TENDER DOCUMENT

NIT No DLI/C&E/WI-665/529R

FOR

Tender for “Design, Engineering, manufacturing at work, Supply for 46 KM MS Painted Perforated Cable Trays of different sizes & Associated Works “Augmentation of Raw Material Handling Receipt and Handling facilities with new OHP Part- B (Package-061) of Bhilai Steel Plant, (SAIL)”.

VOLUME- 2 B

(TECHNICAL SPECIFICATION & SCOPE OF WORK)

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## Contents - (Volume-2B)

NIT No. DLI/C&E/WI-665/529R

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**Scope of Work - MS painted Perforated Cable Trays of different sizes & Associated Works**

Scope of work for MS painted Perforated Cable Trays of different sizes & Associated Works shall include (but not limited to): Design, Engineering, manufacturing & testing at work, Supply of 46000 Meters MS painted Perforated Cable Trays of different sizes & Associated Works for "Augmentation of Raw Material Handling Receipt and Handling facilities with new OHP Part - B (Package- 061) of Bhilai Steel Plant, (SAIL)".

Supply of MS painted Perforated Cable Trays of different sizes & Associated Works complete in all respects with all the components hardware, coupler-plate accessories required to make suitable for proper installation.

- The scope of bidder shall be deemed to include all such items which although are not specifically mentioned in the specifications but needed to make system complete in all respect with all, fittings, fixtures and standard accessories etc. as required.

- Use Of Steel: The contractor shall have to use such items of steel as are manufactured by SAIL, RINL, TISCO, ESSAR, JINDAL, ISPAT etc. conforming to BIS standards and which are required for complete system of cable trays.

- The fabrication of the tray shall be such that there should not be any sharp edge & shall be properly grind for safety of the human.

- The tray shall be painted as per the painting specification.

- The standard length of Cable Tray is 3metre.

- The drawings enclosed are designed as per the basic requirement. Bidder has to quote such that any change during detail engineering/approval of drawings from client, they have to provide the same without any additional cost.

- Bidder has to quote their rate as per the price schedule & fill all the columns having individual detail of total basic price & taxes/duties separately in original only.

- Bidder has to submit Basic engineering, detailed engineering and reference category of drawings/datasheet for approval of BSP / MECON. Further the successful bidder will furnish final basic & detailed engineering drawings/datasheet, manufacturing drawings of fast wearing items and non-standard items, as built drawings, erection drawings/ documents, in soft editable format.

- Getting BSP/ MECON approval of the drawings, documents and calculation to be submitted by the successful bidder, obtaining required approval from statutory authorities, providing adequate personnel, equipment, tools & tackles for timely completion of the project.

- Testing and integrated testing including load test, overload test as per applicable standards, accuracy and performance testing shall be carried out by the successful bidder on continuous basis along with associated facilities followed by commissioning. On successful commissioning of the various sub-systems, PG test shall be carried out.

- Providing all drawings and documents with operation & maintenance manuals.
• Bidders are required to quote the prices as per price bid only in original. These rates will be applied during any changes occurring in quantity during detail engineering stage. In addition to prices as per price schedule for SUPPLY, RECOMMENDED SPARE (OPTIONAL NOT TO BE CONSIDERED FOR BID EVALUATION).

• **Drawings/Documents Submission**

**Documents/Information to be submitted by bidder with offer:**

• List of special tools and tackles if required.

• Price schedule for supply.

• List of recommended spare parts for 2 (Two) years trouble free operation and maintenance as per the format.

• Technical specifications, Catalogues/ Leaflets and O&M manuals

• Reference list of customers for similar supply of items.

• Unpriced copy of price schedules (with technical bid).

• No deviation declaration to NIT technical and commercial terms and conditions and duly signed with date and stamped copy of NIT Vol-1, Vol-2 (2A, 2B & 2C), Vol-3 & Vol-4.

• Approximate weight of the equipment.

**Documents/Information to be submitted by successful bidder for Approval/Reference**

• Drawings related to General arrangement, installation drawing.

• Mounting arrangement Drawings.

• Bill of materials

• Technical specifications

• Technical data sheet of all components, cables; electronic devices etc. for panels of.

• Approximate weight of the equipment

• Internal test reports and certificates

• Accuracy / Performance check reports

• Quality assurance for the MS painted Perforated Cable Trays of different sizes & Associated Works panels & other related components.

• Operation and maintenance manuals

• Other drawings/ documents as per BSP/ MECON requirement for the system and drgs as per the recommendation of manufacturer & exclusion if any.
4.10 ELECTRICAL POWER DISTRIBUTION, DRIVES, CONTROL & ILLUMINATION

4.10.01 General

This section covers major features of Power Distribution System, Shop-Electrics, Drives, Control, Automation and Illumination System to be supplied by Contractor for the Ore Handling Plant Part-B Complex.

The Contractor will refer to General Technical Specification (GTS) for Electrics and Illumination for detailed specification of equipment / components. This Contract Specification (CS), General Technical Specification (GTS) including Preferred Makes for Equipment and supplies (GS-13) and other attached documents / Annexure E-01, E-02, E03 Commissioning Spares), E-04 (Tools & Tackles), E-05 as a whole will comprise the complete Contract Specification. These are complementary and anything laid down in one and not in other will be deemed as binding, as though laid down in the Contract specification as a whole. In case of conflict between the Contract specification and GTS, the Contract specification (CS) will prevail.

4.10.02 HT Power Supply System & Battery Limit

Power supply for the New Ore Handling Plant Part-B Complex will be made available from the 11kV and 6.6 kV switchboards proposed to be installed at HT substations (HTSS) which will be located at OHP-B premises and different locations under a separate package by Employer (package no. 071). Refer enclosed drawing no. MEC/S/9101/11/E1/06/00/00/061.01/R2

The scope of work of the Contractor will commence from the outgoing terminals of 11kV and 6.6 kV switchboards located at new / existing HTSSs for supplying power to LTSS and HT motors & Yard machines respectively under this package.

11 kV Switchboards for supplying power to all LTSSs and 6.6 kV Switchboards for supplying power to all HT Motors and yard machines only will be provided by Employer at HTSSs. Supply, laying and termination (at both ends) of all HT & Control Cables from HT switchboard to LTSS & HT motors, yard machines will be in the scope of Contractor. Power to all the HT motors will be supplied from the 6.6kV HT Switchboards.

Adequate number of LT Substations (LTSS), (at suitable locations to be decided by the Contractor) each comprising of LT switchboard along with two transformers will be included by the Contractor in his scope of work. The
transformer rating will be worked out on the basis of guidelines given in General Technical Specification. However, the rating of transformers will be 2000/1000 kVA depending upon the load. The interconnection between transformer secondary and LT switchboard will be through bus ducts.

The Contractor will indicate the numbers of 11kV and 6.6 kV feeders required by them from the HTSS during Basic Engineering to provide HT feeders by Employer. The Contractor will indicate the details of connected load (KW) & Maximum Demand in 15 min. duration for each feeder and also the overall expected maximum demand in 15 min duration for the entire plant under normal operating conditions.

