



**GUJARAT INDUSTRIES POWER COMPANY LIMITED
SURAT LIGNITE POWER PLANT (SLPP)**

VOLUME II — Package B – Electrical

Design, Engineering, Supply, and Construction of Package A, B, C & D
**New Lignite Feeding System, Associated Works, Contingency Feeding
Arrangement & Dismantling**

Tender No.: GIPCL/SLPP/R&M/LHS/FB-RE/LOCATION/EPC/2026

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Gujarat Industries Power Company Limited
Surat Lignite Power Plant (SLPP), Village: Nani Naroli, Taluka: Mangrol, Dist.:
Surat, Gujarat

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SECTION-1 GENERAL

1. Package B covers Design, Engineering, Procurement, Supply, Fabrication, Erection, Testing, Pre-commissioning, Commissioning, and Handing Over of the New Lignite Feeding System at the Plant End (Feeder Breaker Relocation), on a complete Turnkey EPC basis for the proposed New Lignite Feeding system at Plant end of Surat lignite Power plant, at Village; Nani Naroli, Dist.: Surat in the state of Gujarat, India promoted by M/s. Gujarat Industries Power Company Limited.
2. Description of various items of work under this specification and nature of work in detail are given hereinafter. The complete work under this scope is referred to as ELECTRICAL WORKS. The detailed scope of works covered under Electrical works are given in Section 2.2.
3. The work to be performed under this specification consists of design, engineering as well as providing all materials, consumables, equipment, temporary works and all incidental items not shown or specified but reasonably implied or necessary for the completion and proper functioning of the plant, all in strict accordance with the specifications, including revisions and amendments thereto as may be required during the execution of the work.
4. The work shall be carried out according to the design/drawings to be developed by the BIDDER and approved by the CONSULTANT/OWNER. For all Electrical installations & equipments, etc., necessary layout, GA drawing and details are to be developed by the BIDDER, keeping in view the statutory & functional requirements of the plant and facilities and providing enough space and access for operation, use and maintenance. Certain minimum requirements are indicated in this specification for guidance purposes only. However, the Bidder's offer shall cover the complete requirements as per the best prevailing practices and to the complete satisfaction of the OWNER.
5. BIDDER shall inspect the site, examine and obtain all information required and satisfy himself regarding matters and things such as access to site, communications, transport, right of way, the type and number of equipment and facilities required for the work etc. Ignorance of the site conditions shall not be accepted by the Owner as basis for any claim for compensation or extension of time. The submission of a bid by the BIDDER will be construed as evidence that such an examination was made and any later claims / disputes in



regard to price quoted shall not be entertained or considered by the OWNER on account of ignorance of prevailing site conditions.

6. STATUTORY REQUIREMENT

Complete Electrical system with all its accessories cover under the scope and the scope also include any statutory approvals (DGMS, Electrical inspector approval, GETCO/DGVCL approvals etc.), clearances including approval from DGMS if any, required for equipment /system as per standard and system requirements for satisfactory operation. Approval from electrical inspector, GETCO/DGVCL approval means from drawing approval stage up to charging clearance including all stages of approval as per their guidelines and it also includes payment of all kind of charges / statutory fees but necessary letters shall be issued on the letter head of Client. Liasioning with all statutory approving authorities shall be in the scope of Bidder. Statutory body /Act requirements shall be fulfilled by the BIDDER and in case any modifications /additions to the building /Structures are to be made as per the above, shall be carried out by the BIDDER at no extra cost to the owner.

SECTION-2 ELECTRICAL SCOPE OF WORK

DETAILED SCOPE OF WORK: PACKAGE B

Package B covers Design, engineering, manufacturing, supply, transportation, storage, preservation, shifting, erection, testing and commissioning work of Associated Work for Feeder Breaker Relocation

1. SCOPE AND BRIEF DESCRIPTION OF WORK

1.1. The scope of Bidder shall include design, engineering, supply, loading/unloading, storage in weatherproof shed at site, erection, testing and commissioning in presence of OEM engineer of all electrical equipment required under their scope for Associated Work for Feeder Breaker Relocation.

The major equipment/system covered under scope of work shall be as follows:

- a. Control, protection and metering systems including Electrical control Panel.
- b. Local panels, local PB control stations, JBs MKs, MBs, LP etc.
- c. All LT Power, control, fiber optic and special cables and cable raceway system with necessary fire barriers, fireproof sealing and coating systems.
- d. Cable supporting structures, cable racks, under ground cable trench, cable trays, cable laying, cable dressing, cable identification/tagging and cable termination, will all require accessories.
- e. Welding sockets / receptacles, Welding distribution boards with required number of outlet sockets for identified areas of entire plant.
- f. Indoor / Outdoor Illumination system for all areas covered in this scope of supply including lighting transformer, DBs, lighting panels, high mast towers, poles, lighting fixtures, lamps etc. including entire plant area road lighting, entire plant watch areas, all buildings, various lighting towers across entire area,
- g. Electrics for ventilation, air-conditioning etc.
- h. Installation, erection accessories.
- i. Earthing and Lightning protection for entire area. Chemical treated earth pit shall be provided for all the areas.



- j. Earthing mat with treated / untreated earth pits as per requirement with due approval from Owner / Owners consultant and equipment earthing for all equipment.
 - k. Insulating mat as per latest standard for all the areas for all kind of panels
 - l. First aid box, shock treatment chart, danger boards, EXIT signage boards at all locations, Radium signage in front of all LT panels for maintaining safe clearance, Entry restricted sign boards, authorized entry sign boards, Panel number and identification on front as well as rear side of all panels, danger boards for electrical panel room as well as transformer room, Feeder identification through painting for all feeders of LT panels, each transformer, each light fitting, Lighting panels, Lighting distribution boards, each welding sockets, welding distribution boards, each air conditioner, each water cooler, each electrical equipment, etc for all the areas.
 - m. Startup and commissioning spares
 - n. Essential spares
 - o. Liaisoning with Government statutory authorities like DGMS, Chief Electrical Inspector, Electrical inspector etc.**
 - p. Client PC, network components / hardware, fibre optic cabling and termination accessories, etc.
 - q. Whenever or wherever 3-phase 4 wire power supply is required for any system or application then bidder to derive 3-phase 4 wire power supply from 3-phase 3-wire power supply system by providing required capacity isolation transformer and distribution board after approval from Client.
 - r. Survey / audit shall be carried out for plant areas for classification of hazardous area and according to hazardous area classification category, electrical equipment shall be supplied and commissioned.
 - s. Bidder shall take care about necessary safety aspects while designing any system or area or layout of the equipment outdoor / indoor considering safety aspects to be taken care as per CEA / CERC / NGT Audit recommendations / Other government authority / Electrical inspector DGMS latest guidelines.
- 1.2. Special tools and tackles required for installation, operation and maintenance of electrical equipment. Bidder shall take approval / clearance from purchaser before mobilization for installation, testing and commissioning with minimum tools and tackles. List of minimum tools and tackle shall be subjected to approval from purchasers / purchaser's Consultant before site mobilization.
- 1.3. The required no. of Dry type transformers, LT switch gears being planned by the Bidder shall be provided and it shall be subject to approval of Owner/ Owner's Engineer. Similarly, layout of electrical premises shall be provided as per approval of Owner/ Owner's Engineer. The minimum requirement of LT switchgear, transformer to be considered is given in subsequent chapters.



- 1.4. The technical requirement of the main equipment involved as per the system requirement are covered in technical specification section and other appropriate sections forming part of this specification.
- 1.5. Complete Electrical system with all its accessories cover under the scope and the scope also include any statutory approvals (Electrical inspector approval, GETCO/DGVCL approvals etc.), clearances including approval from DGMS if any, required for equipment /system as per standard and system requirements for satisfactory operation. Approval from electrical inspector, GETCO/DGVCL approval means from drawing approval stage up to charging clearance including all stages of approval as per their guidelines and it also includes payment of all kind of charges / statutory fees but necessary letters shall be issued on the letter head of Client. Liaisoning with all statutory approving authorities shall be in the scope of Bidder.
- 1.6. Auxiliary electrical system studies and design calculations as indicated below and preparation of all drawings (for approval) is all included in Bidder's scope. Sub-Vendor dwgs shall be reviewed by Main bidder before furnishing to Owner/Owner's engineer for review and approval.
- 1.7. **Bidder has to take care each Electrical installations of existing feeding system. Any requirement to rerouting of HT / LT cables, equipment etc. for new feeding system is in scope of bidder i.e. rerouting of cables through rack, underground trench etc. subject to Owner/Owner's engineer for review and approval.**

Following studies and design calculations and others as envisaged during detailed engineering shall be performed as per relevant IS/IEC/IEEE:

- System Short circuit analysis
- System Stability studies
- Insulation coordination studies
- Electrical protection audit
- Fault level calculations at each voltage level
- Load Flow studies
- Earthing & lightning protection design and its calculations
- LT Transformer sizing calculations
- LT bus bar sizing calculations
- Equipment rating calculations
- CT & PT sizing calculations
- LT Cable sizing calculations
- Lighting design calculations



- Switchgear sizing calculations
- Preparation of General arrangement drawings, Cabling, Lighting, Earthing and lightning protection layouts for entire area.
- Interconnection schedules, Cable schedules, cable termination chart
- Preparation of area illumination layout

2. ELABORATION OF ELECTRICAL SCOPE OF WORK

The scope of work and different design requirement have been given in different chapters however for ease of understanding it is considered in following paras:

2.1. SWITCHGEARS

415V Switch gear

415V panel shall be provided for feeding different auxiliaries, power distribution boards as required for the plant.

Each breaker module of the switchgear will be provided with multi-function microprocessor based numerical protective relay with communication facility.

Loads at 415V panel shall be feed to;

- i) Lighting
- ii) Welding Distribution board
- iii) Lighting Distribution board
- iv) Entire area road lighting system, weigh bridge supply, operator cabin lighting, washroom lighting, rest room lighting, transformer room lighting, Air conditioning system, Ventilation system, etc.

Lighting distribution board for all areas shall be provided with necessary outgoing feeders and incomers to take care the area lighting system.

The LT Switchgear panels, LDB, ACDB, Welding DB, DC System etc. shall be located in contractors scope and decided during detailed engineering.

Every LT panels/PDBs, etc. shall be provided with 20% spare for each type or 1 of each type, whichever is more.



Any type of Additional / temporary requirement of power for the existing of new system shall be in bidders scope.

The location of panel & transformer room shall be elevated on ground floor. Underground Cable trench shall made, cable route with necessary cable rack shall consider as required.

2.2. Electrical Switchgear Room:

The location of switchgear room shall be elevated on ground. Underground Cable trench to be made wherever require, ground floor & above cable route with necessary cable rack shall consider.

Electrical switchgear room regulations require restricted access for qualified personnel, minimum working clearances around equipment (typically 30–36 inches to 5 feet depending on voltage), a fire-resistance rating of 1 to 2 hours for walls and doors, effective cable fire-stopping, and independent, controlled ventilation to keep ambient temperatures safe.

These safety and design mandates are typically governed by national electrical and building codes (such as the NFPA 70 / NEC in the US, or the Central Electricity Authority (CEA) regulations in India).

Core regulatory requirements cover the following areas:

1. Space and Clearance Requirements

Working Space: The working clearance in the direction of access to live parts must be at least 30 to 36 inches (762 to 914 mm) wide, and equipment doors must be able to open at least 90 degrees.

High Voltage Clearances: For medium/high-voltage switchgear (e.g., above 600V up to 13.8kV), working clearances are strictly enforced, often requiring up to 5 feet (1.5 meters) of space.

Headroom: The minimum headroom (vertical clearance) around switchgear is generally 6.5 feet (2 meters).

2. Construction and Fire Safety

Fire Ratings: Switchgear rooms must be constructed with fire-resistant materials. Doors should have a minimum fire rating of 60 to 120 minutes and open outwards.

Cable Penetration: All cable trenches and wall entries must be effectively sealed using fire-stops or intumescent fire barriers to prevent fire from spreading to adjacent areas.



Oil Containment: If oil-filled transformers or equipment (holding 2,000 liters or more of oil) are placed inside or near the room, specific curbed sills and oil-drainage/trapping arrangements are mandated to prevent oil spills from fueling a fire.

3. Environmental and Ventilation Controls

Temperature Maintenance: Switchgear rooms must be well-ventilated (either naturally or mechanically) to ensure ambient temperatures typically do not exceed 40°C to 55°C, as excess heat directly degrades equipment lifespan and capacity.

Independent Ventilation: Ventilation systems for electrical rooms must be independent of the rest of the building's HVAC to prevent the circulation of smoke and toxic gases in the event of an arc flash or fire.

4. Access and Egress

Restricted Access: Entry must be restricted to qualified and authorized personnel only.

Emergency Egress: Depending on the equipment size and room layout, at least one or two unobstructed entrances/exits must be available, with minimum dimensions (often 24 inches wide and 6.5 feet high).

Lighting: Adequate emergency egress and task lighting must be provided according to the National Building Code

2.3. CABLING

All LT XLPE insulated power, control cables for LT breakers, all auxiliaries transformer, Main lighting transformer, LT loads of entire area auxiliaries, etc. will be provided by bidder.

Numerical relays etc. shall be in this scope of the bidder. Communication cable shall be laid only in separate conduit wherever applicable in order to avoid damage and magnetic interference.

Control cables from LT Switchgears, CT/PTs, auxiliary relays, ECP, MBs, JBs, etc. shall be supplied, laid and terminated by the bidder.

All LT XLPE insulated power, control cables and cable accessories supporting GI structures, cable installation, cable terminations with necessary junction boxes and fire sealing / fire proof coating are under the scope of Bidder for all areas. All LT power, control cable shall be of FRLS type.

Current, Voltage, MW etc Transducers shall be provided wherever required for the performance monitoring and system requirement.



The entire cable carrier system for entire area shall be in bidder's scope including cable trenches, cable racks etc.

All control and protection cables required for connection to relays, meters, signaling alarm, control, monitoring, IT infrastructure etc. for the area shall be provided, laid and terminated by the Bidder.

The Bidder is responsible for the total implementation of the job.

All erection / installation accessories, cable termination and jointing kits, cable fixing, dressing, tag numbers, route markers, supporting materials for all areas/ equipment.

Bidder to submit the layout indicating location of all major electrical equipment and cable routes. Levels of floor, clearances, entry / exit points, cable structure details to understand their offer clearly.

2.4. EARTHING AND LIGHTNING PROTECTION

Earthing mat shall be provided for complete plant building and outdoor area under the scope of Bidder. Bidder shall also include earthing pits transformers and lightning arrestors and their inter connection with earthing system. The no. of earth pits shall be as per requirement with due approval from Owner / Owners consultant. The complete earthing system shall be provided in all areas, floors etc. in the scope of bidder.

Each earthing pit shall have earthing pit top cover of suitable material and further it shall have separate identification marking plate which shows the data like earthing pit identification, earth pit resistance value, earth pit resistance testing date, testing due date etc. Earth pit identification marking plate shall be designed in a such a way that every year, we have to only replace identification sticker provided over marking plate with new display data.

For Transformer yard separate earth grid shall be suitably formed and treated earth pits including raisers shall be provided for transformer neutral & body earthing, support structures etc.

Lightning protection system shall be provided for all building and structures covered under the scope (incl. high mast towers). Earthing and Lightning system shall be as per standards and as per system requirement.

2.5. ILLUMINATION

Bidder shall provide complete illumination for all areas of the plant.

The plant shall be provided with necessary indoor and outdoor lighting system (LED lighting). Indoor lighting shall constitute of normal AC



lighting. It also includes entire plant area road lighting, lighting high mast towers, all building lighting, shed lighting, lighting masts as per aviation guidelines.

SECTION-3 ELECTRICAL SYSTEM DESIGN

1. General

Standards

The design, engineering, manufacture, assembly and testing/commissioning as well as performance of the equipment shall conform to the relevant IS specifications (latest revision). In case the Bidder is not in a position to comply fully with certain IS specifications, or in respect of certain items for which there are no IS specifications, the Bidder may base his proposals on IEC/BS/VDE/DIN recommendations or other reputed national or international standards subject to the approval of the Owner / Owners consultant.

All equipment supplied and all work done including system design and detailed engineering shall also comply with the statutory requirements of the Government of India, the Government of Gujarat, Indian Electricity Grid Code, DGMS and with the Indian Electricity Rules.

Bidder is also responsible for obtaining all kinds of approval / clearances from government authorities like electrical inspector authorities, DGMS etc including payment of all necessary fees / dues etc.

Climatic Conditions

The climatic conditions generally prevailing at GIPCL, Surat have already been described in other volume.

Electrical Equipment selection and derating shall generally be based on ambient temperature of 50 deg. C.

The equipment offered shall be suitable for smooth efficient and trouble free service in the tropical humid climate.

This specification is issued for procurement of specified equipment and system preferably from indigenous suppliers who may make use of imported systems / sub-systems / equipment / parts and who have valid collaboration agreement with reputed foreign suppliers with experience in design and supply of similar systems as specified. The Bidder shall furnish division list of supplies from foreign and Indian sources indicating the name of the agency or make against the respective items. It shall be the responsibility of the Bidder to



arrange the import licence for the imported items offered and to co-ordinate the supply of equipment from foreign and Indian sources and execute the contract within the agreed time schedule.

The make of major equipment shall be limited to preferred makes indicated under chapter 'Vendor List'. If the Bidder prefers to supply other than from the vendor list, it should be with the approval of the Owner.

Similar equipment and components shall be of same make, equipments of same type and rating shall be interchangeable.

The Owner has the option of selecting the manufacturers of electrical equipment, instruments and controls and any other specialized items in the interest of standardization and the Bidder shall have to supply equipment of the particular make, if so required.

