTERED / CHECKED / APPD. | REV. | DATE | ALTERED / CHECKED / APPD. |
|---|---|---|---|---|---|---|---|---|
| ZONE | | | 02 | 08.06.20 | | 01 | 04.10.16 | |
| | | | ZONE | | REVISED ACC TO FND LAYOUT | ZONE | | REVISED AS PER CUSTOMER COMMENT LETTER DATED 20.09.16 |

CUSTOMER: एनटीपीसी NTPC — एन.टी.पी.सी.लिमिटेड NTPC LIMITED (A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT: NTPC RAMMAM STAGE–III HYDRO ELECTRIC PROJECT (3X40MW)

BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP NOIDA

| DEPT. CODE | NAME | SIGN | DATE | NO. OF VAR |
|---|---|---|---|---|
| DRN | | | | |
| HSE 415 CKD | | | | |
| APPD | | | | |

SUB–VENDOR DRG. NO. | PO REF | NO. OF ITEMS

TITLE: CABLE TRENCH ROUTING LAYOUT

NTPC DRG. NO.: 5602–003–H230–PVE–F–109

SUB–VENDOR NAME | WEIGHT (kg) | SCALE

BHEL DRG. NO.: TB–DG–1–381–316–004 | REV. 02

SHEET NO. 01 | NO. OF SHT.

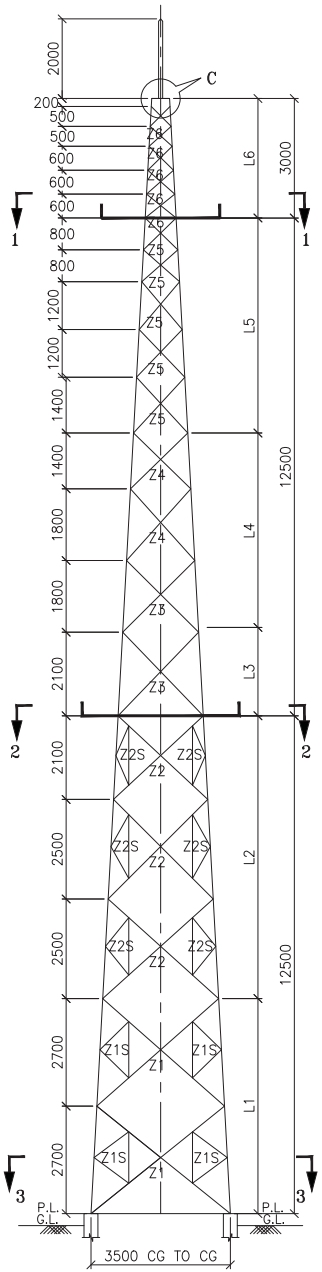
A1 SIZE

FIRST ANGLE PROJECTION

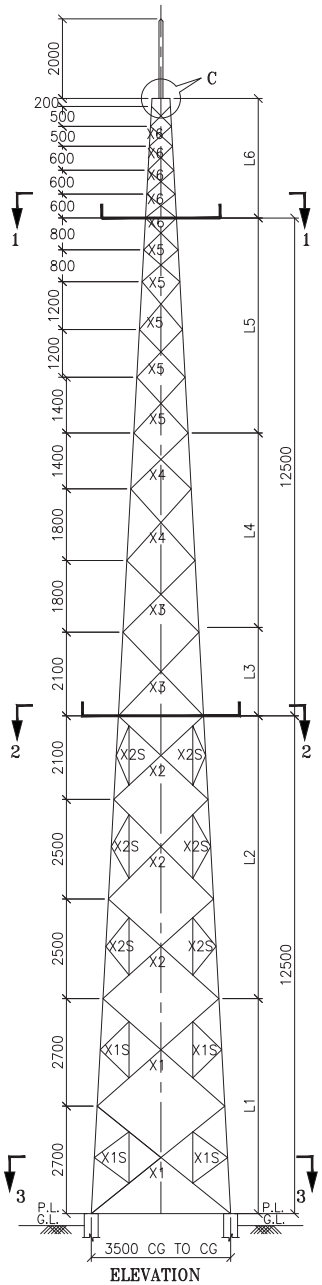
ALL DIMENSIONS ARE IN MM

DRAWING NO. 5602-003-H230-PVE-C-083

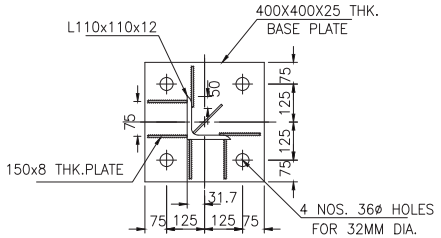
# GENERAL ARRANGEMENT OF LM



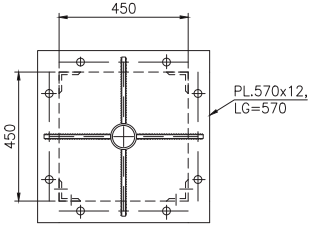

SIDE VIEW
(TRANSVERSE FACE)



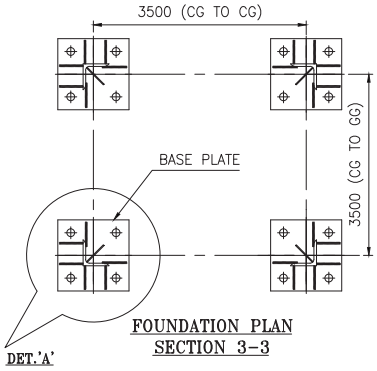

ELEVATION
(LONGITUDINAL FACE)