The following are to be considered in addition to the equipment specification spelt out in GTS.

a) The vector group for all distribution transformers (LT S/S) will be of Dyn11 only to take care of circulation of harmonic currents. However, care should be taken not to envisage mixing of supply with the existing LT power sources of 2.5 MT area as the existing distribution transformers are of Yy0 vector group.

b) Separate analogue voltmeters for line voltage & bus voltage and ammeter in each of the three phases will be provided.

c) All out going ACBs will be 800A, 1000A or 1600 A as per requirement with protection settings selectable at site.

d) Check-synchronising relay will be provided wherever sectionalizing is envisaged between two different sources of power supplies.

e) Care should be taken to avoid location of LT Substations under Conveyor galleries/ dust prone areas.

f) LT Bus duct insulators will be of porcelain.

g) The CT mounting arrangement inside the cable chambers of all feeders will be such that CTs and secondary connections will be easily accessible for maintenance, replacement, etc.

h) For LT Bus duct/ bus bars, the minimum clearance will be considered as follows in line with GTS
   - phase to phase : 25.4 mm
   - phase to earth : 19 mm

i) Training of personnel on operation and maintenance of the new equipment at manufactures work will be arranged by the supplier.
Each of the LT substations will have the following facilities:

a) The substation design will be dust proof and all entry points will be provided with double door arrangements.

b) Sufficient quantity of fire extinguishers at various locations will be provided as part of safety equipment inside sub-station.

c) Air cooling facility will be provided in all LT substations with air washing.

d) Lighting circuits of different rows will be controlled by different MCBs for better energy saving.

e) Breaker handling facilities will be provided.

f) Tools & tackles along with store room facilities will be provided.

g) Two nos of 4 legged wooden stools of height 1m and 4m each will be provided.

h) Chain pulley block or telpher arrangement will be provided.

Following HT / LT Power and motor feeders required for this package have already been included by the Employer’s in other package for the Contractor’s use. Supply of cables from Employer’s boards, laying, termination at both ends, erection, commissioning etc. will be under the Contractor’s scope.

Contractor to note that the feeder rating and locations mentioned are tentative only. Final ratings, nos. and locations will be decided during detail engineering.

A. HT Power and motor feeders for Contractor's use:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>HT Station</th>
<th>Sub Station</th>
<th>Location</th>
<th>Feeders for Contractor's use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HT Sub Station (SS-46)</td>
<td>Near New Storage Yard</td>
<td>LTSS, HT Motors and yard machines</td>
<td>As per Requirement</td>
</tr>
<tr>
<td>2.</td>
<td>HT Sub Station (SS-45)</td>
<td>Near existing Storage yard (Under HT S/Stn OHP-A)</td>
<td>Conveyor Z10-C1</td>
<td>1 No.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Conveyor Z10-C2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Conveyor Z15-C2</td>
<td>2 Nos.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LTSS (11/0.433kV, 2000kVA transformers)</td>
<td>2 Nos.</td>
</tr>
</tbody>
</table>
5. HT S/Stn (SS-60) Near Lime Plant LTSS (11/0.433kV, 2000kVA transformers) 4 Nos.

B. LT Power and motor feeders for Contractor’s use:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>LT Sub Station</th>
<th>Location</th>
<th>Description</th>
<th>Nos.</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LTSS-1 and 2</td>
<td>Near J-3</td>
<td>Power Supply Feeder</td>
<td>1 No.</td>
<td>275 kW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Power Supply Feeders for MCP</td>
<td>2 Nos.</td>
<td>160 kW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Power Supply Feeders for MCP</td>
<td>1 No.</td>
<td>125 kW</td>
</tr>
<tr>
<td>2</td>
<td>LTSS-4</td>
<td>Near J-4</td>
<td>Power Supply Feeders for MCP</td>
<td>2 Nos.</td>
<td>180 kW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MCC</td>
<td>2 Nos.</td>
<td>350 kW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PDB</td>
<td>2 Nos.</td>
<td>400 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MLDB</td>
<td>2 Nos.</td>
<td>400 A</td>
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4.10.03 Scope of work

The scope of work of Contractor will cover design, basic and detailed engineering, submission of drawings for approval, manufacture, factory testing, inspection by client / consultant, packing, loading, forwarding, delivery at Plant site, loading / unloading, storage, handling of material/equipment to erection site, erection, no-load and load testing, commissioning, PG test, PAT/FAT and liquidating the defects and handing over all electrics related to drives & control, illumination for complete & satisfactory operation of Ore Handling Plant on turnkey basis.

Contractor’s scope of work for New OHP-Part-B also includes necessary electrics and PLC based automation system including upgraded of existing automation system for integration of existing drives of OHP and Priority conveying routes upto JH-27/JH-42.

Any item or equipment not specifically mentioned but essential for process and technological requirement, proper installation, reliable operation, maintenance and safety of plant, equipment and personnel will be included by the Contractor in his scope of work.

I. POWER DISTRIBUTION EQUIPMENT

1. Adequate numbers of Double ended 11/0.433 kV LT substations (LTSS )
2. Each double ended substation will comprise of 11/0.433 kV Distribution transformers, 415 V PCC, 415 V bus duct, ACDB, MLDB, LDB, HT/ LT power & control cables and other necessary items as required for completion and successful operation of the power distribution network, in an integrated manner.

3. - Vacuum circuit breaker (VCB) without protections in the transformer room if transformer is fed from remote HT switchboard for tripping of upstream breakers
   - Push Button stations with trip PBs (press to lock and turn to release) in the transformer room if transformer is fed from HT switchboard located in the same building for tripping of upstream breakers.

4. Power and control cables, Cable termination kits, laying and termination (at both ends) of all associated power and control cables from the Employer’s 6.6 kV switchboard. Only 11kV (UE) grade cable will be used for 6.6kV (UE) applications.

5. AC distribution boards (PDB) - Single front, non draw-out type, sheet steel enclosed, modular construction with IP54 enclosure, having two incomer with a bus coupler will be provided for auxiliary equipment of LTSS.

6. Adequate numbers of Lighting Distribution Boards (LDB) for Power supply to various Sub Lighting distribution Boards (SLDB).

7. Illumination system of the Sub-station rooms. Illumination system will include all type of light fittings/fixtures.

8. Power and control junction boxes for termination of field cables.

9. Maximum demand (MD) of the MCC will be calculated considering the following:
   a. Working load of the MCC will be calculated based on the motor kW rating.
   b. The load factor will be considered as follows:
      - For continuous drives – 0.9
      - For intermittent drives like sump pumps etc. – 0.6
      - For electrically actuated valves / dampers – 0.2
      - For maintenance loads like hoists, cranes etc. - 0.4
   c. Load factor will be applied on the kW rating of motor.
   d. Diversity factor will be considered as one.
e. Spare feeders will also be considered for calculation of maximum demand as per guidelines indicated in Sl. No.2

f. Load of power supply feeders will be corresponding to the load being fed with 0.9 load factor.

g. Cyclic load will be converted to continuous load and will be used for MD without load factor. (e.g. 22kW motor at 40% duty factor will have continuous load as 22 x square root of 0.4)

**Construction Power Supply:**

The facilities for distribution of construction power supply will be in the scope of the Contractor.

For construction power supply, one no. outgoing feeder of 415/230V AC, 3ph / single phase, 50 Hz will be made available to the nearest established sub-station by the Employer.

Supply, erection, testing and termination at both ends of incoming power cable to construction power distribution board and regular maintenance of the cable will be included in the scope of supply and work.

**II DRIVES, CONTROLS & ILLUMINATION SYSTEM**

1. All HT and LT AC / DC motors, actuators, brakes etc. as per technological and process requirement.

   HT motor winding and bearings, temperature sensors, vibration sensors will be hooked up with PLC for monitoring. Surge suppressors will be provided at motor end of all the HT motors.

2. Generally Squirrel Cage Induction Motor with DOL starter / VFD / Soft Starter will be provided. Use of Slip ring motor in general will be avoided. Suitable Rotor contactor panels and SS-grid Resistance Boxes will be provided for slip ring motors if inevitable.

3. Indoor 415 V LT MCC and Control panel with CT, PT, metering and Protection etc. as required.

   - Motor Control Centers for New OHP-Part B will be Intelligent, draw-out type with two incomers and bus coupler for control of drives of rating up to 90kW of various technological units having communication with Plant Automation System.
For control of drives of rating from 110kW to 200kW Intelligent type Motor control panels (MCPs) having communication capability as above.