2. DESIGN CRITERIA

Standard voltage levels

The standardised voltage levels as given in the Table below shall be adopted:

Sl. No.	Description	Voltage level
1	LT Power Supply	415V, 3 phase, 3 wire through New MCC
2	Welding socket outlets	415V, 3 phase 4 wire 50 Hz, AC
3	1-ph socket outlets	230V, 1 phase, 3 wire AC

Permissible variations:

The system plant equipment shall be designed suitable for variation in voltage and frequency as indicated in the table below:

Sl. No.	Description	Voltage	Frequency
1.	Permissible variation with rated performance/rated	+10% to – 10%,	+5% to – 5% for LT system



	current and control effectiveness maintained	+10% to – 10%, +10% to – 10%	+5% to – 5% for HT system +5% to – 5% for EHV system
2.	Permissible variations for control and regulation equipment with rated performance and control quality maintained.	+/- 10%	+5% to – 5%

Basic insulation levels:

Equipment shall be designed suitable for basic insulation levels as per all applicable standards.

Symmetrical short circuit ratings:

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

Symmetrical short circuit ratings;

Sl .No.	Voltage level	Symmetrical Breaking capacity	Making Capacity
1.	415 V	50 kA	125 kA

The rated short circuit withstand duration for switchgear of 415 V shall be 1 sec.

TESTING:

In addition to all Routine, Acceptance and Type tests, the major equipments should qualify for seismic Zone –III tests or type test report of same rating/type and type test shall be carried out within 5 year OR as per recent CEA guidelines. Type test reports older than 5 years or as



per recent CEA guidelines of any equipment, the same type test shall be carried out on that equipments at Bidder's cost and submitted to customer, shall be in the scope of bidder. The type test report of seismic is valid for the period of five years from the date of test conducted.

Test conducted at site and shop / factory shall be subjected to approval and witness by customer.

Any special tests on major equipment at the time of testing / commissioning at site shall be carried out, also include in the scope of bidder.

SECTION-4 TECHNICAL SPECIFICATIONS

4.1 TECHNICAL SPECIFICATIONS FOR LT SWITCHGEAR

1. SCOPE

- 1.1. This specification covers design, manufacture, inspection & performance testing at manufacturer's works, delivery for site, including packing, forwarding, loading, transportation to site, unloading at site, storage, erection, testing and commissioning of the switchgears / MCC/ DBs for feeding the 415 / 240 V AC loads.
- 1.2. 415 V switchgears shall be 3 phases, 4-wire system.
- 1.3. The switchgear shall derive power from the designated service transformers or from another 415V switchgear based on geographical location and loads.
- 1.4. LT Switchgears and associated MCCs and DBs for the following systems shall be provided:
 - a. power supply requirement to each and every areas
 - b. power supply requirement to plant Sump pump system
 - c. power supply requirement to plant CCTV system, IT infrastructure etc.
 - d. power supply requirement to entire plant area lighting system, boundary wall lighting, road lighting, area lighting in the form of high mast lighting towers etc.

2. POWER_SOURCES FOR 415V SWITCHGEAR

- 2.1. The switchgear shall derive two (02) power sources from New Feeder Breaker MCC (from Bus-A & bus-B) 415V, 3 phase only.
- 2.2. One suitable rating change over switch with fuse with enclosure panel shall be provided for two sources for incoming power supply.
- 2.3. The Main lighting switchgear shall derive 3-ph 4-wire power from Main lighting transformers.



- 2.4. To feed 3-phase, 4-wire, 63A and 32A welding receptacles, one separate 415V welding distribution board along with transformer of adequate capacity to be provided. Each circuit of this welding distribution board shall feed maximum of 3 nos. welding / power receptacles.
- 2.5. The switchgears will derive power from the designated service transformers. BIDDER will propose the configuration / sources best suited for the system without sacrificing the standby philosophy, reliability, flexibility of operations and common load demarcations.

3. POWER_RECEPTACLES

3-phase, 4 wire, 5 pin, 63A power receptacle / welding receptacles with switch shall be provided. Also, the feasibility of feeding the welding receptacles of other areas shall be preferably from the nearest welding distribution board. The receptacle shall be industrial heavy-duty type and shall have suitable interlock facility for safety. The receptacle shall conform to IS 1293 and the switch to IS 4064. Further quantity can be decided during detailed engineering.

- 3.1. The no. of power DB, location, incoming feeding capacity, number of outgoing circuits and number of WDB in field area shall be decided during detail engineering.
- 3.2. 3 phase & 1 phase receptacles shall be flame proof for Lignite Handling system area.
- 3.3. 2 nos. welding receptacles (3 phase, 4 wire, 5 pin, 63A) & 2 nos. receptacles (1 phase, 3 pin, 20A) shall be provided near weigh bridge & operator cabin areas. The power receptacle shall be flame proof and weather proof.

4. FEEDER DETAILS

The switchgears shall be provided with suitable number and type of outgoing feeders for the respective auxiliary loads of the area, power supply feeders to various panels, lighting, and all other loads encountered in the plant, with 20 % spare feeders of each type.

5. SHORT CIRCUIT CURRENTS & CONTINUOUS CURRENTS

- 5.1. The short circuit current of 415V bus shall be 50kA for 1 sec. The momentary current rating shall be 2.1 times this value.



- 5.2. The continuous current rating of the bus bars, their incomers, bus couplers of the switchgear which are fed by the transformers shall be rated at the LV side full load current of the corresponding transformers with 20% margin rounded off to the next higher standard rating.
- 5.3. The continuous current rating of the bus bars, incomers, bus couplers of the switchgear fed from other switchgears shall be the maximum load on the bus due to all the running auxiliaries during any operation condition plus 20% margin rounded off to the next higher standard rating. For the load calculation, load factors to be considered shall be 0.9 for continuous loads, 0.4 for intermittent loads.

6. SPECIFIC REQUIREMENTS

- 6.1. All the 415V equipments/devices like bus support insulators, CBs, CTs, PTs etc mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions.
 - (a) Variation in supply voltage - +/-10%
 - (b) Variation in supply frequency - +/-5%
 - (c) Combined voltage and frequency variations:- 10% absolute.
- 6.2. Switchgear shall be totally enclosed, metal clad, sheet steel fabricated, indoor, floor mounted / pedestal mounted fully drawout modular type construction, dust and vermin proof of uniform height of not more than 2450mm, easily extendable on both sides having switchgear designation indicating label's on front and rear, in single/ double front execution in totally draw out. Proper gasketing shall be provided all around the perimeter of the adjacent panels, panel and base frame, removable cover and doors. The switchboard shall be fully compartmentalized confirming to form 3 requirements of IS 8623.
- 6.3. LT Panel shall be fed by one incomer (from changeover switch).

White / Yellow colour Zebra painting is required on front as well as rear side for all incomer feeders.
- 6.4. Operating devices shall be incorporated only in front of the switchgear.
- 6.5. Switchgear shall be divided in to distinct vertical section of :-
 - (a) Completely Enclosed busbar compartment running horizontally.



- (b) Individual feeder modules in multi tier arrangements.
 - (c) Enclosed vertical bus bars serving all modules in vertical section.
 - (d) Vertical cable alley covering entire height and minimum 300 mm wide and shall have hinged doors.
 - (e) A horizontal separate enclosure for all-auxiliary power and control bus as required.
- 6.6. All modules of identical size & type shall be fully interchangeable without any modifications.
- 6.7. The sheet steel to be used for the metal enclosed switchgear shall be minimum 2.5 mm thick hot rolled or 2 mm cold rolled.
- 6.8. The cable entry shall be bottom only with separate gland plate for power and control cable. In case of single core cables, gland plate shall be of non magnetic material.
- 6.9. No MCCB shall be used, only SFU type feeder shall be considered.
- 6.10. Minimum of one NO and one NC spare contacts of all contactors, relay devices shall be wired to terminal block.
- 6.11. For CT & VT circuits disconnecting type of terminals shall be provided.
- 6.12. Secondary of CTs & VTs shall be made through disconnecting type terminals with necessary shorting and earthing facilities. All the control wiring shall be through stud type terminal.
- 6.13. Breakers shall be capable of carrying continuously at least 120% of circuit breaker current at an ambient temperature of 50 deg. and with breaker mounted inside the panel. If a higher rated breaker is necessary to meet this, the same shall be used.
- 6.14. A clearance of 250 mm shall be maintained between terminal blocks and gland plate and 150 mm between two rows of terminal blocks.
- 6.15. All the electrical equipment shall be fed from main MCC only and if any specific arrangement is needed, separate panel for that shall be provided in switchgear room.
- 6.16. All LT panels shall be mounted at least on ISMC 100 channels / pedestals as decided during detail engineering.
- 6.17. The cable terminations inside the cable alley shall be completely shrouded.

7. CONSTRUCTIONAL FEATURES

- 7.1. Metal clad Indoor type, single / double front, single/double tier panels, free standing design, with dust Proof construction. The construction shall be compartmentalized with metal / insulation partitions between



compartments. In case of double tier arrangement, sufficient working space shall be provided in cable chamber to work in one cable termination when the other is in energised condition.

- 7.2. Sheet steel of not less than 3.0 mm thickness for load bearing members and 2.0 mm thickness for other members.
- 7.3. Wherever there is requirement of top cable entry then separate cable gland plate shall be provided and separate plate for main bus bar maintenance purpose in LT MCC, DCDB, Any ACDB etc.
- 7.4. Name plate for each incoming and outgoing at front and back on the fixed portion of the panel.
- 7.5. All panels shall have cubicle illumination lamp with door switch.
- 7.6. The back door shall be hinged type.
- 7.7. Enclosure shall conform to IP42 or better for bus bar rating above 1600A and IP 52 or better for bus bar rating up to 1600A.
- 7.8. All types of outdoor panels shall be of double door type construction only.

The following shall be taken care in LT Switchgear:

- a) Each component of panel shall be accessible for maintenance/replacement without requirement of shutdown.
- b) For each module/breaker feeder door fixing, screw type arrangement shall be provided. Plastic knobs shall not be provided anywhere in panel.
- c) For module rack in/ out, flap type arrangement shall only be provided.
- d) Bus bar PVC shrouds shall be provided such that it is very easy to dismantle shrouds during maintenance and again easy to install by providing sufficient space for maintenance purpose.
- e) Cable gland plate in panel shall be provided such that cables for each feeder in each vertical panel shall be terminated and thereafter sufficient space shall remain in gland plate.
- f) In LT panel, interpanel wiring connections shall be through plug & socket type arrangement only.
- g) In LT panel, shutter type arrangement shall only be provided for each breaker feeder / SFU or any other type of feeder.
- h) In each vertical bus bar, for taking out power for each feeder, there shall not be any fixed type contacts arrangement in vertical bus bar. Contacts towards module side shall directly enter into vertical bus bar.
- i) All bus bars shall be adequately supported by non-hygroscopic, non-combustible, track-resistant and high strength type polyester fibre glass moulded insulators / epoxy insulators. Separate supports shall be



provided for each phase bus bar. If common support is provided anti tracking barrier shall be provided between the supports.

- j) All bus bar joints shall be provided with high tensile steel bolts, Belleville / spring washers and nuts so as to ensure good contacts at the joints.
- k) All bus bars shall be colour coded as per IS.
- l) All parts / items of LV switchgear shall be easily accessible so as to have ease in maintenance. Sufficient space shall be provided.
- m) Each Draw out type modules/feeders shall have flap type arrangement instead of rack-out rod for module/feeder rack-out.
- n) Each module/feeder doors have screw type arrangement with door interlock feature for closing door instead of any plastic knobs or other item.

8. CURRENT TRANSFORMER:

- 8.1. The thermal and dynamic stability current for CTs shall be same as for the air circuit breakers. CT ratio shall be as per system requirement with due approval from Owner / Engineer. Protection and measuring current transformer shall be bar primary / window type with 1A secondary conforming to IS-2705 Part-II-1992 and Part-III-1992 respectively.
- 8.2. Measuring CTs shall conform to accuracy class of 1 except for incomer feeders from Transformers which shall be 0.5S. The CT ratio shall be as required by the associated measuring instrument. The CTs shall have saturation factor of not less than 1.5 and higher limit shall be compatible with the overload capacity of the instrument connected on the secondary side.
- 8.3. Protection CTs shall have their accuracy and burden as-required by the protection circuits in which they are used and shall have saturation factor of not less than 20.
- 8.4. CT shall be of cast resin type. Energy accounting and audit meters shall be of accuracy class not inferior to 1.0S or better class as per CEA regulations. The accuracy of CT / PT shall not be inferior to that of associated meter.

9. POTENTIAL TRANSFORMERS (PTs)

- 9.1. Line PTs provided on each incomer and Bus PTs provided in the bus shall be of fixed type. The PTs shall be dry epoxy resin moulded type.



- 9.2. High voltage windings of voltage transformer shall be protected by current limiting HRC fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully draw-out position.
- 9.3. Low voltage fuses, sized to prevent overload, shall be installed in all ungrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the switchgear is energized.
- 9.4. The technical particulars and accuracy class of the PT shall be as per SLD.
- 9.5. LED indications for voltage availability in line PT and Bus PT modules shall be provided.
- 9.6. Bus PT over voltage factor shall be 1.9 for 08 hours.
Each PT cubicle shall be complete with following minimum accessories
 - (a) PTs shall be fully draw out type with required no of cores and ratios as specified elsewhere.
 - (b) Voltmeter with selector switch.
 - (c) Under voltage and No voltage relays with timers and fuse fail relays.
 - (d) Required auxiliary relays.
 - (e) LEDs for voltage indication.
 - (f) Auxiliary PTs, as required.
 - (g) DC and AC control supply and changeover switches with Short Circuit protection.

10. PROTECTIVE EARTHING:

- 10.1. Continuous earth bus of minimum size 50 x 6 mm copper or equivalent aluminium / galvanized steel section, designed to carry the peak short circuit and short time fault current as specified.
- 10.2. Provision at the bottom extending throughout the length of the board, bolted / brazed to the frame work of each panel with an earthing terminal at each end for terminating external earth conductor including provision for termination of cable armouring at earth bus.
- 10.3. Vertical earth bus for earthing individual functional units.
- 10.4. All non-current carrying metal work (including metallic cases) of instruments and other panel mounted components effectively bonded to the earth bus.
- 10.5. Hinged doors earthed through flexible earthing braid.
- 10.6. Looping of earth connection resulting in loss of earth connection to other devices when the loop is broken, not permitted.



- 10.7. Withdrawable units provided with self-aligning, spring loaded, silver plated copper scrapping earth contacts of make before / break after type ensuring earth continuity from service to the test position.

11. OTHER REQUIREMENTS

- 11.1. No motor shall be fed from local control panel. Even small motors shall be controlled through MCCs except single phase motors and sump pump motors.
- 11.2. Bimetal overload relays with single phase preventer shall be provided wherever required along with necessary command, feed back cable, coupling relays etc. Provision shall be made for resetting of Bimetal overload relays without opening the module door. All motors of 30kW and above shall have an ammeter in panel. 20% spare feeders with at least one of each type and rating shall be provided in each switchgear.

12. ACDB / POWER DISTRIBUTION BOARD (PDB)

- 12.1. 415V, 3 phase, 3 wire, of required rating, 50 KA (short time rating for 1 sec.) indoor type.
- 12.2. Board shall be single/double front, metal clad, front matched, dust and vermin proof, fixed type, compartmentalized and extensible on both sides IP52 type enclosure.
- 12.3. Shall have base channel of size ISMC 75.
- 12.4. Shall have isolated busbar chamber for main busbar at the top, running through out the length of the board. Chamber shall have removable cover.
- 12.5. Cable alley shall have sufficient space for aluminium power cables and bottom cable chamber shall be left free completely isolated from the vertical busbar.
- 12.6. Busbars shall have same cross section through out the length. Rating of the neutral busbar shall be 50% of the main busbar. Earth bus bar shall run in bottom chamber throughout the length of the panel.
- 12.7. Shall have switch-fuse Unit triple pole. SFU shall be capable of breaking rated current at 0.3 pf at rated voltage. SFU shall withstand the fault current envisaged for 415V system.
- 12.8. The number of ACDBs and their locations shall be decided based on consumer requirement and shall be finalized during drawing approval stage.
- 12.9. However, the feeder rating and quantity shall be as per system requirement with due approval from Owner / Engineer.

12.10. he type & number of feeders shall be decided during detail engineering.

12.11. 20% spare feeders of each type and rating shall be provided.

13. **SPECIFIC REQUIREMENTS**

13.1. All the switchgears / MCCs shall be designed for bottom entry of cable.

13.2. 20% spare terminals shall be provided for each module.

13.3. Insulation Level:

- Rated insulation voltage 1100 V
- One minute power frequency withstand voltage.
 - 2.5 KV for power circuits.
 - 2 KV for control circuits.

13.4. Clearance in air (minimum)

- Phase to phase – 25.4 mm
- Phase to earth – 19.0 mm

14. **METERING AND PROTECTION**

(a) Incoming feeders

	Protections		Metering
	Short circuit protection (SFU)		Phase Current (1 phase)

(b) Outgoing feeders

	Protections		Metering
	Short circuit protection (through fuse)		Phase Current (1 phase) for modules rated 63A and above.

15. **TESTS**



- 15.1. BIDDER shall submit available type test reports of temperature rise and short circuit tests of similar switchgear. Also, calculations of temperature rise shall be submitted for approval. In case type test certificate for similar equipment is not available or if type test report is older than 05 years, the same shall be conducted in presence of Owner or his representative if Owner so desires.
- 15.2. 1Routine tests shall be carried out on all associated equipment supplied with switchgear as per relevant standards. Type test certificates of all associated equipment shall be furnished.

4.2 TECHNICAL SPECIFICATIONS FOR LOCAL CONTROL PANEL, LOCAL PUSH BUTTON STATION, MISCELLANEOUS PANEL

1. SCOPE

- 1.1. This specification covers the design, material, construction features, manufacture, inspection and testing at the VENDOR'S / his SUB-VENDOR'S works, delivery to site and performance testing of local control panels, Local push button stations, Miscellaneous Panels/ DBs up to 415V.
- 1.2. 1BIDDER shall include in his scope required no. of 415V AC power supply Local control panels/ Distribution boards/Miscellaneous panels for feeding packaged auxiliary loads like centrifuge, etc. BIDDER shall provide one or two (depending on the criticality of the service) incomers from 415V main switchboard to feed the distribution board/local control panel. All the incoming and outgoing feeders shall be MCCB controlled.