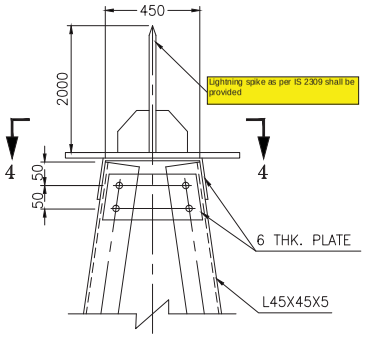

BASE PLATE DETAIL
DETAIL A-A



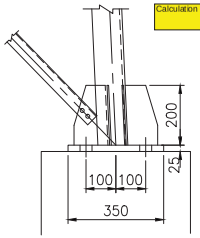

VIEW 4-4



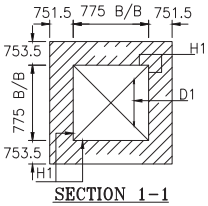

FOUNDATION PLAN
SECTION 3-3



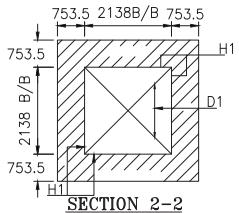

DETAIL-C




DETAIL-B




SECTION 1-1




SECTION 2-2

## DESCRIPTION OF MEMBER SIZE

| S.NO. | MEMBER MKD. | MEMBER SIZE | NO. OF BOLT |
|---|---|---|---|
| 1. | L1 | L110X110X12 | 8(DS) |
| 2. | L2 | L110X110X10 | 8(DS) |
| 3. | L3 | L110X110X10 | 6(DS) |
| 4. | L4 | L100X100X10 | 4(DS) |
| 5. | L5 | L90X90X6 | 4(DS) |
| 6. | L6 | L50X50X6 | 2(SS) |
| 7. | X1 | L65X65X6 | 1(SS) |
| 8. | X2 | L60X60X5 | 1(SS) |
| 9. | X3 | L50X50X6 | 1(SS) |
| 10. | X4 | L50X50X6 | 1(SS) |
| 11. | X5 | L45X45X5 | 1(SS) |
| 12. | X6 | L45X45X5 | 1(SS) |
| 13. | X1S | L45X45X5 | 1(SS) |
| 14. | X2S | L45X45X5 | 1(SS) |
| 15. | Z1 | L65X65X6 | 1(SS) |
| 16. | Z2 | L60X60X5 | 1(SS) |
| 17. | Z3 | L50X50X6 | 1(SS) |
| 18. | Z4 | L50X50X6 | 1(SS) |
| 19. | Z5 | L45X45X5 | 1(SS) |
| 20. | Z6 | L45X45X5 | 1(SS) |
| 21. | Z1S | L45X45X5 | 1(SS) |
| 22. | Z2S | L45X45X5 | 1(SS) |
| 23. | H1 | L65X65X6 | 1(SS) |
| 24. | H2 | L65X65X6 | 1(SS) |
| 25. | D1 | L50X50X6 | 1(SS) |
| 26. | D2 | L50X50X6 | 1(SS) |

LEGEND
(SS) – BOLTS IN SINGLE SHEAR.
(DS) – BOLTS IN DOUBLE SHEAR.

NOTES:–
1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. ALL UNNOTED MEMBERS SHALL BE L45x45x5
3. ALL ANGLE SECTIONS USED ARE EQUAL ANGLES.
4. ALL CONNECTIONS BOLTS SHALL BE 16MM DIA BOLTS.
5. ALL BOLTS SHALL CONFORM TO IS: 12427 OF PROPERTY CLASS 5.6.
6. ALL MEMBERS SHALL BE HOT DIP GALVANISED AS PER IS: 4759 AND IS 2629. THE WEIGHT OF ZINC COATING SHALL BE 0.61KG/SQM.
7. ALL WELDS SHALL BE 6MM THK U.N.O.
8. ALL JOINTS SHALL BE BOLTED CONNECTIONS.
9. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE TECH SPECS.
10. THE CONNECTION DETAILS, STRAINING PLATE AND STEP BOLTS ETC SHALL BE AS PER PROTO-CORRECTED DRAWING.

| REV. | | NAME | SIGN | DATE |
|---|---|---|---|---|
| | ALTERED | | | |
| | CHECKED | | | |
| | APPROVED | | | |

| REV. | | NAME | SIGN | DATE |
|---|---|---|---|---|
| | ALTERED | | | |
| | CHECKED | | | |
| | APPROVED | | | |

PROJECT
NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3x40 MW)

CUSTOMER
एन टी पी सी NTPC
एन.टी.पी.सी.लिमिटेड
NTPC LIMITED
( A GOVERNMENT OF INDIA ENTERPRISE )

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION PROJECTS DIVISION

| | NAME | SIGN | DATE | NO.OF VAR |
|---|---|---|---|---|
| DRN. | AG | | 26.12.19 | |
| CHD. | PNK | | 26.12.19 | |
| APPD. | AKM | | 26.12.19 | |

| DEPTT: | TBEM | SCALE | NTS | WEIGHT(Kgs.) | REF.TO ASSY.DRG. | ITEM NO. | NO.OF ITEMS |
|---|---|---|---|---|---|---|---|
| CODE : | 422 | | | | | | |

TITLE :
GA OF LM

DRAWING NO.
5602-003-H230-PVE-C-083

REV. R0

SHEET NO. 1 NO.OF SHTS.: 1



INVENTORY NO. | SIGN & DATE | REF.DRG.NO.