- MCCs for drive motors of New series conveyors parallel to existing conveyors from OHP-I to Junction House JH-27/JH-42 will be non Intelligent draw-out type and will be connected to Rockwell system / L&T system by providing remote I/O stations as per existing control philosophy.

For control of drives of rating from 110kW to 200kW non-Intelligent type Motor control panels (MCPs) will be provided.

- Control panels for Stacker, Reclaimer, Wagon Tippler, Tripper car, crane, hoist, AC/ventilation system etc will be conventional, non draw-out type. All control panels on the mobile machines will be mounted on anti vibration pad.

- Stacking & Reclaiming conveying routes will have separate MCC.

- Separate MCC for the drives upto JH-15 for new series of OHP-I.

- Separate MCC for the drives from JH-15 to JH-27/JH-42 for new series of OHP-I.

- Electronic over load relay upto 90kW motor and Motor Protection Relays for motors above 90 kW rating in conventional type (non-intelligent) MCC / Control panel will be used.

- Local/Remote selector switch will be mounted on MCC & Control Panel.

4. VVVF converters for 415 V motor drives having requirement of speed control where process requirement calls for variable speed application. All drives will have communication capability with Plant Automation System.

VFD will have following features:

- Minimum rating of AC drives and reactors will be 150% of the full load RMS current of the motor.
- Automatic disconnection of individual Motor in case of failure of AC drive.
- Use of isolation transformer for more than 90 KW drive and use of series reactor for less than 90 KW drive for VFD application.

5. Soft Starter:
• All HT Motors for conveyor drives will have High Voltage Flux Compensated Magnetic Amplifier (FCMA) Soft starter for low starting current. FCMA soft starter will have suitable By-pass contactors and controls to ensure full voltage running of the motor. FCMA soft starter will be indoor duty, rugged in construction, user friendly and maintenance free.
  FCMA Soft starter for HT conveyor motors will be connected to motor at neutral end with suitable enclosure to prevent the dust entry.

• Soft starter will be provided for LT motors of rating more than 75kW.

6. UPS system consisting of SMF battery bank for 30 minute back up incase of power failure, Battery charger, UPS Power distribution boards & sub-distribution boards for distribution of UPS power supply to control & Automation equipments, Instrumentation system equipment, FDA system, Weighing system & any other equipment as per requirements.

7. Local control stations housing push buttons, indication lamps etc. for all drives. LCS for LT motor above 45kW and HT motor will have Ammeter also. LCS for conveyors will have belt sway switch bypass.

8. Power distribution boards (PDB) with two incomers and one bus coupler for repair network like welding sockets, maintenance cranes and hoists. All PDBs to be mounted in Technological/Auxiliary/Service buildings (Other than Electrical room) will have double doors.

9. Main Lighting Distribution Boards (MLDB) with two incomers and one bus coupler for Power supply to various Lighting distribution Boards (LDB).
  Adequate nos. of LDBs and Sub Lighting distribution boards for providing power to light fittings.

10. Emergency lighting distribution boards (ELDBs) with two incomers and one bus coupler for Power supply to various Emergency Sub Lighting distribution Boards (ESLDBs).
  Adequate nos. of Emergency Sub Lighting Distribution Boards (ESLDBs) for providing power to emergency light as given Emergency lighting in all Junction houses, Process / technological buildings, pump houses, compressor houses, conveyor tunnels, underground premises, LTSS, Dispatcher / Control rooms,
staircases, entry / exit of building, office rooms, attendant / operators rooms, shift in charge rooms, canteen / rest rooms etc.

- 10% Emergency lighting in conveyor galleries.

11. DCEM Brakes will be used for Conveyors and brake panels will be housed in MCC room.

12. All LT motors for conveyors will be S6 duty and will have class F insulation with temperature rise limited to class B. Inverter duty motors (used for VFD application) will have class H insulation with temperature rise limited to class F.

13. Surge protection device will be provided at the incoming side of MCCs, VFDs, PLCs/Remote I/O stations etc. to protect the system/equipment as required.

14. All field devices, valves, safety switches like Pull chord switches and belt sway switches, zero speed switch, chute jamming switches and Proximity switches, Warning hooters, photo-electric sensors, level sensors, relays, limit switches, binary encoders, position transducer, isolators, speed sensors etc. as necessary for the process and control of the material handling equipment / system and its all associated / auxiliary equipment / systems.

Addressable type PCS, BSS, ZSS and Belt rupture protection switches will be provided for all new conveyors.

Proximity type Limit switches will be used for shuttle conveyors, tripper car etc.

Sensing distance of proximity in the Zero Sped Switch will be 60 mm.

15. All HT / LT Power, control, signal, communication cables (fiber optic / electrical), special cables, rubber insulated flexible cables, illumination cables etc. as required.

All HT and LT Power cables will be XLPE insulated.

All HT Power cables will be 11kV (UE) grade and FRLS sheathed.

LT Control cables will be PVC insulated and minimum size will be 2.5sq. mm.

16. 415V, 100A interlocked switch socket outlets for repair network, welding sockets at different floor, premises, buildings and area of Ore Handling Plant. Maximum 3 nos. Welding sockets will be connected to one feeder with 100Amp MCCB rating & minimum size of cable will be 3.5 x 70sqmm.

Wagon Tippler Building will have adequate nos. of circuits from PDB
so that minimum 4 nos. welding machines can run at a time.

17. 240V, 15A and 24V, 5A receptacles from Lighting Distribution Board / Sub Lighting Distribution Board.

18. Load break isolators for maintenance crane, hoists, tripper car etc. to be located near the equipment.

19. Power and control junction boxes for termination of field cables.

20. Power trolley line conductor (DSL) / Festoon Cable trolley system / Plastic Cable Carriage system including rails / angles, supporting brackets, insulator assembly, junction box etc. will be provided as follows:
   - Festoon Cable trolley system for hoists etc.
   - Plastic Cable Carriage system for power and control trailing cables for Side Arm Charger, shuttle conveyors, EOT cranes etc.

21. Cable Reeling Drum with stall torque induction motor will be provided for Tripper Car.
    Tripper car will have interlocking of chute clogging switch with conveyor through wireless radio communication. Interlocking with the CRD control cable will be given as back-up.

22. Illumination of the plant covering new storage yards, wagon tippler inhaul and outhaul area, wagon tippler area, Road in and around the proposed Ore Handling Plant, Sub-station rooms, MCC rooms, Control rooms, Ventilation rooms, conveyors, Junction houses, various technological / auxiliary buildings and other installations of the plant by providing Lighting Transformer, Main Lighting Distribution Board, Lighting Distribution Boards, Sub-lighting Distribution Boards, Feeder pillars, Light Fittings, Lighting towers, high mast, low voltage switch sockets, conduits, Ceiling fans, Exhaust Fans, all lighting cables etc.

    Total plant lighting system will comprise of the following categories of lighting system.
    - Normal /240V AC lighting system.
    - 24V AC maintenance lighting system.
    - Emergency lighting system.

23. Contractor will provide Emergency lighting (apart from ELDB) from UPS distribution board for the following areas.
    - LTSSs / Electrical premises
24. Portable Emergency lights will also be provided in strategic areas like LTSSs, Electrical premises, control rooms / Despatchers, staircases, entrance of cable tunnels / basements, escape routes, attendant / operators room in the technological buildings etc.

25. Complete electrics including motors, control panel, LCS, Brakes with panel, field devices, cables etc. for Conveyors, Screens, Actuators, valves, gates, vibro feeders, belt feeders etc. as per technological requirement.

26. Completes electrics including motors, control panel, LCS, Brakes with panel, field devices, cables etc. for Shuttle conveyors, Tripper cars, Cranes, Hoists etc. required under Ore Handling Plant.