Local panel to be located in dusty environment shall be double door type.

Local control panel along with in-built starter shall be provided for all type of sump pumps in entire plant area.

In entire lignite handling system, unless otherwise specified, all local JB, local panels, local control stations etc. shall be double door type and flame proof only.

2. CODES AND STANDARDS

- 2.1. This design, material, construction, manufacture, inspection, testing and performance of local control panels, miscellaneous panels/ DBs (now on referred to as Control Cabinets) shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment

will be installed. The equipment shall also conform to the latest applicable standards.

3. CONSTRUCTIONAL FEATURES

- 3.1. Control cabinets shall be sheet steel enclosed and shall be dust, weather and vermin proof providing a degree of protection of IP 52 for indoor use and IP 54 for outdoor use. Sheet Steel used shall be cold rolled and at least 2.0mm thick and properly braced to prevent wobbling.
- 3.2. Control cabinets shall be provided with hinged door(s) with padlocking arrangement and suitable brackets/channels shall be provided for the type of mounting specified in Data Sheet A.
- 3.3. All doors, removable covers and plates shall be gasketed all around with neoprene gaskets. All accessible live connections shall be shrouded and it shall be possible to change individual fuses, switches, MCBs without danger of contact with live metal.
- 3.4. All live parts shall be provided with atleast phase to phase and phase to earth clearances in air of 25 mm and 20mm respectively.
- 3.5. Adequate interior cabling space and suitable removable cable glands shall be provided. Necessary number of cable glands shall be supplied and fitted screwed-on type and made of brass.
- 3.6. Two earthing terminals shall be provided to suit the Owner's earthing conductor.
- 3.7. All sheet steel work shall be degreased, pickled, phosphated and then applied two coats of zinc chromate primer and two coats of finishing synthetic enamel paint, both inside and outside, of colour as specified. For chemical/corrosive areas epoxy paint shall be used whenever specified.

For local panel located outside, in spite of IP55 protection, canopy shall be provided to prevent dust accumulation and panel shall have double door arrangement.

The JB used in outdoor dust, lignite, ash prone areas shall be weatherproof type, sheet steel thickness of the JB shall be minimum 2 mm. Sheet steel shall be hot dip galvanised. JB shall be double door type with canopy at the top and IP protection shall be minimum IP55.

4. MAIN BUSBARS

Busbars shall be insulated and of aluminium alloy of E91E grade and shall have adequate cross-section to carry the required continuous currents such that the operating temperature of the busbars does not exceed 85°C.

5. SWITCHES

- 5.1. Switches / MCBs / MPCBs shall be hand operated, air break, heavy duty, quick make, quick break type conforming to applicable standards.
- 5.2. The rating of switch shall be so chosen as to get complete protection by associated O/L relay or fuse under all normal/abnormal conditions such as full load, overload, locked rotor, short circuit etc. MCBs / MPCBs shall be provided with overload/short-circuit protective device.
- 5.3. It shall be the responsibility of the VENDOR to fully coordinate the overload and short circuit tripping of the MCBs / MPCBs with the downstream MCBs/fuses/motor starters, to provide satisfactory discrimination.
- 5.4. Switch handle shall have provision for locking in both fully open and fully closed positions. MCBs / MPCBs shall be provided with locking facility when called for in Data Sheet.

6. CONTACTORS

- 6.1. Contactor type motor starters shall be of the full voltage, direct-on-line, air break, single throw, electro-magnetic type unless otherwise specified. Automatic star-delta type starters shall be provided when specified.
- 6.2. Contactors shall be provided with at least 2 'NO' and 2 'NC' auxiliary contacts.
- 6.3. Contactor shall be provided with a three element, positive acting, ambient temperature compensated time lagged, hand reset type thermal overload relay with adjustable settings to suit the rated motor current.

7. FUSES

- 7.1. Fuses generally shall be of the HRC cartridge link type, mounted on plug-in type of fuse bases having a rupturing capacity of 80 kA. Fuses upto 63A may be of HRC cartridge screw-cap, D-type, having a rupturing capacity of not less than 46 kA at 440V A.C. and 16 kA at 250V D.C.
- 7.2. Fuses shall be provided with visible operation indicators to show that they have operated.
- 7.3. 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 metal.

8. CONTROL AND AUXILIARY POWER SUPPLY

- 8.1. All AC control equipment shall be suitable for operation on 240V AC, 1 phase, 50 Hz system. This supply may be obtained from phase and neutral when 4 wire 415V main supply is available. Otherwise, or when control voltage, other than 240V is specified, a suitable transformer shall

be provided. The control transformer shall be complete with isolation facilities and primary and secondary HRC fuses.

- 8.2. Separate circuits with switches, fuses etc. of adequate rating shall be provided for control of space heater, through thermostat and panel illumination etc.

9. RELAYS

- 9.1. Necessary auxiliary release for alarm, time-delay relays, voltage relays as required for control and protection shall be mounted inside the cabinet. Relays shall be equipped with externally reset, positive action operation indicator. Voltage relays shall have sufficient thermal capacity for continuous energization, using external resistors if necessary.
- 9.2. Auxiliary relays shall be rated to operate satisfactorily between 80% and 110% of the rated voltage.
- 9.3. Each relay shall be provided with at least two potential free contacts (1NO+1NC) for the OWNER's use.
- 9.4. Make and type of relay shall be subject to the OWNER's approval.

10. CONTROL AND SELECTOR SWITCHES

Control and selector switches shall be of the rotary type provided with properly designated escutcheon plates clearly marked to show the operating positions. Control switches shall have momentary contacts, spring return to centre, with pistol grip handle. Selector switches shall have stay put contacts with oval handles. The number of contacts and their operation in each switch shall be as indicated in control schematic (when enclosed) or shall be as per the requirements of the connected circuit. The switches shall be rated for minimum 10A at 250V A.C. and 1A inductive break at 250V D.C.

11. PUSH BUTTONS

All pushbuttons shall be of push to actuate type having 2 'NO' and 2 'NC' self reset contacts. They shall be provided with integral escutcheon plates, engraved with their functions. Pushbuttons contacts shall be rated for 10 Amps at 250V/ 110V A.C. and 1 Amp inductive breaking at 250V D.C.

In entire material handling system areas, local push button station shall be flame proof and weather proof type only.

12. INDICATING LAMPS

Indicating lamps of the Clustered Coloured LED type with coloured Lens engraved "ON", "OFF", "TRIP".

13. SPACE HEATER

Strip type space heaters of adequate capacity shall be provided inside each cabinet. Heaters shall be complete with rotary type 'ON-OFF' switch, HRC fuse on phase or a single-pole MCB with overload and short circuit protection, link on the neutral and a thermostat to cut off the heaters at 45 Degree Celsius and shall have continuously settable range from 30 to 90 degree Celsius.

14. INTERIOR LIGHTING AND RECEPTACLE

- 14.1. Control cabinet shall be provided with a 240V, 1 phase, 50 Hz, 40W preferably fluorescent lighting fixture for interior illumination controlled by a 'ON-OFF' switch / MCBs and 240V, 1 phase, 5/15 Amp., 3 pin receptacle with Plug and Switch/MCB for Switching ON & OFF.
- 14.2. Power source for interior lighting and receptacles shall be completely independent of control power source.

15. CABINET INTERNAL WIRING

- 15.1. Control cabinet shall be supplied completely wired, ready for the OWNER'S external connections at the terminal blocks. All wiring shall be carried out with 1100V grade, PVC insulated, stranded conductors. Power circuits shall be wired with standard aluminium conductors of adequate sizes to suit the rated circuit current; the minimum size shall be 6 sq.mm. Control, alarm and indication circuits shall be wired with stranded copper conductors of sizes not smaller than 1.5 sq.mm. While C.T. circuits shall be colored wired for R Y B phases with stranded copper conductor of size, not smaller than 2.5 sq.mm.
- 15.2. Engraved identification ferrules, marked to correspond with the wiring diagram shall be fitted at both ends of each wire. All wiring shall be adequately rated for the circuit current, the minimum rating shall be 20A.

16. INSULATING MATE FOR ALL PANELS

Latest 3.3 KV Class A Synthetic (Elastomer) Insulating Mat as per IS:15652:2006 amended up to date with BIS certification mark, CPRI / ERDA tested, Thickness 2.0 mm, CLASS A, suitable for voltage up to 3.3 KV, Size:2 Mtr (L) X 1 Mtr (W) X 2 mm Thick insulating mats to be used for all LT equipments.

Insulating mats shall be fixed on floor against each LT panel with suitable synthetic rubber adhesive.

17. LOCAL PUSH BUTTON STATIONS



- 17.1. The local P.B. stations shall be metal enclosed, provided with IP-55 protection, made up of die cast aluminum or 2 mm thick sheet metal. Outdoor PB stations shall be made of FRP of standard make.
- 17.2. The P.B. station shall be suitable for wall or structure mounting, provided with lables, earthing terminals, suitable lugs glands.
- 17.3. Push buttons shall be fitted with 2 NO and 2NC contacts (1A at 250V DC and 10A at 250V/ 110V AC) with stop PB of stay put type and red in colour. Other PBs shall be green in colour.

18. LABELS AND DIAGRAM PLATE

- 18.1. Every equipment mounted in the cabinet shall be provided with individual labels with equipment designation/rating. Also, the cabinet shall be provided on the front & Rear side with a non-rusting label engraved with the designation of the cabinet as furnished by the OWNER.
- 18.2. Inside the door a circuit diagram engraved on non-rusting metal / PVC shall be fixed for reference.

19. DRAWINGS AND DATA

- 19.1 As part of the proposal, the BIDDER shall furnish the following drawings and data for scrutiny.
 - a) Control cabinet general arrangement drawing showing dimensioned views, cable entry location and mounting details.
 - b) Schematic wiring diagram of the control cabinet.
 - c) Bill of material listing equipment designation, make, type, rating etc. of the various equipment mounted on the control cabinet.

20. TESTS & TEST REPORTS

- 20.1. Acceptance and routine tests for all supply equipments/component parts shall be carried out as per the relevant standards for the respective equipment. These test reports and available type test reports shall be submitted to the OWNER before despatch of the equipment.
- 20.2. Control cabinet shall be subjected to following tests:
 - a) High voltage test (2000 volts for 1 minute)
 - b) Megger test
 - c) Electrical control, interlock and sequential operation tests.
- 20.3. Calibration certificates. Instruments used for testing and inspection shall have valid calibration and accuracy traceable to National Standards.

DATA SHEET – A

1.0	GENERAL PARTICULARS	Unit	Specification
1.1	DESIGNATION		MLDB/ACDB/MISC PANEL/DB etc.
1.2	LOCATION		INDOOR / OUTDOOR
1.3	DESIGN AMBIENT TEMPERATURE	⁰ C	50
1.4	TYPE OF MOUNTING		FLOOR
1.5	CABLE ENTRY		
	A) TOP / BOTTOM		BOTTOM
	B) GLANDS / CONDUITS -SIZE		D.D.E
	C) GLANDS IF REQUIRED		YES
1.6	OWNER'S EARTHING CONDUCTOR		
	A) MATERIAL		GS
	B) TYPE		STRIP
	C) SIZE		D.D.E
1.7	PAINTING:		
	A) COLOUR FINISH		
	OUTSIDE		SHADE 631 OF IS 5
	INSIDE		GLOSSY WHITE
	B) EPOXY PAINT REQUIRED	Yes/No	YES, 2 COATS (Min 75 Microns)
1.8	CONTROL SCHEME & BILL OF MATERIAL, ENCLOSED	YES. Ref .No	BIDDER TO FURNISH
2.0	VOLTAGE		
2.1	A) SUPPLY VOLTAGE		415V, 3 PH/ 230V, 1 PHASE
2.2	CONTROL VOLTAGE	V, AC	
2.3	CONTROL TRANSFORMER	REQD. NOT REQD.	
3.0	OTHER PARTICULARS WHEN APPLICABLE		
3.1	STARTERS TYPE	DOL/R EVY / <	DOL WHEREEVER APPLICABLE

3.2	CONTACTOR RATED DUTY (AS PER IS:2459 & 8544)		CONT
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DATASHEET – B

(Data to be furnished by Bidder)

1.0	Manufacturer's name		
2.0	Indoor/Outdoor application		
3.0	Thickness of sheet steel	mm	
4.0	Degree of protection provided (as per IS:2147 or equivalent)		
5.0	Bill of Material for the various equipment giving make, type, ratings etc. enclosed	Yes/No	
6.0	Colour of finish paint		
	a) Outside		
	b) Inside		
7.0	Busbars for power devices (when applicable)		
	a) Material		(PVC Insulated/ Bare)
	b) Continuous current rating	A	
8.0	Control Wiring/Power Wiring		
	a) Material of conductor and size	Cu/Al mm ²	
	b) Conductor – solid/Stranded	-	

4.3 TECHNICAL SPECIFICATIONS FOR EARTHING & LIGHTNING SYSTEM

Earthing and Lightning protection system shall be provided for the entire plant covering all buildings, structures, areas, including External Lignite Handling system if applicable at Plant end External Lignite Handling system at Mines end.

1. EARTHING SYSTEM

The earthing system shall be designed for a life expectancy of at-least Forty (40) years and for maximum system fault current or 40kA for 1.0 Second whichever is higher. The minimum rate of corrosion of steel used for earthing conductor shall be considered as 0.12 mm per year while



determining the conductor size. Earthing system shall consist of earth grids and electrodes buried in soil in the plant area, embedded in concrete inside the buildings to which all the electrical equipment, metallic structures are connected to have earth continuity for safety reasons.

For Transformer yard separate earth grid shall be suitably formed and treated earth pits including raisers shall be provided for transformer neutral. Earthing of Owner's equipment shall be carried out by the Bidder. Separate electronic earthing shall be provided if required.

Earthing system shall consist of earth grids and electrodes buried in soil in the plant area, embedded in concrete inside the buildings to which all the electrical equipment, metallic structures are connected to have earth continuity for safety reasons.

All kinds of treated earth pit shall have top cover painted pre-fabricated MS with proper identification with paint which includes details like earth pit identification no., earthing pit resistance value, date of testing and due date of testing. Such details can be pre-printed on specific identification boards and subsequently on every annual inspection, client has to only replace the PVC identification sticker with new details.

The height of earthing pit shall be identical for entire plant areas.

The earthing system shall conform to IS 3043.

2. DESIGN CRITERIA

- 2.1.** The earthing conductor shall be designed for carry highest fault level of the electrical switchgears except IPBD (minimum 40 kA) for duration of 1 second.
- 2.2.** The ambient temperature and allowable maximum temperature rise for steel welded joints shall be considered as 50 deg. cent and 50 deg. cent. respectively.

The earthing and Lightning protection shall be designed on the basis of following codes and standards:-

- (a) IS –3043-1987- Code of practice for safety earthing.
- (b) IS- 2309- 1989 – Code of practice for protection of building and allied structures against lightning.
- (c) IEE-80-1986 - Guide for safety in Alternating Current Sub Station grounding.
- (d) Indian Electricity rules.

The BIDDER shall undertake the soil resistivity measurements at site and select suitable type of conductors.

2.3. Conductor Material

The earthing system conductors and accessories shall be as follows:

- (a) Conductors above ground level and in trenches : Galvanised steel
 - (b) Conductors buried in ground or embedded in concrete : Mild Steel
 - (c) Electrodes : GS Pipe / Rod
 - (d) Lightning protection air termination : GS Flat
- and down conductors for buildings

2.4. Size of Conductors

(a) Main Earthing Conductors

The earthing conductor sizes shall be calculated as per the following formulae.

$$\frac{I_f}{A} = K \frac{1}{\sqrt{t}}$$

A = Cross-section area in sq. mm

I_f = Maximum a.c. rms ground fault current amperes.

t = Operating times of the protective device to disconnect the faulty circuit, in secs.

K = Factor depending on the earthing conductor, the insulation and other parts, and the initial and final temperature.

The factor “K” is determined by the formula

$$K = \frac{Q_c (B + 20)}{P20} \text{Log}_e \frac{(B + \phi t)}{(B + \phi 1)}$$

P20 = Electrical resistivity of conductor material at 20 deg. C (ohm-m).

Q_c = Volumetric heat capacity of conductor material (J/deg.C/cu.m).

B = Reciprocal of temperature co-efficient of resistivity at 0 deg. C for the conductor.

φ1 = Initial temperature of conductor, (deg.C).

ϕ_t = Final temperature of conductor, (deg. C)

depending on the type of joints.

The calculated size shall be suitably (depending on the resistivity of soil) increased as per table below to account for the loss of material (steel) due to corrosion in soil.

Resistivity of soil Ohm-Meter		Reduction in thickness / diameter, mm
> 0	<10	8.0
>10	<25	7.0
>25	<50	5.5
>50	<75	4.5
>75	<100	3.0
>100		1.5

2.5. Rod Electrodes

Galvanized steel rod electrodes of suitable diameter and length shall be used as per the recommendation of IS-3043. For test pits, electrodes shall be heavy-duty type (Class – C) GI pipes of suitable diameter with perforations. Electrodes installed in the test pits will have disconnecting facilities. The size of GI pipe shall be of minimum 3m length, 40-mm dia and of thickness 1.2 mm. All earthing electrodes (rods and pipes) shall be in RCC chamber with disconnecting links.

2.6. Earthing of Electrical equipment and travelling machines:

Every electrical equipment shall have double earthing.

A ring earthing system shall be provided within the machine to which electrical equipment shall be connected at least at two places.

For mobile equipment with flexible cables, one separate copper conductor of adequate size shall be provided for earthing.

2.7. Equipment Earthing Leads

The size of the earthing leads shall be decided based on the type of equipment and structure to be earthed and shall be provided generally as per IS-3043 and also with a view to minimize the number of sizes and per clause no 6.0 to 9.0. Earthing connection to all equipment shall be through disconnecting type link.

2.8. Conductors for lightning protection system

The size of conductors for lightning protection system shall be decided based on mechanical strength.

3. General

- 1 Metallic frames of all current carrying equipment, supporting structures adjacent to current carrying conductors, structures in contact with switchyard earth, lightning protection system conductors and neutral points of various systems shall be connected to a single earthing system. Two earthing leads shall be used if rated voltage of equipment is above 250V. If the rated voltage is 250V or below, one earth lead shall be provided. Metallic structures adjacent to electrical equipment shall be earthed by one earthing lead. For HT/LT motors, earthing with GI flat shall be extended up to motor then from earthing flat to motor body shall be through sufficient / equivalent size aluminium power cable by bolting arrangement in order to have ease in motor maintenance.

Earthing conductors in outdoor areas shall be installed at a minimum depth of 600 mm.

All cable trays in the plant buildings as well as inside the trenches shall be connected to earth grid at an interval of about 10 m.

3.1. Earthing Conductor Layout for Transformer

- 1 Main earthing conductors shall be laid in the form of a grid. Spacing between conductors, number of parallel conductors, etc., shall be decided such that step and touch potential are within safe limits.
- 2 The maximum permissible step and touch potentials shall be calculated in accordance with the formula, given in IEEE-80. The aging effect of conductor shall also be taken into consideration while arriving at the maximum permissible step and touch potentials.
- 3 Earthing conductors shall be provided around the outside edge of fence at a distance of approximately 1000-mm. This shall be connected to the switchyard-earthing grid.
- 4 Each earth leads of all transformer neutral shall be directly connected to separate treated pit pipe electrodes with disconnection link in RCC chamber which in turn will be connected to station grid. Earth leads of all Lightning arrestor shall be directly connected to two separate treated pit pipe electrodes with disconnection link in RCC chamber. The earth grids of different areas of the plant shall be interconnected through, test pits to enable measurement of earth resistance for each area separately.

3.2. Earthing Conductors Inside Building

- 1 Main earthing conductors shall be buried in earth around the building. Minimum two taps-off from this earthing loop shall be taken inside the



building and connected to the earthing grid embedded in the floor slab with approximately 50 mm concrete cover.

- 2 In case, the building has more than one floor, each floor shall be provided with earth grid as discussed earlier. Floor earthing grids shall be interconnected.
- 3 Each RCC / Steel column of the building shall be interconnected to the floor earthing grid in the ground floor.
- 4 Cable trays, steel pipes / conduits, steel columns, etc., shall not be used as earth continuity conductors.
- 5 Instrumentation system and computer system shall be provided with a dedicated earthing system suitable for the equipment.
- 6 Earthing grids of all the buildings, outdoor yards shall be interconnected to form a single grid for the plant.
- 7 Earthing grid design shall be done in such a manner that the grid resistance is less than 1 ohm.

4. EARTHING SYSTEM INSTALLATION

- 1 The spacing between two electrodes shall be atleast equivalent to twice the length of the electrode.
- 2 Earthing conductor running exposed on column, walls, etc., shall be supported by suitable cleating, at intervals of 750 mm.
- 3 The earthing conductor crossing the road / track shall be laid in hume pipe or laid at a greater depth to avoid damage.
- 4 When earth conductor passes through floors, walls, etc., suitable pipe sleeves shall be provided and the same shall be sealed after installation.
- 5 The connection between earthing pads / terminal to the earth grid shall be made short and direct and shall be free from kinks & splices.
- 6 Metallic conduits and pipes shall not be used as earth continuity conductor. Metallic structures adjacent to electrical equipment shall be earthed by one earthing lead
- 7 Street lightning poles, flood light poles & towers, their junction boxes shall be connected to the earthing conductor to be run along with supply cable. This earth conductor shall be in turn connected to earth grid at two extreme points.
- 8 Flexible earth conductors shall be provided at expansion joints for earthing the gates, operating handles, etc..
- 9 Equipment bolted connection/All exposed parts after being checked and tested shall be painted with anti-corrosive paint / compound.
- 10 Connection between the equipment earth lead and the grid conductor shall be necessarily welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.



- 11 The cable sheaths, screens armour shall be earthed at both ends for multi-core cables. For single core cables the same shall be done at one end (switchgear end) only.
- 12 All bimetallic connections shall be treated with suitable compound to prevent moisture ingress. Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity, crane rails, tracks, metal pipes and conduits shall also be effectively earthed at two points. Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post.
- 13 In areas where chemicals are used, the earthing strip shall be provided along the cable trays (above ground) to avoid damage.
- 14 The connection between earthing pads / terminal to the earth grid shall be made short and direct and shall be free from kinks & splices
5. All utility and process pipe lines shall be earthed on entering or leaving the hazardous area. In addition steel pipes racks shall be earthed at every 25 meters. Earth continuity shall be ensured across all flanges.

After installation of entire earthing system for entire plant area, the following tests are to be conducted area-wise for ensuring healthy earthing system.

- Riser integrity test
- Touch and step potential test
- Grid integrity test
- Gravel resistance measurement
- Tag slope test
- Transient ground potential rise
- Vertical loop impedance testing

6. LIGHTNING PROTECTION SYSTEM

Lightning protection system shall consist of vertical air termination rods, horizontal roof conductors, downcomers, and pipe electrodes.

6.1. Need for Protection

The need for providing the lightning protection system shall be established by calculating risk index value for each building structure, etc., as per procedure given in IS-2309 AND IS/IEC 62305 and any building whose risk index is more than 40 shall be provided with lightning protection.

6.2. Lightning Protection System Layout

- 1 The lightning systems design and installation shall generally comply with IS:2309 and IS/IEC 62305 code of practice for the protection of building and allied structure against lightning.
- 2 Each down conductor shall be connected to a rod electrode which in turn shall be connected to the station earthing system through test links.

6.3. Lightning Protection System Installation

- 1 Conductors of lightning protection system shall not be connected with conductors of safety earthing system above ground level.
- 2 The down conductors shall be welded to steel structures at 1000 mm interval or cleated to wall at 750 mm interval. Wherever welded, the weld locations shall be treated to provide rust protection.
- 3 Each down conductor shall be provided with a test link at a height of about 1000 mm above ground level. The lightning event counter shall be installed at less than 2.0 meters height from ground level. Down conductor preferably installed at the corner of the building should be supplied with a 4 digit electro-mechanical lightning event counter housed in weather proof IP 65 enclosure. It shall be sensitive enabling the detection of minimum current of 250A (8/20 micro-second) and a max current of 100kA (10/350 micro second). It shall have a range of 0 to 9999, suitable for cable cross section up to 1000 Sq.mm and cable of withstanding a temperature range of minus 40 deg. Cent to plus 60 deg. Cent. Performances of the lightning event counter shall not be affected by extreme climatic conditions (operating temperature range minus 40 deg. Cent. To plus 70 deg. Cent)
- 4 All the metallic structures within a vicinity of 2000 mm shall be connected to the lightning protection conductors.
- 5 Lightning protection system shall comprise vertical air terminations, horizontal air terminations, down conductors, test links and earth electrodes. For tall buildings and structures, early streamer emission (ESE) type air terminal systems are preferred.
- 6 Lightning protection conductors / air termination rods and circumferential bands provided at the top portion of chimney stack shall be lead coated.
- 7 Horizontal air termination flats provided on top of boilers, main plant building , pump houses and other buildings shall be laid such that no part of the roof shall be more than 9 meters.
- 8 Down conductors shall be cleated on outer side of building wall at 1000 mm interval or tack welded to outside of building columns at 1000 mm interval.
- 9 Down conductors shall be connected to separate earth electrodes through test points located at height of above 1000 mm above ground level. These earth electrodes shall in turn be connected to earth mat at two points.

- 10 Lightning protection conductors shall not pass through or run inside GI conduits.
- 11 Lightning protection shall have as few joint as possible and avoid sharp bends.
- 12 For off site buildings, which do not come under zone of protection, Lightning protection system, with horizontal/ vertical air termination and adequate nos. of down comers and earth electrodes shall be provided as per IS 2309- 1989 / IEC 62305.
- 13 Lightning protection down conductor shall be directly connected to a separate earth electrode.

6.4. Minimum size and material of main earthing conductors:-

Systems	RECOMMENDED SIZE	
	Buried in earth	Above ground or Embedded in concrete
MAIN EARTHING CONDUCTOR		
a. 415V system	40mm dia	75x10 mm flat
EARTH ELECTRODES		
a.Rod Electrodes	3000mm long galvanised steel	
b.Pipe Electrode	40mm dia, 3000mm long galvanized steel class C pipe.	
MATERIAL		
a. Above ground	Galvanised Steel- Galvanizing as per IS 2629- 1985	
b. Below ground & Embedded in concrete.	Mild Steel.	

7. TESTING



- 7.1.** Testing shall be conducted as per the relevant IS/IEC Standards. Individual chemical treated earth pit resistance measurement shall be taken at site and for total earthing grid also.

4.4 TECHNICAL SPECIFICATIONS FOR LIGHTING

1. Lighting system shall be provided for the entire plant covering all the buildings, lighting as per aviation guidelines, structures, outdoor areas, roads for entire plant area, yards, perimeter (boundary wall inside / outside), conveyor galleries, junction towers, stacker reclaimer, security watch towers, security cabins, parking area, inside / outside shed area, conveyor area and corridors to these areas, external lignite handling system, LHS system Ramp area, highmast lighting tower (Min 4 no's), LHS system Feeder breaker area highmast lighting tower (Min 4 no's) etc.

In lighting system of any area, if LP is 3-phase then there shall be ELCB / RCCB in each phase at incoming side and MCB's for all outgoing circuits. If LP is of 1-phase then there shall be ELCB / RCCB at incoming side and MCB's shall be at each outgoing circuits.

Lighting for indoor shall be direct controlled and shall be through photocell timer for outdoor areas (photocell outdoor duty timer with photocell sensor, powder coated IP 65 protected box for outdoor applications. With time delay, Input - 230 VAC +/-15%, Potential free contact for switching ON & OFF light, along with 'NO' contact).

2. CATEGORIES OF LIGHTING

- 2.1. The plant lighting system shall comprise the following categories:

(a) Normal 240V AC Lighting System

1. Normal 240V AC Lighting System

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

2. The area wise distribution of lighting fixtures connected to the three systems covered: The Lighting towers shall be provided for unused open space.

Area wise Distribution of Lighting System in and out of the Plant

Area / building
All Switchgear rooms, cable spreader rooms, etc.
Flood lights for area lighting
All Operator rooms, Wash rooms, Rest area etc.
Aux area bldgs - weigh bridges, Lignite Handling system, road lighting for the entire plant area plus from ELHS plant end to mines end roads, ventilation system, plant boundary wall, security cabins, weigh bridge area, main plant all entry gates plus respective security cabins etc.
All roads including out of boundary roads leading to Plant area
Service and administration building if applicable

3. LIGHTING SUPPLY DISTRIBUTION SYSTEM

3.1. Normal AC System

Separate lighting transformer s/s shall be provided to the main lighting and sub-lighting distribution boards located at required location. Lighting distribution system shall be distinct and separate from the LT main distribution. Separate lighting transformers shall be used to supply lighting load.

- For these systems, the distribution shall be by 415V, 3 phase 4 wire, 50 Hz supply with effectively earthed neutral. This supply shall be derived from 415V, 3 phase 3 wire, 50 Hz received from lighting supply changeover switch panel. Switchgear located lighting through delta/star lighting transformer. The secondary of lighting transformer will be connected to respective 415V, 3 phase 4 wire AC lighting distribution board (LDB). The LDBs will be provided with number of outgoing circuits controlled by RCCB, MCBs to feed the lighting panels distributed in and around the plant as well as to directly feed three phase street lighting and yard lighting supplies.

The lighting panels shall be individual phase wise and not complete three phase. Timers shall be provided in lighting panel for lighting of strategic locations.

The lighting transformer shall have ratio of 3 phase 3 wire 433 V / 433 V 3 phase 4 wire with tap of +/- 10% (in steps of 2.5%) on primary side. All the lighting transformers shall have at least 15% extra capacity after considering all connected lighting & receptacle loads. All the lighting transformers in non dusty area like main swgr rooms etc. shall be dry type and in dusty area like LHS conveyors etc. these shall be Resin cast transformers.

2. AC lighting panels shall have single phase 2 wire incomer controlled by earth leakage circuit breaker (ELCB) / RCCB and number of single phase outgoing circuits controlled by MCBs. Lighting fixtures in indoor areas shall be controlled from the respective lighting panels. Aviation warning lights also shall be contactor controlled for remote operation. The control of all such lighting shall be done automatically through timer units. Manual switching 'ON and OFF' facility shall also be provided through auto/off/manual selector switch.

All lighting shall be segregated in three categories as follows.

Sr. No.	Description	Control	Remarks
1	Lighting required for 24 hours	Manual control from LP	All the lighting fixtures shall be segregated and grouped in three these categories in each area and feeding arrangement shall be done accordingly. Categories of lighting for this purpose shall be decided during detailed engineering in each area.
2	Lighting required during night hour only	Automatic control through timer and contactor. (with auto / off/manual selection facilities)	
3	Lighting required occasionally in unmanned area etc.	Manual control through switches mounted near entrance of the building.	

3. LPs to be used to supply 230V 1 phase 3 wire receptacles in an area. However, 415V, 3 phase 4 wire receptacles shall be fed from welding DBs/ACDBs. Further please note that supply for single phase receptacles shall not be fed from lighting LP. Lighting LP shall be separate and used only for lighting distribution. For single phase receptacles, separate LP is to be used for distribution across entire area.



Further, supply to that lighting distribution board shall be through cable from LP only, Lighting distribution shall be done through cables up to junction box instead of conduits/wires for the complete Area.

Power / welding receptacle (3 Phase 4 Wire) in switchgear room, transformer yard, conveying system, Material handling areas shall be provided.

Further, WDB (Welding Distribution Board) (3 phase 4 wire) shall be provided at switchgear room for feeding welding power supply requirement for entire area. One changeover switch shall be provided in each WDB with two incoming power supply. The WDB incoming feeding capacity, number of outgoing circuits and number of WDB shall be decided during detail engineering. However, minimum no. of WDB's in area shall be 01 nos. with each having outgoing 16 nos. 63A output, minimum 12 nos. 16A 1-ph outputs.

All Three phase & Single-phase receptacle shall be flame proof /weather proof for Lignite Handling system / Fire prone area of BALS make only.

4. Lighting system should be such that:

- (a) All lighting fixtures are segregated and equally distributed on all three phases. This above ground lighting circuit should have auto switching through a lighting pre-set timer.
- (b) Periphery lighting shall be with timers for auto switching.
- (c) Lighting fixtures should be located at reasonable height to facilitate maintenance.
- (d) Illumination of access road to above ground hopper at lignite transfer point shall be provided.
- (e) Adequate size and type of lighting fixtures shall be provided at all locations.
- (f) For proper unloading of dumpers at unloading hoppers, suitable signal lighting of LED type with separate for ON / OFF with remote Push button and through remote (PLC) shall be provided.
- (g) For tunnel areas, 20% lighting shall be waterproof, fed from separate circuits.

- 5. The design, manufacture, testing, erection of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. Nothing in this specification shall be construed to relieve the BIDDER of these responsibilities.

6. ILLUMINATION LEVELS AND CHOICE OF LIGHTING FIXTURES

All energy efficient LED fixtures shall be provided. In walkways, corridors lounge the energy efficient LED lamp fixtures shall be used. All lighting fixture shall degree of protection IP54 minimum. Flameproof lighting fixture shall be provided in hazardous area. The area-wise distribution of average illumination levels and type of luminaries shall be as indicated below:

Sl. No.	Area/ Structure	Avg. illum. Level in Lux.	Type of Fixture	Type of Luminaries (LED Fixtures)
1.	GENERAL			
1.1.	General (auxiliary equipment areas)	150-200	Industrial well glass vitreous enamel reflector / Industrial bulk head with LED lamps	1 x 40 W / 1 x 80 W
1.2.	Cable vault	100	Industrial well glass with LED Lamp	1 x 40 W
1.3.	All switchgear room area (including off-site building control room)	200-250	Industrial type with vitreous enamel reflector	2x 20 W
1.4.	Building ground, mezzanine Floor, and misc. Floors	150-200	Industrial well glass	1 x 40W
2.	VARIOUS OFF-SITE BUILDING			
2.1.	Equipment room	150-200	Industrial medium bay for mounting heights above 6 M	80 W
2.2.	Switchgear room	200-250	Industrial type with vitreous enamel reflector up to mounting height of 6 M	2 x 20W
2.3.	Outside working areas	70	Flood light medium beam	100W



3.	LIGNITE HANDLING PLANT			
3.1.	Open lignite stock pile and lignite runoff pond	15 – 25	Flood light (tower mounted)	1 x 250W
3.2.	Coal unloading, track hopper stacker reclaimers	25-50	Flood light (Tower mounted flood light shall be provided for illumination for Ramp with suitable lux level)	1 x 250W
3.3.	Lignite stock pile Shed area	50 - 20	Industrial high bay with anodised aluminium reflector	1 x 200 W
This is only indicative. Details will be decided/worked out during detailed engineering and subject to Owner's approval.				
4.	ROAD & YARD LIGHTING			
4.1.	Roads	20	Street light	1 x 90W
4.2.	Perimeter (compound) lighting	10 – 20	- do -	1X150W Boundary
4.3.	Yard lighting	15 – 20	General purpose Flood light	200W
4.4.	Parking area	50	Industrial type with vitreous enamel reflectors channel mounted type	1 x 40W Light fixture
5.	GENERAL			
5.1.	Corridors, walkways, staircase, etc.	100	Industrial type with vitreous enamel reflectors channel mounted box type	1X20
5.2.	Lockers, toilets, wash rooms, rest room etc.	80	Channel mounted box type The details are indicative only. Details will be decided/worked out during detailed engineering and subject to Owner's approval	1 x 20 W



5.3.	Building periphery lighting	-	Industrial well glass with	1 x 40 W
5.4.	Watch towers		-do-	200W LED fitting
5.5.	Boundary wall		-do-	200W LED fitting
5.6.	Various lighting high mast for the areas like lignite stock yard area, outplant lignite stock-yard area etc. to be provided			

In entire Lignite handling system, single phase and 3-phase receptacles shall be flameproof, weatherproof type only.