27. Completes electrics and load cell for Weigh feeders, Weigh hoppers, Belt scales etc. as per technological requirement. Conventional load cell type Belt Weigh Scale / non-contact type Belt Weigh Scale will be provided as per site requirement. Type and location of them will be decided during detailed engineering in consultation with Employer / Consultant.

28. Completes electrics required for Suspended magnets, In Line Magnetic Separators, Metal presence detectors etc. as per technological requirement.

29. Complete electrics, controls, instruments, level controllers, solenoid valves, Bag filters, Timer controls etc. for the Dust suppression system, Dust extraction system, Ventilation, Air Conditioning system, Compressor required under Ore Handling Plant (Part-B).

30. Completes electrics including motors, control panel, LCS, level sensors, cables etc. for sump pumps, slurry and dewatering pumps will be provided in underground floor of technological building/ Junction houses, Tunnels, cellar etc. 415V, 100A Sockets will also be provided near sumps.

31. Completes electrics including motors, control panel, LCS, level sensors, cables etc. for all pump houses, fire fighting system etc.

32. Complete electrics for Bin vibrators with rectifier panels and Air Blaster with solenoids, control panels, cables etc. for Bunkers as required.

33. Complete electrics for sampling systems covering motors, control panels, cables LCS etc. as required.
34. Scope of work and Battery limit for Electrics and Automation for upgradation / modification of existing drives / mechanism are defined in the Clause No. 4.10.11.

35. Automation system of OHP (Part-A) will be interfaced with Automation system of New OHP (Part-B) so that entire OHP consisting of existing OHP, new OHP (Part-A) and proposed OHP (Part-B) can be operated in an integrated way from a common automation platform.

36. Complete electrics for Wagon tippler and Side Arm charger (SAC).
   - Motors with necessary accessories and brakes.
   - Conventional type Control panel, VVVF drive panels, PLC panel at Electrical room and Control panel on SAC.
   - Control desk both at control room and on SAC. Provision in control desk for control of Dust Suppression system for Wagon Tippler.
   - Weighing facility with load cells for recording and transmitting data of incoming materials to Despatchers D1 & D2 and central control room.
   - Local Control Station and Field devices such as actuators, valves, photo-electric sensor/relay, limit switches, proximity switches, encoders, position transducer, isolators, safety switches, speed sensors, junction boxes; warning hooters, Rail Clamp, Earth shoes etc.
   - Plastic Power cable carrier system and necessary Flexible cables.
   - Air Conditioning / Ventilation facility for Electrical panel room and Control room.
   - All power, control and special / instrument cables, cabling, terminations etc.
   - Complete earthing of machine including rail earthing.

37. Complete electrics for Paddle feeders including Motors with necessary accessories and brakes, Control Panel, VFD, Brake panel, Local Control Station, control desk, separate Power CRD & Control CRD, Field devices such as limit switches, proximity switches, position transducer, isolators, safety switches, speed sensors, junction boxes, power, control and special cables, earthing etc.

38. Complete electrics for Stacker and Reclaimer including the followings:
   - VCB without protection with manual and electrical ON and OFF
facility on the ground and the machines.

- Motorised cable reeling drums (power & control) including flexible cables, stalled torque motors, slip ring boxes, Cable guide and clamp, Power and control Junction boxes etc.
- Dry type Transformer will be wheel mounted and with suitable protection.
- AC drive motors with DCEM / Thrustor Brakes.
- Conventional type Control Panel, VVVF AC drives, Relay panel, Resistance boxes, Brake panels, LCS, junction box etc.
- Long Travel for Yard Machine will be VVVF drive. Separate VVVF will be provided for Right & Left side of drive. Each VVVF will have capacity to run all travel drive in case of emergency.
- 2 nos. Lighting Transformers of adequate rating in parallel for yard machines illumination.
- Complete electrics for hydraulic drives and hydraulic cylinder with necessary accessories.
- Anemometer and motorised rail clamps.
- UPS, PLC, HMI stations with necessary hardware and software for Radio communication with the respective Control room / Despatcher PLC. A provision will be kept for remote programming, interlocking and status monitoring etc. Radio communication will be in addition to hardwire interfacing between Machine PLC and the Despatcher PLC through CRD control cable for minimum interlocking requirement.
- Control desks, Fault Annunciati on panels and programming unit.
- All Safety switches / devices (including pull chord, belt sway etc.), Limit Switches, instruments, Tacho-generator, Pulse Encoder, Warning hooters, anti collision feature, chute jamming switch, Zero speed switches, material sensing probe etc. as required.
- HT and LT power, control and special/ instrument cables etc.
- Suitable indoor and outdoor Illumination with lighting Transformer, lighting DBs, 240V and 24 V socket outlets.
- 415 V Welding sockets.
- Complete earthing of machine and rail earthing.
- Air conditioning system for Electrical panel room / Control room and
operator’s cabin.

- Telephone and Walky-Talky for voice communication between machine and Despatcher/central control room.

39. PLC based Level–1 automation system will be provided as mentioned in the automation chapter for running the new and existing material handling plant in an integrated manner.

40. Total 20 Nos. CCTV cameras with cleaning facility will be provided with monitors at Despatchers / Control rooms for extensive monitoring of OHP. Few tentative location will be as follows:

- 2 Nos. for new & existing OHP Yard.
- 1 No. at new Wagon Tippler.
- 1 No. at new Track Hopper
- 1 No. at JH-Z10.
- 1 No. at JH-Z15.
- 1 No. at JH-N102.

Exact locations of the CCTV cameras will be finalised during detailed engineering.

41. Electrical equipment will be supplied as per the Make list given in GTS (GS-13). However, in case of non-availability or delay in delivery, the Contractor will take prior approval of BSP/MECON for additional make before ordering. Make of Plastic Cable Carrier system will be IGUS / Kable Schlepp.

III CONTROL ROOMS, ELECTRICAL PREMISES, VENTILATION, AIR-CONDITIONING & FDA SYSTEM

1. All civil construction work for cable basement/cellar, cable tunnel and concrete cable channels, MCC Rooms, Despatchers/Control rooms, Electrical premises etc. including their associated utility areas like Ventilation rooms, Stairs, Toilet etc.

2. Renovation, Modification of existing Despatcher D2 at JH-10 will be considered, Approx. size of cabin will be 10X6m. Paneling, False roofing, False flooring, split AC- 4nos., 2Ton will be considered. Power supply for the AC will be taken from Employer’s DB.

3. Cable Tunnels / Structures for overhead cable bridge as required.
CHAP-4.10 ELECTRICS

4. LTSSs / Electrical premises, Dispatcher/control rooms, overhead cable bridge etc. will be designed considering the features as per GTS.

5. Intelligent, microprocessor based, addressable type automatic fire detection and alarm system for all MCC rooms, Electrical Premises, Cable cellar, Despatchers/Control rooms using smoke detectors, heat detectors with cross zoning etc.

6. Air conditioning system for Control rooms / Despatchers (housing Operator control/HMIs, Servers, Engg. stations, Instrument panels, UPS etc).

7. Air conditioning system at (35 deg C max.) for premises housing Intelligent MCCs, MCPs & VVVF panel rooms and other local control rooms complete with instruments, electrics, controls etc.

8. Ventilation system for substation building, Cable tunnels, Cable basement / cellar consisting of suitable capacity fan, Pumps, GI ducting etc.

9. Exhaust ventilation system for toilets, storerooms, Battery rooms etc.

10. Excavation, back filling, and leveling of cable trenches within battery limits.

11. Cable supporting structures in the Electrical Premises, Despatchers / control rooms, cable cellars, cable tunnel, cable channel or overhead cable bridge for interplant cabling.