At every watch tower installed along periphery of plant, should have minimum 02 nos. single phase power socket, lighting inside cabin and outside cabin etc.

security system related power supply points, computer points etc. shall be provided and requirement shall be furnished by Owner/Owner's Engineer / Consultant during detail engineering.

In every weigh bridge, power supply for computers, power supply for weigh bridge electronic system, air conditioning power supply, sufficient number of single phase sockets etc. shall be provided as per Owner requirement.

In all plant area lighting fixtures shall be provided near to all major equipments for proper illumination for monitoring and maintenance of equipments.

BIDDER may change the type of fixture to be used in different area against indicated above with approval from Owner/Engineer, provided minimum illumination level as indicated above is maintained. Lighting shall appear aesthetically good. Lighting shall be provided for all areas in the plant and not limited only to the areas indicated above.

BIDDER shall measure the lux levels in the above areas (measured at the working plane) using suitable devices/meters as per relevant standards to prove the specified values.

Electrification of entire plant buildings as well as non-plant area buildings including below mentioned areas shall be in the scope of Bidder. Electrification includes providing LED lighting for indoor and outdoor area both, ceiling fans, wall mounted fans, pedestal fans, split air conditioner (quantity during DDE), sufficient capacity water cooler (quantity during DDE) etc. Entire electrification shall be carried out through concealed wiring for building / office areas.

Entire balance of plant area buildings (as per Civil layout) lignite handling system, weigh bridges, entire conveyor Gallery including junction towers, entire plant road lighting, entire plant boundary area inside and outside lighting, entire plant area high mast area lighting at strategic locations decided during DDE, sanitation facility area, security gates, watch towers, etc.

- a. Security gate complex including office area
- b. Various parking area
- c. Any building which is not mentioned in above list but becomes part of plant area

7. LIGHTING SYSTEM DESIGN

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

7.2. INDOOR LIGHTING

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

1. Maintenance Factor:

- | | | |
|---|---|------|
| (a) Air-conditioned clean interiors like office rooms | : | 0.8 |
| (b) Clean interiors such as Office rooms | : | 0.75 |
| (c) Industrial areas with normal interiors such as workshops, stores. | : | 0.7 |



- | | | |
|--|---|-----|
| (d) Industrial areas with dusty interiors. | : | 0.6 |
| (e) Industrial areas with very dusty interiors such as coal handling area, crusher house and junction towers | : | 0.5 |

2. Reflection factor for wall/ceiling

- | | | |
|----------------------------------|---|-----|
| (a) White and Very light colours | : | 0.7 |
| (b) Light colours | : | 0.5 |
| (c) Middle tints | : | 0.3 |
| (d) Dark colours | : | 0.1 |

3. Utilisation factor considering the room index at applicable surface Reflection factors. The working plane shall be considered at 0.85 m from the Floor level.

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

7.3. OUTDOORS LIGHTING

1. The recommended illumination levels for outdoor areas are indicated in the above table.
2. Mounting height, spacing of Floodlights shall be based on lamp wattage, uniformity of illumination and vertical angles. Ratio of minimum to average illumination shall not be less than 0.3 and for minimum to maximum shall not be less than 0.5.
3. Maintenance factor shall be generally 0.6 under average conditions.
 - a. Lighting for lignite stockpile - tower lighting shall be provided and minimum 04 nos. of towers are to be provided for lignite stock pile, ramp and weigh bridge area. Its total electrical load shall also be provided in LT MCC with isolation transformer. Further, light fittings can be taken at ground level from top through motorised arrangement for maintenance purpose.

Lighting fitting in shed shall be of telescopic type for carrying out easy maintenance.

7.4. ROAD LIGHTING



1. Road lighting provided shall consider the general visibility on the roads and reasonable uniformity in illumination levels.
2. Lighting design for roads shall consider a maintenance factor of 0.6 for average conditions.
3. Ratio of minimum to average illumination shall not be less than 0.3. The road lighting layout shall consider the width of the road to decide whether the lighting poles shall be located on one side, on either side.
4. Mounting height of the luminaries shall be generally 9 m.
5. For the yard lighting, suitable poles, towers distributed suitably shall be provided. The FTlood light towers shall be made of standard galvanised structural steel members, suitable ladder for accessing and platform at the lighting fitting levels shall be provided for maintenance.
6. Streetlights shall be provided with MCBs in the junction boxes.
7. Streetlight JBs shall be IP55 and installed at 1.5 ft above pedestal top. Minimum size for 2 way street light JB s shall be 275 x 250 mm JB s shall be provided 1.5 m above grade level.

8. SWITCHES, RECEPTACLES, CEILING FANS & AIR CONDITIONERS

- 8.1. In the plant areas, the lighting circuits shall be controlled directly from the MCBs / RRCBs in the lighting panels. Wherever the lighting panel is not in the same area, separate switches shall be provided. For cabins, rooms etc., separate switches shall be provided for each point. Similarly, for entrances, building periphery lighting separate switches shall be provided. Industrial toggle / decorative switches shall be provided as per the requirement of area of utilisation.
- 8.2. 240V, 50 Hz, 3/5 pin Power Receptacles (5A & 15A) shall be provided in all building/areas of the plant. Inside a building, receptacles shall be provided at regular intervals so that any point of the building is not more than 10 m from the switch. Inside each of the operator cabins/ office areas at least 5 (five) receptacles shall be provided and the same shall be indoor/outdoor/Flameproof as per the location. Single phase receptacle shall be flame proof, weather proof for Lignite Handling system, Oil/Fire prone area, transformer yard area.
- 8.3. In all office areas/ operator cabins / rest rooms / wash room etc. sufficient numbers of double ball bearing 1200 mm sweep bottom make-up ceiling fans, LED tube lights, Points for computer accessories / IT networks shall be provided. Required numbers shall be decided during detail engineering.
- 8.4. Air conditioner type (Split / Window) shall be decided during detail engineering. Outdoor unit (in case of split AC) / outer part (window AC) shall be covered with suitable size canopy confirming proper heat transfer.

9. LIGHTING DISTRIBUTION BOARDS (LDB) & LIGHTING PANELS (LP)

- 9.1. Each of the LDBs shall be provided with output voltmeter and ammeter along with selector switches, 'Supply ON' indicating lamps, etc. The LDBs and LPs shall be sheet steel enclosed and shall be fully dust and vermin proof, with a degree of protection of IP 52. Outdoor panels shall be double door, weatherproof types with IP-55 degree of protection & canopy. The switch boxes receptacle boxes etc. shall be made up of 18 SWG sheet steel.
- 9.2. The distribution of lighting fixtures shall be such that the loading on each phases of the LDB is approximately equal.
- 9.3. Bottom cable entry shall be provided in all LDB, LPs, JB, Switches, and Fixtures.

10. WIRING

- 10.1. 1100/650V grade stranded copper conductor, PVC insulated, colour coded, wires laid in GI conduits of size 25 mm and 20 mm shall be used for lighting in non hazardous area. In the hazardous area viz., hydrogen generation plant and outdoor areas like transformer yard, switchyard, boiler and road lighting, cable wiring shall be adopted. The specification of cable shall conform to the details indicated in Section 15.14. Wiring shall be through lighting cables instead of GI conduits for entire plant area.
- 10.2. Minimum size of wires in case of conduit wiring shall be 2.5 sq. mm in case of lighting and 4 sq. mm in case of receptacle wiring. Minimum cable size in case of cable wiring shall be 4-sq. mm Copper. In case of outdoor receptacle wiring, the minimum cable size shall be 6 sq., mm Copper.
- 10.3. Wires of lighting and power receptacles will be carried out in separate circuits. Wires of AC and DC lighting systems shall be carried out in separate circuit.
- 10.4. For outdoor lighting, the cable shall be buried at a minimum depth of 750 mm from ground level or run in cable trays. The buried cables shall have suitable bedding, protective covers & markers.
- 10.5. Material used for saddles, clamps, JB, etc., shall be galvanised.
- 10.6. Loop in / Loop out from fixture is not acceptable.
- 10.7. Buildings shall have concealed wiring with minimum 2.5 sqmm cable using PVC conduits.

11. LIGHTING CIRCUIT DESIGN

- 11.1. In an area, the lighting fixtures shall be arranged in different phase / LPs such that even in case one lighting panel is faulty complete lighting is not affected. In case of any location the lighting shall be arranged from all three phases. The lighting panel shall be provided at every alternate Floor of the building / structures and shall be easily accessible from the stairs.



- 11.2. The circuit loading on each circuit shall be restricted to 70% of the MCB rating. Additional 2 MCB s / circuits shall be provided in each LP s as spare.
- 11.3. The voltage drop from LDB and any fixture shall not exceed 3%.

12. TESTS

Acceptance tests & routine tests for the lighting fixtures and accessories covered in this specification shall be carried out as per the relevant standards.

4.5 TECHNICAL SPECIFICATIONS FOR CABLES

1. CABLES

1.1. LT POWER CABLES

For Material Handling plant/fire prone area following cable shall be provided.

"LV Power Cable shall be 1100 V grade, single / multi core, armoured, stranded aluminium conductor, XLPE insulated, with extruded inner sheath FRLS PVC type ST-2, galvanised single round steel wire/strip armoured and extruded outer sheath made of FRLS PVC compound, overall PVC ST-2 FRLS, generally conforming to IS 7098 Part-I. The cables used for DC system shall be of single core type. All other details shall be same as that of HT XLPE cables. Minimum conductor cross section of power cables shall be 4/6-sq. mm."

1.3 CONTROL CABLES

For Material Handling plant/fire prone area following cable shall be provided.

"Control cables shall be 1100V grade, multi core, minimum 2.5 sq. mm cross section, stranded copper conductor having minimum 7 strands, PVC type-C insulated, extruded FRLS PVC type ST-2 inner sheathed / galvanised steel wire armoured, overall extruded PVC type ST-2 FRLS outer sheathed generally conforming to IS 1554 Part-I. In situations where accuracy of measurement or voltage drop in control circuit warrants, higher cross sections as required shall be used."

1.2. LIGHTING WIRES



For entire lighting system, 1100V grade, 2-core armoured cables shall be used instead of conduit and lighting wires. Minimum cross section of copper wires shall be 2.5 sq. mm for lighting circuits and 4-6 sq. mm for receptacle circuits.

Signal / communication cables are to be laid in separate conduits in order to avoid any interference and damage to cable in entire plant area.

1.5 TRAILING POWER AND CONTROL CABLES FOR MOBILE EQUIPMENT.

Flexible cable shall be used for equipment with vibration, movement or portability.

Conductor material / Armouring / Insulation / Inner-Outer sheath for HT/LT Power, Control cables used in Mining area if applicable shall be as per DGMS guidelines and specifications.

2. CABLE PROPERTIES

- 2.1.** All single core power cables will have wire / strip armouring of aluminium, whereas multi core power cable will have galvanised steel wire / strip armouring.
- 2.2.** The outer sheath of all cables shall be of extruded layer of suitable synthetic material compatible with specified ambient and operating temperature of the cables. The sheath shall be resistant to water, UV radiation, fungus, termite and rodent attack.
- 2.3.** The outer sheath of FRLS PVC compound shall meet the following performance requirements:
 - (a) The critical oxygen index value shall be minimum 29 when tested at $27 \pm 2^{\circ}\text{C}$ as per ASTM-D-2763-77 and the temperature index shall be minimum 250°C at oxygen index value of 21 when tested as per NES-715.
 - (b) The maximum acid gas generation as determined by titration method shall be less than 20% by weight when tested as per IEC-754-1 (1994).
 - (c) The smoke generation under fire shall have maximum smoke density rating of 60% when tested as per ASTM-D-2743-7 (1977).
 - (d) The cables will pass the hydraulic stability and ultraviolet tests as per DIN 53377.
- 2.4.** The finished cable shall pass the flammability test as per IEC-322-1 (1993) and IEEE-3733. In addition, it shall also pass flammability test as per Class F3 of Swedish Standard SS-424-1475 (1977).
- 2.5.** Cables for devices mounted on or near hot surfaces of Steam Generators, Turbine Generators, Main steam etc will have heat resistance type outer sheath.



For lignite air lock feeder motor, insulation class shall be H, motor cooling fan shall be AL and motor incoming cable shall be through local JB and cable shall be suitable for its use in high temperature application like PTFE cable or heat resistance type Copper power cable. Likewise for all hot zone area drives, this is applicable.

All the LT power cable, Control cable, instrumentation cable etc. shall be having different colors of outer insulation so that can easily be identified. The color of the outer insulation to be decided during the detailed engineering.

3. DESIGN CRITERIA FOR CABLE SIZING

3.1. POWER CABLES

Power cable sizes shall be selected on the following basis & shall be as per final sizing calculations.

1. Power cables shall carry the full load current of the circuit continuously under site conditions considering the condition listed below :-
 - Ambient designs temperature 50 deg. C.
 - Maximum allowable temperature under normal full load condition and under short circuit condition based on material selected (XLPE).
 - Maximum short circuit fault current as specified in relevant section.
 - Ambient temperature for underground cables, 40 deg. C.
 - De-rating factors:(a). Cable laid in air - 0.7 (b) Cable laid in ground touching each other – 0.6.
2. Power cables shall withstand the fault current of the circuit for the duration not less than the maximum time taken by the primary protective system to isolate the fault. Fault clearing times for 6600V motor feeders and transformer feeders having high-set instantaneous protection shall be 0.16 sec., whereas tie between two 415V switchgear and any two 6600V switchgear shall be 0.5 sec, and for incomers and tie feeders 1.0 sec.
3. For the cables to 415V motors and feeders protected by fuses, the cross section shall be chosen according to the cut-off current of the fuse and its fusing time.
4. Voltage drop in feeder cables shall be limited to 3% during full load running condition. Voltage drop from transformer secondary to motor terminals during full load running of motors will be limited to 5 % of rated voltage.
5. For power supply to valve actuator motors and exhaust fans, 3 core 2.5 sq. mm stranded copper conductor cable may be used in view of ease of termination. These cables shall be in other respects similar to cables described in Clause 1.2 above.
6. Design Calculation for arriving at cable size shall be submitted for Owners approval.



3.2. CONTROL CABLES

1. Current transformers leads shall be checked for the lead burden vis-a-vis the current transformer VA capacity. Minimum 2.5sqmm cables for within panels, while 4.0sqmm between independent panels/equipment shall be used for connection of CTs and PTs to the load. In case 2.5/4.0 sq. mm conductor impose unacceptably high burden on CTs/PTs higher conductor shall be used. The conductor material shall be copper.
2. Voltage transformer leads shall be checked for voltage drop which shall be limited to within 0.2/0.5/1% as specified elsewhere. For tariff metering the voltage drop shall be limited to 0.2%. In case the voltage drop with 2.5/4.0 sq. mm conductors exceed this value, higher conductor sizes shall be used.
3. The multi-core cables shall have 2 to 4 nos. cores on spare. The grouping of cables for critical application shall be avoided.
4. For the control cables suitable size printed cross ferruling to be provided. No cable shall be laid without cable tags at specified distance and cable dressing.

4. CABLE TERMINATIONS

- 4.1. All 1100V termination for XLPE/PVC power cables and control cables shall be by Double compression weather proof type cable glands and heavy duty, tinned, long barrel copper lugs shall be used for termination.
- 4.2. Cable shall be terminated using double compression type cable glands. Cable glands shall conform to BS:6121 and be of robust construction capable of clamping cable and cable armour firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating.

Cable lugs for power cables shall be aluminium solderless crimping type conforming to IS:8309 suitable for aluminium conductor cables and for control cables shall be tinned copper type.

- 4.3. Cables shall be laid in trays /trenches/ conduits by the bidder. Also joint markers shall be provided at each joint.

5. CABLE JOINTS

Cable joints shall be avoided to the extent possible. If joints are unavoidable due to circuit length, in excess of permissible maximum drum length, they shall be heat shrinkable types having a short circuit with stand capacity value as specified in clause 3.1.2 above. Lugs shall be heavy duty, tinned copper, long barrel. All cable glands shall be double compression, weather proof. For fire prone areas, flame proof cable gland shall be used.



6. CABLE CARRIER SYSTEM

- 6.1.** The cable carrier system shall be designed considering the following :
- (a) Facility for easy laying of cables.
 - (b) Access to maintenance.
 - (c) Neat and aesthetic appearance.
 - (d) Safety of equipment & personnel.
 - (e) Ground water seepage.
 - (f) Drainage system for oil and water.
- 6.2.** Cables shall be laid in prefabricated ladder / perforated type trays and in conduits. Also, joint markers shall be provided at each joint. The cable trays shall be laid vertical only Lignite area.
- 6.3.** Underground Cable trenches shall be considered in required area.
- 6.4.** Direct underground burial cables shall be laid for lighting tower, street lighting, high mast lighting towers. For some exceptional case like isolated individual equipments it shall be allowed after Owner's approval.

7. CABLE INSTALLATION AND ACCESSORIES

- 7.1.** All material and accessories required for cable installation like cable trays, tray covers, support steel, etc., shall be hot dip galvanized and conduits/pipes shall also be hot dip galvanized. The racks/trays, conduits/pipes, trenches required to route the cables to individual equipment shall be supplied and installed by the BIDDER.

Separate trays shall be provided for LV Power Control & Instrumentation cables.

After laying all the cables, BIDDER shall dress all cables by clamping at every metre, so that the cables are securely held and aesthetically good.

1100 V cables up to 120-sq. mm. can be laid in two layers. Control and Instrumentation cables can be laid in three layers.

Cable trenches shall be considered wherever require subject to Owner's approval.