IV EARTHING AND LIGHTNING PROTECTION

1. Measurement of soil resistivity test at site for designing earthing system.

2. Lightning protection system for entire plant including Air termination, separate dedicated earthing stations, conductors, testing links, interconnections and accessories as per IS.

3. Supply and installation of complete earthing system including earth pits, earth grid with GI strips for the substations, neutral earthing of transformers, earthing of all electrical equipments in electrical premises, Junction houses, process / technological building etc.

4. Special earthing system (including earth pits, earth grid with GI strips, Copper Cables as required) for earthing of PLC, RIO panels, VFD, other Electronics equipment & automation system etc.
V ERECTION ACCESSORIES, SPARES, SAFETY ITEMS, DOCUMENTATION & OTHER MISCELLANEOUS ITEMS

1. Supply of all erection accessories and materials, all steel members (angle, channel, plate, steel sheet, etc.) for installation of electrical equipment, GI pipes, GI conduits, bends, clamps, nut, bolts, ladder and perforated type cable trays, tray installation materials & accessories, cable supporting structures, heat protection materials, flexible metallic hoses, sealing materials for openings/conduits, double compression cable glands, cable lugs, cable tags, cable fasteners, insulating tapes, ferrules, RCC slabs, sand, bricks for under ground cable laying, GI pipes for protection of cables at road crossings and other places, cable markers, cable jointing & termination kits and materials, earthing strips of different sizes, junction boxes, pull boxes, heat resistance paints and all consumable materials for complete laying & termination of cables, erection of electrical equipment and earthing system etc.

2. Construction power supply will be provided by the Employer at one point. Further distribution including PDB, power (both incoming and outgoing) and control cables, cable trays, cable laying etc. will be in the Contractor’s scope.

3. Submission of basic and detailed engineering drawings, design calculations etc.

4. Supply of As-built drawings, operation and maintenance manuals. CD in duplicate and reproducible of all As built drawings.

5. Supply of all commissioning spares as required till the plant is commissioned and handed over to BSP.

List of minimum commissioning spares to be supplied as per attached Annexure E-03.

6. List of two years Maintenance / operational spares will be finalized during detailed engineering stage.

7. Supply of Special tools & tackles, measuring instruments etc. as per Annexure - E-04. If additional items are required during the erection, commissioning etc., the same will be supplied by the Contractor without any price implication.

8. Canopy of all outdoor electrical equipment, if any.

9. First fill of all consumables, printers, papers, cartridges, floppy, CDs etc.

10. Safety items like hand gloves, shock treatment charts, discharge rods, rubber mats (of required voltage classes) in front and rear of all panels,
danger/caution boards, fire extinguishers, fire sand buckets, nicely framed As built Single Line Diagram of LT PCC/ LTSS, MCCs, PDBs, MLDBs, LDBs, SLDBs keys and key boxes etc., keys and key boxes, etc.

11. Portable fire extinguishers, sand buckets & other fire fighting equipments as per statuatory requirements at each sub-station.

12. Supply and installation of GI pipes for protection of cables at road crossings and other places where cables may be subjected to mechanical stress and damage.

13. Supply and installation of cable supporting structures in the LT substation building, cable cellars, cable tunnel, cable channel or overhead cable bridge for interplant cable routing.

14. Walkable Cable Bridge between Employers’s HT Substations to Contractor’s LTSSs and further for routing outgoing cables to different consumers / buildings etc. as required.

15. No underground buried cable will be provided. Cables will be laid either over ground through structural cable bridge / conveyor gallery (for less cables) or through concrete cable trench covered with pre-cast slabs (only in covered / indoor area).

16. Cables of one area/conveying route will not cross and will not be laid through conveyor of other area/conveying route.

17. Minimum one no. Electrical Area Repair Shop in Ore Handling Plant (minimum size 18M x 9M) will be considered with a facility of rest room, repair area, store, provision to keep tools and tackles, measuring instruments/testing instrument including meger, clamp tester, hand held tachometer, CRO, multimeter, vibrometer etc.

 Provision for following in the Electrical Repair Shop will be provided :

- 3 Ton Manual Hoist will be provided.
- Testing motor upto 30KW
- Power supply feeder for 2 Welding Transformer, power hexa and one drill m/c

18. Furniture for the monitor, control rooms etc.

19. Training of Employer's engineers at manufacturer's works / training centers for Automation system, UPS system, AC drives, Weighing system etc.

20. Any additional items/equipment which is necessary for achieving specified performance and completeness of the system will be
provided by the Contractor within the time schedule unless it has been excluded from the scope of the Contractor.

4.10.04 Approval of Statutory Authorities

The Contractor will obtain necessary approval of statutory authority as per rules of State Government and Central Electricity Authority for the work under his scope, before energizing/charging the equipment. However, Employer will extend all assistance in this regard, like submission of application, relevant documents and payment of statutory fees etc.

4.10.05 Installation

For installation work at site, the contractor will be fully responsible for arranging the required tools and tackles, welding sets, pipe bending machine, cable crimping tools, gauges, scaffoldings, ladders, temporary water and power connections.

On completion of the installation but before energisation of the system, all installation will be physically checked and properly tested. These checks and tests will be conducted by the contractor under the supervision of BSP / MECON. The contractor will furnish the final status and test results. Any defect observed during such check and tests will be rectified by the contractor free of cost within contract completion period.

All clamps brackets, bolts, nuts, screws, markers, ferrules, lugs and glands and other hardware necessary for erection work, will be included in the scope of work and will be arranged by the contractor. Equipment will be painted to withstand the heavily polluted and saline environment prevailing in at site.

4.10.06 Design basis for equipments & installations

A) Voltage Level:

- Control Voltage – 230V AC
- PLC input interrogation Voltage will be 230V AC and output voltage 24V DC.

B) Ambient conditions of shop units
Generally following ambient temperature will be considered in Electrical / Control Rooms.

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Area</th>
<th>Ambient Temp</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Electrical Rooms</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>LT Sub-station/ switchgear room (Pressurized ventilation)</td>
<td>+ 45 Deg. C</td>
</tr>
<tr>
<td>2.</td>
<td>MCC rooms (housing intelligent MCCs, VFD panels, TR controllers, RI/Os etc.)</td>
<td>+ 35 Deg. C</td>
</tr>
<tr>
<td>3.</td>
<td>Cable basements / tunnels</td>
<td>+ 50 Deg. C</td>
</tr>
<tr>
<td>B.</td>
<td>Control Rooms</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Control rooms – Air conditioned</td>
<td>+ 24 Deg. C</td>
</tr>
</tbody>
</table>

- Equipment selection and dating will generally be based on ambient temperature of + 50 Deg.C. For specific areas and shops, the ambient temperature conditions indicated above will be taken into consideration and equipment suitably derated wherever necessary.

- Equipment installed in MCC rooms/Control rooms will be designed for + 50 deg C so that in case of failure of Air-conditioning/ventilation facilities also the equipment should not be affected.

- The equipment should be suitable for smooth, efficient and trouble free service in the tropical humid climate prevailing at plant site and under the ambient temperature conditions indicated above for the different shops and areas. In hot areas of higher temperature conditions, the equipment will be adequately protected against damage from radiant heat and hot air.

- The equipment will be designed to give efficient and reliable performance under heavy steel mill conditions and will be such that the risks of accidental short-circuit due to animals, rodents and vermin are obviated.

- The quantities of equipment, cables, cable terminations, straight through joints, cable supporting structures, earthing / lightning and erection materials, will be as per actual requirement in accordance with the approved detail engineering drawings.

- All equipment will strictly conform to the General Specification, except where any deviations have been explicitly spelt out, specifically discussed and mutually agreed upon between the Contractor and the Employer.
- The detailed specification and schedule of quantities will be worked out based on the detailed engineering to be carried out by the Contractor, for complete and proper execution of the specified tasks.