Cable shall not be laid inside lignite conveyor gallery, shall be outside conveyor gallery with suitable maintenance and approach platforms.



Wherever any cable has to cross conveyor, the crossing should take place above the conveyor either above the cross over ladder or by providing separate platform.

For LT power cables having termination size more than 120 sq.mm, termination to motor shall be through JB. Higher size cable shall be terminated between MCC feeder and local JB. Suitable size copper cable to be used between local JB and respective LT motor.

All the cable trays shall have painted identification tag at an interval of 5 meter. Separate perforated cable trays of suitable size along with supports to be provided for lighting cables, only one layer of cables per tray shall be allowable. Cable rack shall be prefabricated and of Galvanised steel.

7.2. Cable Carrier Installation practice

Minimum level difference between two tiers of horizontal cable trays in building, shall be 275 mm. In vertical raceways with multi tiers the tiers shall be located atleast with 400 mm intervals.

The width of the cable tray shall be minimum 150mm and limited to 600 mm.

Separate cable trays/tiers shall be provided for different voltage grade cable viz., 415V/240V power, control cables and instrumentation cables. Cable laying in tray shall be in double layer only.

Cable trays shall be supported at every 1000 mm interval.

Cable trays shall be welded to the mounting/carrier structures.

All outdoor cable trays shall be erected in vertical plane. Vertical trays (raceways) and all outdoor cable trays shall be provided with removable 16 gauge galvanised MS sheet covers.

Each continuous laid out length of cable tray shall be earthed at minimum two places by MS flats of minimum size 25mm x 3mm, the distance between earthing points shall not exceed 10 metres.

When cables are taken in vertical raceways /trays and they pass from one floor & other floor pipe sleeves in concrete shall be provided.

7.3. UNDERGROUND CABLE TRENCH



An underground cable trench is an excavated channel used to safely route, protect, and manage power and telecommunication cables. These systems protect cables from mechanical damage, chemical exposure, and environmental factors. Redundancy in cable layouts is also common to ensure continuous power supply in case of system failures.

Standard Installation Process

The process of laying cables within an underground trench involves several precise steps to guarantee long-term system integrity:

Excavation: Digging a trench to a specific depth (typically 950 mm to 1.5 m) based on cable voltage and local regulations.

Sand Bedding: Placing a 100–150 mm thick layer of fine, soft sand (or dune sand) at the bottom. This prevents sharp rocks or soil movement from damaging the cable insulation.

Cable Laying: Positioning the cables atop the sand. If multiple cables are installed, they are placed with deliberate horizontal and vertical spacing to prevent mutual heating.

Protection & Warning: The cables are covered with another layer of soft sand. For cables, protective bricks, warning tiles, or concrete covers are used to alert future excavators.

Backfilling: The trench is filled with the original soil and compacted using a roller.

Thermal Considerations

Underground cables generate heat during operation, and if this heat is not properly dissipated, it can lead to cable degradation and potential system failures. The thermal properties of the surrounding soil play a significant role in determining how much heat the cables can safely carry.

Bidder must calculate the soil's thermal resistivity and select the appropriate cable type and installation method to ensure that the system operates within safe temperature limits. In some cases, additional cooling measures, such as heat sinks or specialized backfill materials, may be required.

In areas with unstable soil or high groundwater levels, additional protective measures may be necessary to prevent moisture ingress, which can cause corrosion or electrical faults.

Safety Standards and Compliance



Compliance with local and international safety standards is essential to ensure that underground cable installations are safe and reliable. Regulations typically cover a range of topics, from trenching and excavation practices to electrical safety protocols and environmental protection measures.

Standards organizations, such as the International Electrotechnical Commission (IEC), the Institute of Electrical and Electronics Engineers (IEEE), and local regulatory bodies, provide detailed guidelines on how underground cables should be installed and maintained. Following these guidelines not only ensures safety but also helps extend the lifespan of the cables and prevent costly repairs.

7.4. Cable Installation

Cables to each circuit shall be laid in one continuous length. Cable jointing and splicing shall be avoided. Jointing shall be allowed only for the cases where the route length is more than the maximum possible drum length. Drum length of the cables shall be so chosen that straight through joints are eliminated. However, the drum length shall not be less than the following lengths:

1100V grade power cables – 500 meter

1100V grade control & instrumentation cables – 1000 meters

Outdoor cable installation

- (a) Where cables cross roads and water, oil, gas or sewage pipes, the cables shall be laid in hume or steel pipes. For road crossings, the pipe for the cable shall be buried at not less than 600 mm. Hume pipes shall be preferred to steel pipes from the point of view of corrosion. Minimum 20% of total laid hume or steel pipes to be kept empty (if possible in top two layer) for future requirement.
- (b) The cables shall be tied to tray rungs by means of 3mm dia. nylon cord at an interval of 5000 mm and also at bends.
- (c) For good sealing arrangement at entry points, suitable pipe sleeves, adequate in number and of adequate sizes shall be provided in building walls/slabs for passage of cables into a building from cable trays/racks/cable trenches located outside the building.

8. CABLE TRAYS AND COVERS

- 8.1.** Cable trays shall be of ladder / perforated type complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories. Cable trays of ladder and perforated types and the associated

accessories such as coupler plates, tees, elbows, etc., shall be fabricated from 12 gauge (2.5 mm thick) mild steel sheets. Cable tray covers shall be provided for all cable trays and raceways. The cable tray accessories like trays, elbows, bends, etc., shall be fabricated and galvanized before bringing to site. Cable tray covers shall be fabricated from 16 gauge (1.7 mm thick) MS sheets. All the sheet steel shall be hot dip galvanized.

- 8.2.** 1100 V rated cables of sizes 120-sq. mm and above shall be laid in single layer. Single core cables used for 3-phase AC power circuits shall be laid in Trefoil form with suitable PVC aluminum clamps to hold the cables.
- 8.3.** The sizing of cable trays to avoid crowding and crises crossing of cables.
- 8.4.** Separate cable trays shall be provided for fire alarm/fighting, DC system cables communication system cables to avoid damage to these cables during a fire in other cables. Communication cable to be laid inside conduit only to negate interference from HV power & control cables.
- 8.5.** Slotted angles shall not be used for cabling. In all locations smaller size cable trays of 50 mm / 100 mm wide shall be used for one or two cables.
- 8.6.** Cable trays shall have standard width of 150 mm / 300 mm / 600 mm and in standard length of 2.5 meters.

Cover shall be provided on cable rack / cable tray wherever possibility of Lignite / Dust accumulation just like sheds

8.7. Bending radii for cables

The bending radii for various types of cables shall not be less than those values specified by the cable manufacturer.

8.8. Terminations, clamping and miscellaneous details

- (a) Cable entry to motors, push button stations and other electrical devices shall be from the bottom as far as possible or from the sides. Top entry shall be avoided particularly for outdoor equipment.
- (b) Identification tags made from aluminium sheet shall be attached to each end of each cable by means of GI binding wire. Tags shall be additionally put at an interval of 20 metres runs of cables in trench/trays and in pull boxes.
- (c) All cable terminations shall be done with solderless tinned copper crimping type lug. Cable terminations shall be done with double compression type brass cable glands. For transformer feeders, HT motors, LT motors of 110kW and above only 'Amp' make lugs shall be used at both motor and switchgear ends. Wherever required, necessary bi-metallic strips / round ferrule are to be used for cable termination.
- (d) Control cable termination: 'Wago' type or equivalent type cage connectors shall be used.

- (e) Saddle type clamps to suit number of cables to be clamped at a particular location shall be used for clamping cables running along walls, ceilings, structures, etc. at 750mm interval.
- (f) The armour and semi-conducting screen of single core cables shall be earthed at one end. The continuity of armour and semi conducting screen shall not be broken at each joint. The unearthed end of armour and screen shall be insulated.

8.9. Earthing

- (a) Metallic sheaths, screens and armour of all multi-core cables shall be earthed at both equipment and switchgear end.
- (b) Sheath and armour of single core power cables shall be earthed at switchgear end only. For long lengths of cables multiple earthing may have to be adopted to safeguard against the presence of standing voltages under normal as well as fault conditions by providing sheath interrupter.

9. FIRE-PROOF SEALING OF CABLE PENETRATION

9.1. Cables / cable tray openings in walls and floors or through pipe sleeves from one area to another or one elevation to another, between the units and within the same unit, shall be sealed by a fire-proof sealing system. The fireproof sealing system (FPSS) shall effectively prevent the spread of fire from the flaming to the non-flaming side, in the event of a fire. The FPSS shall conform to the following requirements:

- (a) FPSS shall have a fire rating of two hours.
- (b) The FPSS shall be subjected to fire endurance test, hose stream test, temperature measurement of non-flaming side as per ASTM-E119. 'Standard method of fire tests of building construction and materials'.
- (c) The FPSS will also conform to the in-combustibility test carried out in accordance with IS: 3144-1992.
- (d) Under fire condition, the FPSS material shall not emit excessive smoke or any corrosive or toxic fumes.
- (e) FPSS shall have life of 25 years.

9.2. Fire Stop/Seal

The FPS system adopted for cables or cable trays penetrating through walls and floor openings, or cables passing through embedded conduits/pipes/ pipe-sleeves, constitutes a 'fire stop/seal', which is meant to prevent spreading of fire between areas separated by fire-resistant barriers.

Performance Requirements

- (i) Requirement of fire stops



- The material, design and construction of the fire stops shall be such as to provide the fire-rating of 120 minutes for a fire on any side and meet all requirements listed in this specification and the relevant codes and standards.
- The materials used in the fire stops shall be non-hygroscopic, compatible with the type of cables.
- The fire stops shall be suitable for retrofitting of cables through the penetration seal without disturbing the sealing of the cables already existing.

(ii) Requirements of fire breaks

- Each firebreak shall have a fire-rating of 30 minutes and shall be capable of withstanding for the duration specified a fire on any side of the fire break.

9.3. Application of fire proof sealing system

(i) Fire stops

Fire stops shall be provided for cable penetration openings listed below:

- The passage of cables/cable trays pipe sleeves/embedded conduits through walls / floors.
- Vertical raceways, which carry cables between successive floors, through openings provided in the RCC floor slab, shall be sealed by fire stops at each floor level.
- Cable entry through openings in floor slabs below HT/LT switchgear, MCCs, various control and relay panels and other bottom entry panels, shall be effectively sealed by fire stops.

(ii) Location of fire breaks

- Firebreaks shall be provided on both cable rack and trenches at all cable tray intersections and tee-offs.
- On linear runs of cable trays between fire stops or fire breaks, fire breaks shall be provided at intervals of 15 metres on horizontal cable runs and 5 m on vertical cable runs.
- Fire breaks in linear runs of cable trenches between intersections and tee-offs shall be provided at intervals of 30 metres.

9.4. Bidder shall furnish the test certificates for the fire stops and fire breaks after award of contract for Owner / Owner's Representative review. If the certificates are not satisfactory all the tests shall be conducted free of cost. The offered system i.e. fire stops and fire breaks shall be identical (or better) with the system which is successfully type tested for the specified

rating i.e. the composition density of the material, thickness of coating in case of fire breaks and any other properties of the material / system offered shall be identical or better than the tested system and shall be subject to Owner / Owner's Representative approval.

9.5. Performance Tests: Tests on Fire Stops

- (a) The fire stops shall be subjected to the following type tests:
 - (i) Fire Rating Test
 - (ii) Hose Stream Test
- (b) Type tests shall be conducted on different fire stop test specimens described above as per IEEE-634. The sizes of the fire stop test specimens, shall be similar to the largest of the sizes being used in the plant.
- (c) Preconditioning of fire stop test specimens

Before conducting the fire rating and hose stream tests, each test specimen shall be preconditioned for thermal ageing, water immersion and vibration.

- (d) Test on Fire Stops

During the fire rating test, the transmission of heat through the cable penetration fire stop shall not raise the temperature on its unexposed surface above the self ignition temperature of the outer cable covering, the cable penetration fire stop material, or material in contact with the cable penetration fire stop, with a maximum temperature limit on the unexposed surface of 200°C.

- (e) Tests on fire breaks

Firebreaks shall undergo the following tests as per ANSI-IEEE-383:

- (i) Ampacity test
- (ii) Flame test

9.6. FIRE BREAK

1. Fire break shall be provided by applying a suitable fire-resistant coating on cables for the required length to meet the fire rating of two hours.
2. Fire break shall be provided at an interval of 15 metres in the straight portion of each of the cable tray above ground, at intervals of 30



metres in cable trenches and at 5M for all vertical trays. All cable inter section and tee offs shall be provided with fire breaks. Fire coating shall be provided on entire length of cables in lignite handling system.

3. When pipe sleeves are provided for cables from outdoor areas to indoor areas, the pipe opening at the outdoor side shall be sealed by fire proof sealing material which is also continuously water proof. Water should not enter through any pipe sleeves from outside area to any MCC room, control room etc. The indoor side of the pipe opening shall also be sealed by continuous fire proof sealing materials. The duct banks in outdoor areas also need to be sealed by water proof seals. It is necessary to explore possibility of applying waterproof coating on fireproof sealing in the form of water-proof barrier wall if suitable.

10. TESTS

- 10.1.** All routine tests, acceptances tests and FRLS tests as per relevant standard shall be performed on each size of cable at works/ factory. If same size is supplied in different lots, inspection shall be done for each lot. If same cable is supplied by different agencies, test shall be carried out on cables supplied by each agency. These tests shall be carried out as per relevant standards as applicable.

Routine and acceptance test shall be carried out on FPSS.

10.2. Testing and commissioning of cables

- (a) Cables shall be checked for insulation resistance before and after jointing.
- (b) High voltage testing

All cables of 1.1 kV grade 400 mm² and above and all HV cables shall be subjected to DC or AC (preferably DC) high voltage test after terminating but before commissioning as per Table 4 in IS : 1255.

- (c) Type test certificates for each type & size of the cable supplied by the Bidder shall be submitted. In case Type test certificate for similar type & size is not available or the same is older than 05 years, the same shall be conducted in presence of Owner or his representative.

TECHNICAL DATA SHEET – CABLES

TECHNICAL DATA

The Bidder shall indicate the following for each type and size of cables:

1	Make	:	
2	Type	:	
3	Applicable Standard	:	
4	Voltage Grade	:	
5	Suitable for system with		
	a Service voltage	:	
	b Neutral earthing	:	
6	Maximum conductor temperature		
	a Continuous, °C	:	
	b Short time, °C	:	
7	Conductor		
	a Material	:	
	b Size, mm ²	:	
8	Shielding on Conductor (HT Cables)		
	a Material	:	
	b Type	:	
	c Thickness, mm	:	
	d Whether extruded	:	Yes / No
9	Insulation		
	a Material	:	
	b Type	:	
	c Thickness, mm	:	
10	Shielding on insulation (HT cables and instrumentation cables)		
	a Material	:	
	b Type	:	
	c Thickness, mm	:	
11	Inner sheath		
	a Material	:	
	b Type	:	
	c Thickness, mm	:	
	d Extruded?	:	Yes / No
	e Approx. outside dia over sheath, mm	:	
12	Armouring		
	a Material	:	
	b Size, No. x dia	:	
	c D.C Resistance at 20°C, Ohm / km	:	
13	Outer sheath		
	a Material	:	
	b Type	:	
	c Thickness, mm	:	



14	Approximate overall diameter, mm	:	
15	Standard drum length with tolerance, mm	:	
16	Net weight of cables, kg/km	:	
17	Continuous current rating for standard IS condition laid direct		
	a In ground	:	
	B In duct	:	
	c In air	:	
18	a Short circuit current for 1 sec., kA	:	
	b Conductor temperature allowed for the short circuit duty	:	
19	Electrical parameters at maximum operating temperature, i.e. 90°C for HT power, 85°C for LT power, 70°C for Control cables and 85°C for instrumentation cables.		
	a Conductor resistance, Ohm / km	:	
	b Insulation resistance, Ohm / km	:	
	c Reactance at 50 Hz, Ohm / km	:	
	d Impedance, Ohm / km	:	
	e Image attenuation (instrumentation cables)	:	
	f Cross talk attenuation (Instrumentation cables)	:	
20	Recommended minimum bending radius	:	
21	Derating factor for following ambient temperature in Air/Ground		
	• At 30°C	:	
	• At 35°C	:	
	• At 40°C	:	
	• At 45°C	:	
	• At 50°C	:	
22	Group factor for following nos. of cables laid touching / 2 x diameter centre to centre apart		
	a Single core cable (in trefoil)	:	
	i. 2 nos.	:	
	ii. 3 nos.	:	
	iii 4 nos.	:	
	.	:	

Gujarat Industries Power Company Limited (GIPCL)

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V2-S3.3: Package B – Electrical

	b Multicore cable (in trefoil)	:	
	i. 3 nos.	:	
	ii. 4 nos.	:	
	iii 5 nos.	:	
	iv 6 Nos.	:	
23	Single line to ground fault current withstand capability of screen (HT cables)	:	
24	The cables shall be tested as specified	:	
25	Whether type test certificates for similar type of cables enclosed with the Bid?	:	Yes / No
26	Cable sectional details submitted?	:	Yes / No

SECTION-5 GUIDELINES FOR INSTALLATION OF ELECTRICAL EQUIPMENT

1. GUIDELINES FOR INSTALLATION OF ELECTRICAL EQUIPMENT

All electrical equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, and squat and properly aligned and oriented. Tolerances shall be as established in the Manufacturer's drawings and statutory requirements. Bidder shall prepare detail QAP using SOP for erection/ preservation/ testing/ commissioning of all electrical equipments considering relevant standards, best engineering practices and OEM guidelines and submit to Owner for approval. Bidder shall have to submit details list of tools and tackle required for erection / preservation / testing / commissioning of all the electrical equipments considering relevant standards, best engineering and industrial practices, and OEM guidelines and submit to Owner for approval before mobilisation for ETC. Bidder shall have to submit work completion schedule with microcline planning for all major electrical equipments for Owner approval. However, following are the minimum requirements.