- The final ratings of the circuit breakers, CTs, busbars will be adequate for the actual loads and considering the derating factors as substantiated by temperature rise test on the 415 V switchboards. All CT ratios / VA burdens, ranges of meters and instruments, types of relays and relay setting ranges will be submitted for Employer’s approval during detail engineering.

- All HT cables will be 11 kV (UE) grade of size 3x185 sq mm (min).

4.10.07 Design basis for Electrical Premises of Ore Handling Plant

GTS is to be referred for designing of electrical premises & layouts, selection of equipment and installation. In addition to this, following points will be considered.

- Motor Control Centre (MCC), RIO stations, PDB, MLDB etc. to be installed in various MCC rooms, will be provided near various shop/technological units.

- Wherever required, MCC rooms and LT substation rooms (including rooms for distribution transformers) can be combined with separation wall and independent entry for both LTSS and MCC rooms considering the location of Substation and shop unit. Each LTSS building will have store facility.

- No under ground cable basement to be provided below MCC buildings.

- PLC, CPU panels, Operator panel / HMIs, Engg stations, UPS, UPS battery will be located in the air-conditioned room in the control room floor.

- For high rise buildings structural walkway will be provided for maintenance of light fittings.

4.10.08 Design Basis for Illumination System

GTS is to be referred for designing of Illumination System, selection of equipment and installation. In addition to this, following points will be considered.

- Illumination levels of all units will be as indicated elsewhere in this specification.

- The maintenance factor for design of illumination level will be considered as 0.6 for all areas.
- For arriving at utilization factor, manufacturer's recommendation will be followed.

- For Illumination of Track Hopper Inhaul & Outhaul area, 2 nos. High mast on each side will be provided. (100m on either side).

- For Illumination of Wagon tippler Inhaul & Outhaul area 2 nos. High mast on each side will be provided. (100m on either side).

- All rooms with false ceilings will be provided with recessed type decorative mirror optics fittings.

- All MCC Rooms will have lighting switches near doors.

- All decorative type fittings will be mirror optics type.

- All buildings will be provided with peripheral lighting.

- The power factor of lighting system will be improved to 0.9 by providing in built capacitors with individual light fittings.

- Area, outdoor and peripheral lighting will be fed from separate LDB/SLDBs having two modes of control - AUTO and Manual. Under AUTO mode lights will be automatically switched ON/OFF through timers where as in Manual mode, lights will be switched ON/OFF through local control station located in Despatcher/Control room. Selector switch for mode of control will be located on local control station.

- Lighting in conveyor gallery and junction houses (Floors above ground) will be connected to separate lighting circuit and the same will be switched ON/OFF by PLC based control from HMI at Despatcher.

- Area lighting, wherever applicable, will be provided through 400W, HPSV flood light fittings mounted on lighting towers.

- Road lighting will be provided with 250W HPSV street light fittings.

- Well glass light fittings will have threaded covers.

- All the offices will be provided with ceiling fans.

- For indoor lighting, outgoing feeders in MCB DBs will be 20A SPN MCBs. Each feeder will not be loaded more than 2 kW. Incomer to MCB DB will be suitably rated heavy-duty switch and ELCB for detection of leakage current.

- For area and road lighting, 3 phase & neutral feeders may be used and accordingly suitably rated 4 core cables may be provided.

- HPSV lamp fittings will be provided with external electronic igniters and a built in sensor to sense failure of lamp and switch off igniters.

- Single phase/three phase circuits are connected to RYB phase such that total connected load to each phase equal and phase balancing is achieved.
- Stroboscopic effect will be corrected by providing power factor improvement capacitor and power phase distribution.

- Point wiring will be done through PVC insulated PVC sheathed copper cable. Minimum 6 sq.mm aluminum cable for 15A socket outlet and min. 4 sq.mm cable for lighting circuit will be considered.

- Single phase 3 pin 230V, 15A and 5A, switch-socket outlets will be provided with interlocked switches (male and female units) at the following locations:
  
  o At each floor of building at every 30 m intervals or minimum one for each row/side.
  o Two numbers each in switch gear room, cable basement, control room and MCC room.

- Group control and sectorial control will be envisaged through MCBs provided in the respective LDBS. Separate control switches will be envisaged for light points and fan points.

- Near every chute in Junction houses and other technological buildings 24V, 5A sockets will be provided for maintenance lighting by hand lamp.

### 4.10.09 Cable Routes, Cables

Contractor will note the following requirements.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Requirement</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Inter shop cable routing</td>
<td>Through overhead cable bridge/structure/Cable Tunnel/ Conveyor gallery.</td>
</tr>
<tr>
<td>2.</td>
<td>Bottom most level of cable trench in MCC room</td>
<td>Above ground level</td>
</tr>
</tbody>
</table>

### 4.10.10 Control and Operational Requirement:

1. All the necessary controls, interlocks and annunciation as required for smooth, efficient and safe operation of the plant will be provided.

2. Contractor will provide suitable PLC based automation system including all hardwares and softwares to run the existing and new material handling plant in an integrated manner.
For integrating the existing drives of Ore Handling Plant and priority conveying route system for Sinter Plant, Junction House-27/JH-42 etc. in the new PLC based automation system, the existing 5-60/5-80 series PLC of M/s Rockwell make (located at Despatcher D1 & D2) will be upgraded by replacement of Processor, communication cards etc. to make it compatible with new PLC system retaining the existing RI/O panels and hardware. Quantum series PLC (of M/s L&T make) located at exiting Despatcher-D3 near JH-27.

For integration of OHP (Part-A) being arranged by the Employer through a separate package, suitable gate way will be provided in the automation network. Integration and interfacing will be done to run the entire ore handling plant and Priority Conveying route system in an integrated manner.

Automation configuration diagram is enclosed to refer in this regard.

3. All HT drives will be provided with extensive monitoring facilities for fault detection and alarm annunciation. Alarm annunciation will be provided for over winding temperature, over bearing temperature, overload etc.

4. Alarm annunciation system will cover all the equipment of the electrical system.

5. Mode of control:

   i) Plant will have four modes of control.

   - Local de-interlock mode for control of individual drive motor from local push button station (LCS).
   - Local interlock mode for running the drive motor in sequence interlock mode from LCS.
   - REMOTE interlocked individual drive control from the HMI at Dispatcher/Control room.
   - REMOTE interlocked route wise control of conveying system from the HMI at Dispatcher/Control room.

   ii) Mechanism selector switch for selection of above modes of operation of each drive motor will be provided in the MCC / Control Panel / DFP. A selector switch box will be provided near respective Remote I/O station for HT motors. Local selection of any drive will be shown on the HMI screen with some sort of caution.
iii) The local de-interlock mode is meant for testing and maintenance purpose only. However, all safety interlocks (Pull Chord Switches, motor Over Load & emergency stop etc.) will be connected in LOCAL de-interlock mode of operation. In local de-interlock mode the mechanism is not interlocked with other drive and after receive of permission from operator / PLC, drive / equipment can be started from LCS independently.