1.1. Transformers

Proper arrangement shall be provided for transformer unloading and handling at site before final erection as per OEM guidelines and relevant standards. Proper weather proof arrangement shall be provided for storage of all the accessories of transformer. Care shall be taken during handling of insulating oil to prevent ingress of moisture or foreign matter. In the testing, circulating, filtering or otherwise handling of oil, rubber hoses shall not be used. Circulation and filtering of oil, heating of oil by regulated short circuit current during drying runs and sampling and testing of oil shall be in accordance with the Manufacturer's instructions and specified Code of Practice.

1.2. Switchgear, Control/ Relay Panels

Switchgears and control relay panels/desks shall be installed in accordance with specified code of practice and the Manufacturer's instructions. Proper weather proof arrangement shall be provided for

storage of all the switchgears, control / relay panels at site as per OEM guideline and relevant standards.

In joining shipping sections of the switchgear/panels/control centres together, adjacent housing or panel sections provided shall be bolted together after alignment has been completed.

2. TESTING AND COMMISSIONING

Test of all equipment shall be conducted as per latest IS. Tests shall also confirm to International Standards IEC / VDE / DIN / BS.

Routine tests and Type tests shall be conducted as given in relevant chapters of Electrical Volume III (1 OF 3).

The site tests and acceptance tests to be performed by Bidder are detailed below.

The bidder shall be responsible for satisfactorily working of complete integrated system and guaranteed performance. Field quality plan related to field erection, testing & commissioning shall be submitted for Owner / Engineer approval. For power transformer, tan delta test, SFRA (sweep frequency response analysis) test, DIRANA testing shall also be conducted at site before charging over and above BDV, PPM & DGA analysis of transformer oil before charging and after charging. For generator, tan delta test, ELCID test on generator stator and RSO test / rotor inter turn fault by dynamic wave method on generator rotor shall also be included in SITE test.

- 2.1. All equipment for testing and commissioning shall be calibrated by authorized third party & calibration shall be valid at time of testing.
- 2.2. The BIDDER shall perform operating tests on all switchgear and panels to verify operation of switchgear/panels and correctness of the interconnections between various items of the equipment. This shall be done by applying normal AC or DC voltage to the circuits and operating the equipment for functional checking of all control circuits, e.g., closing, tripping, control interlock, supervision and alarm circuits. All connections in the switchgear shall be tested from point to point for possible grounds or short circuit.
- 2.3. Insulation resistance tests shall be carried out by following rating meggers :
 - (a) Control circuits upto 220V : By 500 V megger
 - (b) Power circuits, bus bars,



connections upto 11kV : By 1000V megger

- 2.4. In order to avoid hazards to personnel moving around the equipment such as switchgear etc. Which is kept charged after installation before commissioning, such equipment shall be suitably cordoned off to prevent any one accidentally going near it.
- 2.5. The BIDDER shall possess or obtain valid working license from the concerned State Electricity Authority/Inspectorate for carrying out electrical installation work in the region before commencing the work.
- 2.6. Sufficient nos. of tools and tackles required for the testing and commissioning of the complete system, as per relevant standards shall be in the scope.

3. SITE TESTS AND CHECKS

General

All the equipments shall be tested at site to know their condition and to prove suitability for required performance.

The test indicated in following pages shall be conducted after installation. All tools, accessories and required instruments shall have to be arranged by Bidder. Any other test which is considered necessary by the manufacturer of the equipment, Bidder or mentioned in commissioning manual has to be conducted at site.

In addition to tests on individual equipment some tests / checks are to be conducted / observed from overall system point of view. Such checks are highlighted under miscellaneous tests but these shall not be limited to as indicated and shall be finalised with consultation of client before charging of the system.

The Bidder shall be responsible for satisfactory working of complete integrated system and guaranteed performance.

All checks and tests shall be conducted as per OEM requirements, approved by Owner/ Engineer in the presence of Owner / Engineer and test results shall be submitted in six copies to Owner and three copies to Electrical Inspector. Test results shall be filled in proper Performa.



Testing formats and procedures and protocols shall be submitted prior to commencement of testing three weeks in advance for all the electrical equipments at the time of commissioning to Owner / Engineer for approval.

Testing of tariff metering CTs and PTs shall be carried out at ERDA or any government approved NABL testing lab as per state grid authority rules in presence of state grid authority / Owner / Engineer and submit to state grid authority / Owner / Engineer for approval before charging, also included in the scope of Bidder.

After clearance from Electrical Inspector system / equipment shall be charged in step by step method.

Based on the test results clear cut observation shall be indicated by testing engineer with regard to suitability for charging of the equipment or reasons for not charging are to be brought by the Bidder.

Trial Run Test

After the successful test of each equipment as per standard test procedure the entire control system shall be put on trial run test on actual site conditions and operation of the system.

Acceptance Test

The acceptance test on the system shall be carried out by the Bidder as per mutually agreed test procedures to establish satisfactorily functioning of the system as a whole and each equipment as part of the system.

	<u>SITE TESTS</u>
	Site tests shall include all tests to be carried out at site on various equipment. They shall include but not be limited to calibration tests, configuration tests and commissioning tests. The Bidder shall be responsible for all site/commissioning tests. All necessary testing equipment required for erection, testing and commissioning shall be arranged by the Bidder. Bidder shall furnish detailed Field quality plans including commissioning check lists along with procedures and formats for recording of the tests for all individual equipment for Owner's review/approval. The tests to be carried out on the equipment at pre-commissioning stage shall include following but not limited to



	that indicated below. Site tests indicated in respective equipment sections are also included.
1.	ACDB / MLDB / LP / Misc. PANELS / DRY TRAFO. etc.
1.1	IR test before and after HT test.
1.2	HV test by HV megger.
1.3	Checking for functions of components for each module. MCCBs and MCBs testing as per OEM guideline.
1.4	Checking for interchangeability of similar components.
1.5	Checking of tightness of earth connection.
1.6	Testing and calibration of all indicating meters.
1.7	Check output of each feeder after energisation.
2.	Cables & Cable Supporting Structures
2.1	Checking of continuity / phasing and IR values for all the cables before and after HV test.
2.2	HV test and measurement of leakage current after termination of cable kits (for HT cables)
2.3	Checking of earth continuity for armour.
2.4	Check for mechanical protection of cables.
2.5	Check for identification (tag number system) distance placement of cable marker, cable joint etc. as per the cable layout drawing.
2.6	Check earthing of cable structures.
2.7	Check safe head room in gallery area.
2.8	Check clearance from ventilation duct and light fittings for cable structures.
2.9	Check proper fixing of cable structures.
2.10	Check for proper drainage and removal of water (if any). Checking proper dressing of all the cable laying as cable routing and layout drawing before charging.
3.	Indoor Lighting
3.1	Check dressing of cable.
3.2	Measurement of lux level at various places.
3.3	Check accessibility for replacement of lamps.
3.4	Checking for black spots or poor visibility near operating and indicating equipments.
3.5	Check for mechanical protection of cables.
3.6	Checking for adequacy of emergency DC light.
3.7	Checking for starting system of periphery lighting.
3.8	Check for auto switching of battery supply on failure of AC.
3.9	Checking of earthing of light panel, socket boards light fittings.

3.10	Checking of type of fittings w.r.t. specification at various locations.
3.11	Check adequacy of support of fittings.
3.12	Check water tightness of outdoor located panels.
4.	Outdoor Lighting System
4.1	Check lux level of general lighting.
4.2	Check for visibility of insulators, bushings and indicating instruments of transformers, breaker and isolator cabinets etc. during night.
4.3	Check for adequacy of escape light during night after failure of general light.
4.4	Check for proper painting of lighting supporting structures.
4.5	Check for automatic switching of light
4.6	Check for earthing connections on light fittings and other control accessories.
4.7	Check for mechanical protection of cables.
4.8	IR measurement of lighting cables.
5.	Earthing
5.1	Check tightness of all earth connections.
5.2	Check two point separate earthing of all metallic equipments, cable trays, busbar supporting structures, yard fencing steel structures of yard, rails gates building column (if steel all elect equipments, gas / oil / water pipe lines etc. as per the drawing / specification
5.3	Measurement of earth resistance for each electrode.
5.4	Measurement of total earth resistance.
5.5	Measurement of earth loop resistance for E/F path of biggest LT drive. Measurement of treated earth pit resistance. Checking of proper connection and identification of each treated earth pit.
6.	Lightning Protection
6.1	Check continuity of all the earth strips / shield wire.
6.2	Check tightness of all connections.
6.3	Measure earth resistance of each electrode and combined system.
7.	General
7.1	Check tightness of all foundation bolts, structures etc.
7.2	Check for cable dressing
7.3	Check the completeness of the system and layout wrt approved drawings.
7.4	Checking for earthing connection
7.5	Check for all inter lockings / logics /settings
7.6	Check availability of earthing Mats at all required locations
8.	Lightning arrestor
8.1	Check for connection to ground

8.2	Check insulators for cracks
8.3	Check reading of leakage current
8.4	IR test of each element Measurement of earth resistance for LA
9.	Miscellaneous
9.1	Checking of continuity of the system.
9.2	Checking of phase sequence from overhead line consumer end.
9.3	Checking safe accessibility of all operating points
9.4	Check availability of emergency lighting
9.5	Check availability of control aux. supply.
9.6	Ensure availability of first aid box, fire fighting equipments, earth discharge rods, rubber mats, rubber glove.
9.7	Check for safe movement of operators from yard control room / switchgear cable gallery etc., wrt proper illumination, escape light uncovered openings provision of hand railings in stairs etc.
9.8	Check proper covering of cable channels.
9.9	Placement of shock treatment chart, danger boards provision of boards indicating 'Man on work' Do not switch ON' 'Do not switch OFF'. 'EARTHED' etc.
9.10	Provision of route map at gallery entry points for indication of escape.
9.11	Check proper dressing of cables, mechanical protection of cables, placement of cable markers.
9.12	Check sealing of all cable openings including conduits opening with fire resistance material.
9.13	Check sealing of all openings at bottom of electrical panels.
9.14	Check and testing of all equipment of lab and repair shop as per the manufacturer's commissioning manuals.
9.15	Checking of annunciation and indication circuits where applicable.
10.	For all equipment including, Bidder to refer to OEM's recommendation and furnish the individual Filed Quality Plans for Owner's approval.
11.	Installation checks as per OEM guidelines to be followed subjected to Owner / Owner's Engineer approval.

NOTE: The Bidder shall note that the Site Acceptance Test (SAT) is a part of the scope of work. The Bidder shall prepare and submit a detailed SAT plan for all major electrical equipment along with the Technical Bid. The SAT plan shall be as per applicable standards, The Sat procedure/plan shall be subject to Owner approval.



Routine site testing list shall be included for LT variable frequency drives including measurement of harmonics at the output of variable frequency drives as well as at the point of respective 6.6kV bus during operation of drives starting from no load to full load.

SECTION-6 TECHNICAL SPECIFICATION FOR CONSTRUCTION POWER SUPPLY

1. Construction power supply (3-Phase) for the proposed project which will be made available to the successful Bidder at one point only. Bidder shall carry out further distribution of power through underground cabling only to meet their construction requirements. Bidder shall procure sufficient number of required panels, DP structure, switch with structure, energy meters, distribution transformer, distribution boards, LT cables etc.

Power supply availability is subjected to availability of power and making alternative majors, like providing DG set, to ensure the continuous availability of power for completion of the work as per the schedules shall be the responsibility of the Bidders.

2. On award of contract, the BIDDER shall furnish the electrical scheme, for construction power supply for OWNER's review / approval. The Bidder shall indicate 6 monthly maximum demand requirements.
3. Operation and Maintenance of all construction power supply equipments is in the scope of Bidder including liasioning with the supply authority (DGVCL / DGMS etc). Bidder shall engage round the clock shift manpower for construction power facility.
4. After the completion of the job, the BIDDER shall remove the entire installation and make area available to the OWNER.
5. Sufficient temporary lighting in all areas including road lighting, lighting mast, watch tower, boundary wall lighting shall be provided to facilitate construction activities round the clock. Bidder shall submit detailed drawing with site enabling program for approval of Owner / Engineer.
6. Submersible pumps / dewatering pump (especially in monsoon) shall be arranged and operated by the Contractor.

Construction of substation building with all necessary equipment, its foundations, DP structure, fencing, treated earth pit, cabling etc. as per statutory requirement is in the Bidder scope.

Bidder to arrange DG sets as back-up power supply arrangement during critical continuous. List of such critical continuous activities shall be mutually discussed or finalized during contract stage if required.



7. **Start-up and Commissioning Power Supply**
8. Start-up and Commissioning power supply required for plant commissioning shall be provided by Owner on chargeable basis.
9. Bidder has to furnish their start-up and commissioning power requirement month-wise at-least prior to 04 (four) months from the start date of commissioning till COD operation.

SECTION-7 DOCUMENTS WITH BID

The technical parameters as sought for in this section and all other sections along with other schedules shall be filled in and furnished with the Bid.

1. Auxiliary Power Supply System

- 1.1. Bidder shall prepare Key One line Diagram. This shall cover power distribution up to 415V.
- 1.2. Auxiliary system write up indicating the standby sources, switchgear, arrangement of redundant auxiliaries, live changeover arrangement, automatic changeover, control mode from control room, etc.
- 1.3. Electrical single line diagram indicating the configuration and rating.
- 1.4. Load list indicating kW rating, load factor, no of running / standby, pf, efficiency etc.
- 1.5. Underground cable routes layout

2. Service Transformers

- 2.1. Calculations for sizing the transformers MVA rating and the impedance.
- 2.2. Performance certificate from clients, type and routine test certificates for dry cast resin transformer.

3. 415 V Switchgear / All type of LT Panels

- 3.1. Performance certificate from other client for similar system/equipments.
- 3.2. Descriptive literature/pamphlets on the switchboards offered and main components like circuit breakers, relays, contactors
- 3.3. Key One Line diagram showing the interconnection of various Switchgear /MCC, ratings of all the bus bars, the incomer breakers and bus couplers/ties.
- 3.4. Type test certificates.

4. Earthing, Lighting & Lightning protection equipment

- 4.1. Layout for Earthing pit, earthing grid / network
- 4.2. Layout for Lighting system (i.e. power sources to equipment)
- 4.3. Incoming power supply & Lighting cable route
- 4.4. Lightning Protection system layout with earthing details



4.5. Performance certificate from other client for similar system/equipments.

5. Fire Detection & Alarm System

- 5.1. Relevant catalogues, technical literature, installation procedures, etc. for various types of detectors
- 5.2. Make and type of detector and panel offered.
- 5.3. Performance certificate from other client for similar system/equipments.

SECTION-8 DOCUMENTS AFTER AWARD OF CONTRACT

(1) DOCUMENTS AFTER AWARD OF CONTRACT

1	<u>ELECTRICAL WORKS</u>		
1.1	Concept note covering the equipment main parameters, design and operation philosophies including synchronising through auto synchroniser and manual synchronising gear, sizing criteria, selection criteria, schemes proposed, operation, indication and alarm philosophies for all electrical equipment/systems.		A
1.4	Technical specifications and technical data sheets for all electrical equipment/systems.		A
1.8	Electrical equipment layout drawings in all buildings.		A
1.9	Cable tray/trench layouts, lighting layouts, earthing & lightning protection layouts, fire alarm system layouts, communication system layouts, etc. for all buildings/areas.		A
1.10	Relay settings along with calculation and co-ordination curves/chart.		A
1.11	Standard/typical installation sketches for cabling, lighting, earthing and lightning protection.		I
1.12	Control wiring diagrams for each drive / auxiliary	: Showing the details of the switchgear module, external cable connection to motors, devices, control panels, system cabinets, etc., interconnection between panels related to the respective drives, cable nos., and cable core nos.	A



1.13	Cable interconnection schedules / diagrams for all the cables showing the cable no., core no., cable size, terminal nos., on either side for all the equipment in the Bidder's scope		I
1.14	Bidder shall furnish the following drawings / data / information:		
1.15	<u>Transformers</u>		
	(a)	General outline drawings showing plan, front elevation, end elevation, cable boxes / disconnecting chamber section views, locating dimensions of cable entries, earthing terminals, foundation / floor fixing details, jacking pads and weights	A
	(b)	Bushings : Plan, elevation, terminal details, mounting details, make and type number, current and voltage rating, creepage distances and principal characteristics.	I
	(c)	Marshalling box terminal connections: Wiring diagram, Cooler control circuits, OLTC Control circuits, Cooler control cabinet drawings	I
	(d)	Rating and diagram plates,	A
1.18	<u>415 V Switchboards / ACDB / MLDB / LP etc.</u>		
	(a)	Switchgear cubicles: Outline dimensions and general arrangement, including plan, front elevation, rear elevation, side elevation and relevant cross-sectional views, foundation details	A
	(b)	Feeder List and Schematic control circuit diagrams	A
	(c)	Detailed wiring diagrams including terminal block numbers, ferrule numbers and cable connections.	I
	(d)	Development diagrams of switches	I
	(e)	Switchgear schematic diagrams of all 415V boards/ switchgears	A
1.19	<u>Electrical Control Panels</u>		
	(a)	Outline dimensions including plan, front elevation including the mimic, rear elevation, side elevation and door opening sizes.	A



	(b)	Drawings showing foundation details, floor openings for cabling and weight of each panel	I
	(c)	Schematic control circuit and block logic diagrams. The latter shall indicate the location of all devices relays, sensors, transducers, instruments and their interaction to serve as a basis for developing elementary diagrams	I
	(d)	Layouts and cross section views of front / rear panels and desks complete with identification markings for all mounted devices and complete material list giving ratings, make and type.	I
	(e)	Switch development diagrams	I
	(f)	One line diagrams of power circuits and control power circuits arrangement and distribution.	I
	(g)	Detailed wiring drawings including identification of devices, terminal block numbers, ferrule numbers and cable connections.	I
	(h)	Inter panel interconnection diagrams indicating terminals and external connections between panel to panel and panel to field devices.	I
	(g)	Control philosophy write up	I
1.20	<u>Control Cabinets (For all services)</u>		
	(a)	Schematic diagram indicating terminal numbers for external connections and with a Bill of Material for all the equipment	I
	(b)	Control cabinet drawing showing outline dimensions, cable entry openings, floor / wall / pedestal fixing arrangement, padlocking arrangement, weights	I
1.26	<u>Lighting System</u>		
	(a)	Distribution boards and panels general arrangement dimensioned drawings showing front, side and plan views, outline dimensions, floor openings, floor / wall / structure fixing arrangements, earthing terminals and weights.	I

	(b)	Schematic wiring diagram of the distribution boards / panels, showing the terminal numbers.	I
	(c)	Inside view of distribution boards / panels showing mounting and wiring arrangement of various component equipments.	I
1.28	<u>Fire Proof Sealing for Cable Carrier Systems</u>		
	(a)	Detailed drawings including the constructional features, outline dimensions, general arrangement and cross-sectional views of the Fire Proof Sealing System to be provided in the areas specified in specification for each type of fire stop and fire break supplied.	I
	(b)	Type test certificates as per this specification for all types of fire stop / fire breaks included in the order.	I
1.29	<u>Lightning protection system layout</u>		
		Earthing layout	A
2	<u>QUALITY, INSPECTION, SHOP AND SITE TESTING</u>		
2.1	Quality assurance plan for all the systems/equipment/ components		A
2.2	Quality assurance plan for all site activities including erection, pre-commissioning, testing and commissioning for the entire plant Package		A
2.3	Preliminary and final shop test schedule for all the systems/equipment/ components		I
2.4	Detailed shop tests procedures including sample calculations for all the systems/equipment/ components		I
2.5	Detailed site tests procedures including sample calculations for all the systems/equipment/ components		I
2.6	Material test certificates and performance test certificates for all equipment tested at works		I
2.7	Procedure for tests before taking-over which shall include performance guarantee tests, unit characteristic test, reliability test etc.		A



2.8	Inspection test reports including test certificates as called for in quality assurance plan for all the systems/equipment/ components.	I
2.9	Type test, Acceptance tests and Routine test reports of all equipments/systems	A
3	<u>ERECTION AND COMMISSIONING MANUALS</u>	
3.1	Storage instructions for all equipment	I
3.2	Erection and commissioning manuals for all the systems/equipment/components including installation drawings	I
4	<u>OPERATION AND MAINTENANCE MANUALS</u>	I
	Operation and Maintenance manuals for all the systems/equipment/ components of the plant package	
5	<u>AS BUILT DRAWINGS / DOCUMENTATION</u>	
5.1	As-built drawings and documentation for the entire plant package, all equipment / system supplied under this contract, for all building / structures / works under this contract incorporating all changes / modifications upto the time of commissioning / handing over to the PURCHASER.	I
5.2	Project design manual consisting of concept studies of all the systems, design criteria, sizing calculations for all major equipment / systems bill of material, equipment list etc.	I

SECTION-9 CODES & STANDARDS

	APPLICABLE STANDARDS	IS	BS	IEC	ANSI / IEEE
Standards indicated in the specific sections also to be referred. In the event of conflict between the codes and standards referred below and the specification included in tender documents, the stringent requirement will be considered.					
A.	TRANSFORMERS				
1	Dry type transformers				C-75.12.01
B.	SWITCHGEARS				
1.	LV Switchgear and control panel	13947	7354		
2.	Degree of protection for LV Switchgear	2147		144 / 947	
3.	Factory built assemblies of low voltage switchgear and control gear	13947		439	
4.	Specification for metal clad base materials for printed circuits for use in electronic and telecommunication equipment	5921			
5.	Electrical insulation classified by thermal stability	1271	2757	85	
6.	Metal enclosed switchgear	3427	162	298	
7.	Switchgear			62271-100 & IEC-62271-200	
7.	HT Circuit breakers	13118	116 / 3659 / 5311	62271	
8.	Switches and switch isolators above 1000V and upto 11 kV			265	
9.	(Off-Load) isolators, EHV Isolators	1888	3078 / 3189	129 / 156	



	APPLICABLE STANDARDS	IS	BS	IEC	ANSI / IEEE
10.	Arrangement for switchgear busbars, main connection and auxiliary wiring	5578 / 11353	158		
11.	Bus bars	5082	159	105	
12.	Bus bar support insulators	2544	3297	273	
13.	Current transformers	2705	3938	185	
14.	Potential transformers	3156	3491	186	
15.	AC Electricity meters	722	2692 5685		
16.	Electrical indicating instruments	1248	89	51	
17.	Electrical relays for power system protection	3231	142	255	
18.	High voltage fuses	9385			
19.	HRC Fuses	9224			
20.	Environmental requirements of semiconductor devices and integrated circuits	6553			
21.	Factory built assemblies of switchgear and control gear for voltages upto and including 1000V AC and 1200V DC	8623	60947	439	
22.	Miniature circuit breakers	8828	3871		
23.	HRC cartridge fuse	13703	88		
24.	D-Type fuses	8187			
25.	Control switches / push buttons	6875			
26.	Static protection relays	8686	142		
27.	Electric graphic (Recording) instruments		90		
28.	Starters	13947	EN- 60947-4	292	
29.	Interconnecting bus bars for AC voltage above 1 kV upto and including 36 kV	8084			
30.	Code of practice for selection, installation and maintenance of switchgear and control gear.	10118			
31.	Semiconductor converters			146	



	APPLICABLE STANDARDS	IS	BS	IEC	ANSI / IEEE
32.	Semiconductor rectifier cells and stacks	3895 / 4540	4417	146	
33.	Electrical installation and wiring installation	732			
34.	Environmental testing procedure for electronic and electrical items	9000			
35.	Safety code for semiconductors rectifier equipment	6619			
36.	Printed wiring boards	7405			
37.	Single and double sided PCB with plain holes – Electromagnetic compatibility			61000 – 1995	
48.	Semiconductor rectifier assemblies and thyristor convertors		4417	148	
5.	Construction and testing of electrical apparatus with type of protection 'e'	6381			
6.	Designations for types of construction and mounting arrangement of rotating electrical machines	2253		34-7	
7.	Terminal marking and direction of rotation for rotating electrical machinery	4728	4999	34-8	
8.	Designation of methods of cooling for rotation electrical machines	6362	4999	34-6	
9.	Measurement and evaluation of vibration of rotating electrical machines		4999-142	34-9	
10.	Degrees of protection provided by enclosure for rotating electrical machinery	4691	4999	34-5	
11.	Guide for testing three phase induction motors	4029		34-34	
12.	Measurement and evaluation of Mechanical vibration of rotating electrical machines	12075	4999	34-14	
13.	Classification of hazardous areas	5572		79	



	APPLICABLE STANDARDS	IS	BS	IEC	ANSI / IEEE
14.	Dimensions of slide rails for electric motors	2968	4999		
15.	Permissible limits of noise level for rotating electrical machines	12065		34	
16.	Guide for testing insulation resistance of rotating machines	7816			
17.	Procedure for measurement of loss of tangent angle for coils & bars	13508			
18.	Impulse voltage withstand test			34-15	
19.	Temperature rise measurement of rotating electrical machines	12802			
20	Type of duty and classes of rating assigned to rotating electrical machines	12824			
D.	ELECTRICAL INSTALLATION				
1.	Brass glands for PVC cables	12943			
2.	Flame-proof enclosures of electrical apparatus	2148	4683		
3.	Compression type tubular terminal ends for aluminium conductors of insulated cables	8309	4683		
4.	Code of practice for earthing	3043	1013		
5.	Rigid conduits	9537			
6.	Accessories for rigid steel conduits for electrical wiring	3837			
7.	Fittings for rigid steel conduits for electrical wiring	2667			
8.	Fittings for rigid non-metallic conduits	3419			
9.	Flexible steel conduits for electrical wiring	3480			
10.	Flexible non-metallic conduits for electrical installation	6946			
11.	Adaptors for flexible steel conduits	4649			
12.	Plugs and socket outlets	1293			
13.	Lightning arrester	3070	BSEN-60099	60099	
14	Insulating Mats for Panels	15652			



	APPLICABLE STANDARDS	IS	BS	IEC	ANSI / IEEE
E.	LIGHTING				
1.	General and Safety Requirements for luminaires	1913	4533	60598	
2.	Code of practice for industrial lighting	6665			
3.	Industrial luminaire with metal reflectors	1777		60598	
4.	Decorative lighting outfits	5077			
5.	Dust proof electric lighting fittings	4012		60598	
6.	Dust tight electric lighting fittings	4013			
7.	Electric lighting fittings for division 2 areas	8224	4533		
8.	LED Luminaires	10322			
9.	Water proof electric lighting fittings	3528	4533 / 5225		
10.	Watertight electric lighting fittings	3553	4533 / 5225		
11.	Bayonet Lamp Holders	1258	BSCN: 61184	60061	
12.	Edison Screw Lamp Holders	10276	BSCN: 60238		
13.	Bi-pin Lamp Holders for Tubular fluorescent lamps	3323			
14.	Starters for fluorescent lamp	2215	BSCN: 60155		
15.	Holders for starters for tubular fluorescent lamps	3324	BSCN: 60400		
16.	Ballast for Fluorescent lamps	1534	BSCN: 60920	60400	
17.	Transistorised ballasts for fluorescent lamps	7027			
18.	Ballasts for HP Mercury Vapour Lamps	6616		60923	
19.	Capacitors for use in tubular fluorescent, HPMV & LP Sodium Vapour Discharge Lamp Circuits	1569	BSCN: 61048		



	APPLICABLE STANDARDS	IS	BS	IEC	ANSI / IEEE
20.	Vitreous enamel reflector for use with illuminating device.	8017			
21.	Tubular Fluorescent lamps for general lighting service	2418	BSCN: 60081	60081	
22.	High pressure mercury vapour lamps	9900	3677	60188	
23.	Tungsten filament general service electric lamps	418	6179	60432	
24.	Cast acrylic sheets for use in luminaires	7569			
25.	High pressure sodium vapour lamps	9974			
26.	Emergency lighting units	9583			
27.	Code of practice for interior illumination	3646	8206		
28.	LED lamps	16102			
F.	FIRE PROTECTION				
1.	Code of practice for fire safety of industrial buildings : Electrical Generating and Distributing Stations	3034			
2.	Components of automatic fire detection system : Introduction		5445		
3.	Specification for manual call points		5839		ANSI UL38
4.	Smoke detectors for use in automatic fire alarm system	11360	5445		UL 268
5.	Smoke detectors for duct application				UL268A
6.	Single & multiple station smoke detectors				UL 217
7.	Heat sensitive fire detectors for use in automatic fire alarm system	2175	5445		
8.	Specification for high temperature heat detectors		5445		
9.	Methods of test of sensitivity to fire		5445		



	APPLICABLE STANDARDS	IS	BS	IEC	ANSI / IEEE
10.	Auxiliary protective signalling system for fire alarm services				ANSI – NFPA – 72
11.	Automatic fire alarm system in buildings : Control & indicating equipment		3116		
12.	Protection of buildings and allied structures against lightning	2309	6651		
13.	Code of practice for fire safety of buildings	1646			
14.	National Electric Code				Article 760
15.	National Building Code of India (1983)				
16.	Rules for fire alarm system				TAC
G	GENERAL				
1.	Climate proofing		CP:1014		
2.	Code of practice for phosphate coatings of iron and Steel	6005	3189		
3.	Classification of maximum surface temperature of electrical equipment for explosive atmospheres	8239			
4.	Method of marking for identifying electrical equipment for explosive atmospheres	8241			
5.	Flame proof cable glands	4821			
6.	Ambient temperature of electrical equipment	9676			
7.	Terminals for electronic equipment	4007			
8.	Guide for colour coding of electrical mimic diagrams	11954			
9.	Boxes for enclosure of electrical accessories	5133			
10.	Codes for welding	816, 9595			
11.	Dust-tight Ignition proof enclosures, for electrical equipment	11005			



	APPLICABLE STANDARDS	IS	BS	IEC	ANSI / IEEE
12.	Electromagnetic compatibility			6000 – 1995	
13.	Code of practice for climate proofing		6751		
14	Code of practice for selection, Installation and maintenance of transformers	10028			
15	Code of practice for maintenance and supervision of mineral insulating oil in equipment	1866	5730	422	
16	Code of practice for Installation and maintenance of induction motors	900			
17	Guide for safety procedures and practices in Electrical work Indian Electricity Act	5216			
18	Indian Electricity Act 1910, (As amended)				
19	Electricity Supply Act, 1948, (As amended)				
20	Indian Electricity Rules, 1956 (As amended)				
21	Indian Electricity Act 2003				

CEA GUIDELINES/ REGULATIONS

SL. NO	CEA GUIDELINES/ REGULATIONS	YEAR
1	Safety Requirements for Construction, Operation and Maintenance of Electrical Plants and Electric Lines	2022
2	Installation and Operation of Meters	2022
3	Technical Standards for Connectivity to the Grid	2019
4	Technical Standards for Construction of Electrical Plants and Electric Lines	2022



5	Technical Standards for Communication System in Power System Operations	2020
6	Flexible Operation of Coal-Based Thermal Power Generating Units	2023

DGMS Guidelines & regulations to be incorporated as applicable.

SECTION-10 SCHEDULE OF SUB VENDORS

The vendor list provided by the OWNER is based on experience and for the standardization purpose. However, OWNER may reject the Contractor's choice even as per the given vendor list, but are not meeting the specific requirements as per the OWNER's specification.

The list of acceptable Vendors/makes for system/equipment are as listed.

ELECTRICAL WORKS

SL. NO	ITEM DESCRIPTION	SUB VENDOR
1	415 V SWITCHGEAR	SIEMENS / L&T / SCHNEIDER
2	AC POWER CONTACTOR	SIEMENS / L&T / SCHNEIDER
3	AMMETER VOLTMETER/ WATTMETER	TOSHNIWAL/IMP/AE/MECO/RISHAB
4	AUXILIARY RELAY	SIEMENS / L&T / SCHNEIDER
5	AVIATION OBSTRUCTION LUMINAIRE	GEC/PHILIPS /WIPRO/VINAY
6	AUX.CONTACTOR	SIEMENS / L&T / SCHNEIDER
7	AUX. CONTROL PANEL/ LT SWITCH BOARD (DRAW OUT TYPE)	SIEMENS / L&T / SCHNEIDER
8	BIMETALLIC OVERLOAD RELAY / AUX. RELAY	SIEMENS / L&T / SCHNEIDER
9	CABLE TRAY	INDIANA ENGG. / INDUSTRIAL PERFORATIONS / PATNI CABLE TRAYS / SADHNA / STEELITE ENGG. LTD. MUMBAI
10	CABLE GLANDS	COMET



11	CABLE LUGS	DOWELL
12	CEILING FANS	KHAITAN / ORIENT / USHA / BAJAJ / CROMPTON
13	CONTROL CONTACTOR	SIEMENS / L&T / SCHNEIDER
14	CONTROL PANEL & SYNCH. PANEL	SIEMENS / L&T / SCHNEIDER
15	CONTROL SWITCH	L&T/SIEMENS/ALSTOM/KAYCEE/SALZER/ BCH
16	CONTROL TRANSFORMER	INDCOIL/AE/BCH/KAPPA/PRECISE/ SOUTHERN ELECTRICALS / SILKAANS
17	CT / PT	AE/BHEL/CGL/SILKAANS/JYOTI/KAPPA/ ABB/TELK/WSI/PRECISE/INDCOIL/ PRAGATHI
18	EXHAUST FAN	GEC ALSTOM/CROMPTON GREAVES/POLAR/ KHAITAN/BAJAJ/FLAKT/USHA
19	FUSE	SIEMENS
20	FUSE SWITCH UNIT	SIEMENS / L&T
21	HRC FUSE	SIEMENS
22	INDICATING LAMP	ALSTOM/TM/SIEMENS/L&T/TEKNIC/ PRECIFINE
23	KWHR. METER	BHEL/SIMCO/ABB/ENERCON/L&T/SEMS
24	LIGHT FITTING (FLAME PROOF)	GE / BAJAJ / CROMPTON / PHILIPS / WIPRO
25	LIGHTING SYSTEM	BAJAJ ELECTRICALS LTD. CROMPTON GREAVES LTD. PHILIPS INDIA LTD. WIPRO
26	LT MOTORS	SIEMENS / ALSTOM LIMITED / CROMPTON GREAVES LIMITED
27	LIMIT SWITCH	SIEMENS/ESSEN/BCH
28	LT XLPE FRLS POWER CABLES	POLYCAB WIRES PVT.LTD UNIVERSAL CABLES TORRENT CABLES



29	MCB / RCCB	SIEMENS / SCHNEIDER / L&T
30	ALL LT SWITCHGEAR	SIEMENS / SCHNEIDER / L&T
31	MOTOR CIRCUIT BREAKER	SIEMENS / SCHNEIDER / L&T
32	PANEL METER	AEL / MECO
33	PUSH BUTTONS	ALSTOM / SIEMENS / L&T /TEKNIC / HONEYWELL
34	PVC FRLS LT POWER & CONTROL CABLES	POLYCAB WIRES PVT.LTD UNIVERSAL CABLES LTD. TORRENT CABLES
35	NUMERICAL RELAYS	SIEMENS / SCHNEIDER
36	SEMICONDUCTOR FUSE	BUSSMAN / FERAZ
37	SWITCH SOCKET OUTLET	ALSTOM / CGL / ANCHOR
	1-PH & 3-PH RECEPTACLES	BALS / BALIGA
38	TERMINAL BLOCKS	ELMEX
39	TIMER/TIME DELAY RELAY	SIEMENS/L&T/MINILEC
40	EARTH RESISTANCE TESTER	SONEL, SWITZERLAND/FLUKE / MEGGER
41	TRANSDUCERS	SECURE (PROGRAMMABLE)

NOTE: The name of other reputed vendors who meets the requirement of technical specification may also be included on BIDDER's request, subject to OWNER/ ENGINEER approval.