The stop P.B. of local control station will be able to stop the drive mechanism selected for any mode of control. Hooter PB will be provided in LCS for pre start warning.

iv) In Local interlock mode the drive / equipment can be run in sequence interlock from LCS. Selector switch will be put in local interlocked position and permission from operator / PLC will be a condition for operation in this mode. Start, stop, motor Over Load, emergency stop, Pull Chord and Belt Sway Switches, Zero Speed Switch, chute jamming switches will be connected in the circuit in addition to sequence interlock with successive drives. All the above will be connected through hardwire.

v) In Remote interlocked individual mode of control the drives/ mechanisms in the material flow path will be started in succession sequentially opposite to direction of material movement from operating station / HMI. On tripping of any conveyor/drive/ mechanism, all the mechanisms feeding to the affected (tripped) mechanisms will stop according to material flow diagram. All the mechanism selector switches of the selected material flow path will be set to REMOTE position in this case. Programmable Logic controller will be used for the control, interlocking, operation, and monitoring of the equipment.

vi) In Remote interlocked Route-wise control, following operations is to be carried out from HMI by the operator before starting of a conveying route:

a) Selection of material flow path including source and destination as per requirement.

b) Selection of mechanisms within the selected material flow path.

c) Selection of switching devices, flap gate etc. in a conveying route

d) Selection of control mode in REMOTE of master selector switch for each material flow path block chain.

On receiving start permissive signal from HMI, the operator will give ON command to start the desired conveying route.
vii) Normal stop and Emergency stop of mechanism for each material flow path, P.B. switches for pre-start warning signal for each material flow path, start & stop P.B. switches of drives with independent operation etc. will also be mounted on desk/ HMI.

viii) A pre-start audio warning signal through motorised hooters will be given in the premises where the mechanisms are to be started before start of the mechanism. The duration of the pre-start audio signal will be as per requirement. Sequential start of the mechanism will be possible only after the pre-start audio signal is over.

ix) The conveying system will be integrated with the associated auxiliary / other system for interlocking, sequencing and monitoring.

x) **Stopping of mechanisms**:
   
a) For regular stop, the feeding equipment will be stopped first to stop the material flow in the conveying path and then after some time delay the equipment in the route will be stopped in sequence from feeding end ensuring no material is in the conveying path.

b) Emergency stop push button will be provided on the Control desk for emergency stop of material flow path.

c) In case of tripping due to fault of any drive, the part of the conveying route before the faulty drive will stop. There will have signaling of the stopped mechanisms by changing colour in the graphic. This will give an indication of the fault.

6. **Signaling**:

A) Status of ON, OFF, Trip/Fault, Route selection etc. for all mechanisms of conveying system, dedusting system, dust suppression system, weigh feeder etc. will be available in the operator work station.

B) When a drive in a conveying route is shifted to local controls, indication will be available in the HMI.

C) The annunciation will be provided on HMI for each drive fault and actuation of safety and limit switches.
   
a) Annunciation for O/L & fault of each drive motor.

b) Individual annunciation for all HT motors trip due to high bearings and winding temperature.
c) Combined fault HT switch gear for Each HT motor including power supply to MPR failure separately.

e) Switching devices, flaps etc failed to close or open.

f) Individual annunciation for HT motors bearings and winding temperature high alarm.

g) Individual annunciation for following conditions of electrical system:
   - 11kV and 6.6 kV switchgear trouble
   - 415 switchgear trouble
   - Transformer trouble alarm.
   - Combined fault/trouble in bag filter system of D.E
   - Unhealthiness of various machines
   - Any other failures

h) Every unplanned stoppage or abnormal condition will be brought to the notice of operator.

7. Current readings of all HT and LT motors connected to Intelligent MCC will be available in HMI at Dispatcher.

8. Drainage / sump / slurry pumps will be provided with Auto/Local mode of operation. Under automatic mode of operation any one of the pump motors will start automatically at set level and if the level rises further the second/ reserve pump will start automatically at second set level and both the pumps will stop at set low level. If the first pump trips, second pump will start automatically. Emergency high level annunciation will be available in the control room.

   Under local mode of operation, the pump motors will start/stop locally through local control boxes depending on level.

9. For fire fighting system, suitable control system will be provided for main fire water pump, jockey pump, hydro pneumatic tank etc. with line pressure switch.

4.10.11 ELECTRICS AND AUTOMATION FOR EXISTING DRIVES

Scope of work for Electrics and Automation will be as follow for upgradation / modification and integration of existing conveyors / equipment :

For Reversible Shuttle Conveyor J9B-RSC1 :

• Contractor will dismantle existing motor, Festoon Cable trolley system, associated power and control cables, related to the particular drives and replaced by the new drives / Plastic Cable Carriage system for power and control trailing cables and associated cables.
• Supply and installation of new Limit switches for additional feeding points.
• Necessary cabling for additional feeding point.
• Existing feeders of the MCC will be modified by the replacement of the relays, components etc. to match with the upgraded drives.
• Scheme and Software modification for selection and feeding of additional points.

The approval / clearance of BSP / their representative will be taken before carrying out new installation for upgradation / modification for existing conveyors / equipment.
For the Employer’s approval / clearance, Contractor will submit detailed shut down plan of the existing drives indicating temporary arrangement to be made by the Contractor for running suitable alternative conveying routes so that plant can maintain production level.

In the temporary arrangement in case any electrics is required, the same will be provided by the Contractor without any price implication.

List of Existing Conveyors controlled from MCC and PLC/ RI/O Panels :

Details of existing drives with MCC No. / RI/O Panels and their location are as indicated below. Further details , if any , will be furnished during detailed engineering stage.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Existing Equipment / Conveyor</th>
<th>MCC No.</th>
<th>MCC / R-I/O Location</th>
<th>Nos. of RI/o Panels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Conv.-J9BC1</td>
<td>30MCC</td>
<td>Near SIS-22</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Conv.-J9CC1</td>
<td>-DO-</td>
<td>-DO-</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Sh. Travel -J9BRSC1</td>
<td>-DO-</td>
<td>-DO-</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Sh. Conv.- J9BRSC1</td>
<td>-DO-</td>
<td>-DO-</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Sh. Travel -J9CRSC1</td>
<td>-DO-</td>
<td>-DO-</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Sh. Conv.- J9CRSC1</td>
<td>-DO-</td>
<td>-DO-</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>STC-4</td>
<td>-DO-</td>
<td>-DO-</td>
<td>2 Nos.</td>
</tr>
</tbody>
</table>
4.10.12 TECHNICAL SPECIFICATION

4.10.12.1 General

GTS will be referred for technical specification of various electrical equipment. However for specific application following TS will be considered.

4.10.12.2 Wagon Tippler and Side Arm Charger

01 Variable Voltage Variable Frequency Converters (AC Drives):

- AC drives will have communication facility with PLCs for data transfer and speed reference set point.
- Software of AC drives will be developed in such a way that after over voltage or under voltage when the drive trips, the AC drive will be automatically resetted without any manual intervention after normalising of the voltage.
- Remaining features will conform to General Technical Specification (GTS).

02 Programmable Logic Controller (PLC) :

- The system will be complete with CPU, I/O racks, memory, key board and monitor. HMI will depict graphics of various mechanism operations and also provide alarm annunciation system. Spare CPU with loaded software will be installed in the PLC panel.

- Communication between PLC and AC drive will be possible for smooth operation of the Tippler. PLC will have facility to communicate with Despatcher-D1 / Central Control room PLC. All the required hardware and software for these communications will be provided.

- PLC will perform the following task :
  - Logic interlock functions, control & supervision of drives & solenoid valves.
  - Automatic sequential operation of various drives.
  - Status indication & signaling.
  - Fault monitoring & annunciation.
  - Diagnostic features to recognise and display faults.
- Communicate with Despatcher-D1 / Central Control room PLC.

- Remaining features will conform to General Technical Specification (GTS).

03 Control Desk :

- Control desk will be provided for centralised control, monitoring of all the drives of Wagon tippler and SAC, including annunciations of all the faults, over-load trip condition of drives, failure of safety devices, all faulty conditions, warning conditions, over/under positioning conditions, over travel conditions etc. Separate and independent annunciation for each will be provided instead of group annunciation.
- Control desk will have suitable nos. of status indication lamps to cover complete dust suppression system, SAC positions & movements including arm positions etc. and also for down stream equipment of wagon tippler.
- A control desk will be provided also on the side Arm Charger.
- Remaining features will conform to General Technical Specification (GTS).

04 Weighing System :

Microprocessor based weighing system will be provided. The load cell will be magneto – elastic type / strain gauge type, suitable for over load up to 300% of their nominal load. Minimum 4 (Four) numbers of load cells are to be provided at each weigh bridge integral with wagon tippler table. Accuracy of weighing system will be +/- 0.1% or better. For other features Specification for Belt scale will be referred.

Indicating cum data logging type weighbridge for weighing both loaded and empty wagon will be complete with PC based operating station in the wagon Tippler Control Room.

The supply will be complete with the following:
Load cells, signal converters, PCs, 19” colour monitor, keyboard, mouse, etc.), original licensed operating software and application software, inkjet printer, UPS, control room furniture for installation of PCs, printers, power distribution boards, etc.

The capacity of the weigh bridge will be adequate to permit passing of 180 metric tones weight of shunting loco at the speed of 8 Km per hour.
• Remaining features will conform to General Technical Specification (GTS).

05 Control and Operational Requirement

• All drives and mechanisms will have Auto, Remote -interlocked mode and Local mode controls. Local controls will be provided and normally it will be used for maintenance and testing purpose only. Only safety interlocks will be covered in Local control. STOP push button of Local control will be able to stop the drive/mechanism selected for any mode of control.

• It will be possible to operate the side arm charger (SAC) both from control panel located in the Operator cabin of SAC and Control desk located in the control room. Auto operation of SAC along with wagon tippler operation will be done from Control desk. SAC operation from its control box in the SAC operator cabin will be done as required after the receipt of instructions / permissive from control desk operator.

• Operation philosophy will be developed in such a way that normally one operator will be required to operate the wagon tippler and SAC from wagon tippler control room and one helper near tippler table to de-couple the leading wagon from the rake. Emergency stop switch will be considered at WT and SAC in addition to control desk.

• The loaded wagon to be tippled will be decoupled manually from the rest of the rake and the person doing the decoupling operation will press a switch installed near-by to indicate to control room that decoupling operation is complete. Subsequently, pulling of the wagon by SAC, placing it on wagon tippler, return of SAC to wagon rake for start of next cycle, tippling of wagon by wagon tippler etc. will start automatically in proper sequence.

• The SAC will pull and place the decoupled wagon over the tippler. Once the wagon is placed on tippler deck and SAC clears the tippler deck, tippler will clamp the wagon, tipple it, return to its original position, declamp the wagon and other operations as required. The wagon vibrator will operate automatically, if selected for auto-mode when the wagon is in inverted position. The type of wagon being unloaded, identification of sick wagons etc. will be registered in Control desk by the control room operator.
• The water spraying for dust suppression will start automatically when wagon is being tippled and will stop when the tippler is not operating by establishing suitable interlocking between controls of wagon tippler and dedusting system.

• Each operational cycle will be repeated automatically till the last wagon is tippled and removed from the tippler deck. The complete operation will be done in automatic sequentially interlocked manner and some of the activities will be parallel so that system can easily achieve a required tippling rate per hour.

• Positioning of Wagon Tippler and SAC will be through proximity switches and backed-up by heavy duty rotary limit switches. All limit switches and proximity switches must work smoothly and without adjustment and mal-functions under severe conditions of vibrations. All rotary switch and limit switches should be mounted and housed with suitable vibration damping arrangement.

• Wagon counter will be provided with correction facility by authorized person to account for sick wagons.

• Laser Beam sensors with transmitter and receiver at both ends of Wagon Tippler to ensure that no other wagon is in close proximity to the wagon tippler table.

4.10.12.3 Yard machines

01 HT VCB without Protection
General Technical Specification (GTS) will be referred for detailed specification.

02 Cable Reeling Drum

a) For Yard Machines
• Two cable reeling drums, one for power and other for control will be provided on the machine. The cable reeling drum will be complete with stalled torque motors, suitable slip-rings and brush assembly, cable guides for proper paying in/paying off cables, cable layering arrangement, protection against over tension and under tension of cable, limit switches
etc. The stalled torque motor may be of slip-ring induction type with rotor resistance steps automatically adjusted depending on the position of the machine and tension in the cable.

- The cable reeling drum will also be provided with gear cam limit switch, pendulum limit switch, the directional limit switches etc. as necessary for the application. At least two spare turns of cable will be provided for each reeling drum. The traveling gear will stop when the next to last turn of cable is reached. Necessary limit switches will be provided for the same. The speed of the winding of cable will be properly matched with machine travel speed.

- The number of slip-rings for the power cable reeling drums will be four, three for power and one for earth. The number of slip-rings for control reeling drum will be as per requirement keeping at least two as spare. Slip-ring & brush-gear assembly of cable reeling drums will have dust and weather proof enclosure having inspection window suitably located. The inspection window will be readily accessible.

- The enclosure of motor will be IP:55 as per IS:4691 and the motor will have weather-proof construction.

- The cable reeling drum will be of substantial strong construction with components such as chain etc. selected for heavy duty applications.

- Flexible cable length and CRD will be adequate to take desired travel length of machine and dead turn of cable.

- To avoid damage of HT flexible cable during paying off from CRD a structural arrangement beside rail / yard conveyor will be provided to place the CRD cable. Arrangement will be such that cable will be pay off on the guided structural platform installed at one side of yard conveyor.

b) TS of CRD in Tripper car, Paddle feeders and other mobile machines will be as above.

03 Variable Voltage Variable Frequency Converters (AC Drives):

- Long Travel for Yard Machine will be through VVVF drive. Separate VVVF drive will be provided for Right & Left side of drive. Each VVVF drive will have capacity to run all travel drives in case of emergency.
AC drives will have communication facility with PLCs for data transfer and speed reference set point.

Software of AC drives will be developed in such a way that after over voltage or under voltage when the drive trips, the AC drive will be automatically resetted without any manual intervention after normalising of the voltage.

AC drive panels will be mounted on anti vibration pads.

Remaining features will conform to General Technical Specification (GTS).

04 Programmable Logic Controller (PLC):

Each machine will be provided with PLC and HMI. The system will be complete with CPU, I/O racks, memory, keyboard and monitor. HMI will depict graphics of various mechanism operations and also provide alarm annunciation system. Spare CPU with loaded software will be installed in the PLC panel.

Communication between PLC and AC drive will be possible for smooth operation of the machine.

PLC will have facility to communicate with PLC at Despatchers / central control room / HMI through radio communication and also hardware communication by CRD control cable. All the required hardware and software for radio communication will be provided.

Minimum 2 nos. field programmer for yard machines will be provided.

PLC will perform the following task:

- Logic interlock functions, control & supervision of drives & solenoid valves.
- Automatic sequential operation of various drives/devices.
- Status indication & signaling.
- Fault monitoring & annunciation.
- Diagnostic features based on logical rules to recognise and display faults.
- Communicate with respective Despatchers / Central Control room.

PLC panels will be mounted on anti vibration pads.
05 **Control Desk**

Control desk in operator's cabin will contain:

- Machine power 'ON' lockable push button and indication lights.
- Machine control 'ON' push button and indication lights.
- Selector switches for various sequences.
- Push buttons and indicator lights required for auxiliaries control.
- Master controllers will be provided as required.
- Inductive type master controller will be provided for VVVF controlled drive.
- Ammeters will be provided.
- Monitor & key board of HMI system and printer.
- The monitor of HMI system will depict the required graphics.

06 **Control modes**

1. **Local de-interlocked mode** operation from Local control station mounted near the drives and the same will be generally used for testing.

2. **Remote mode** from Control Desk:

   All the drives will be controlled from control desk located in the operator's cabin. Robust industrial type hooters & sirens will be ON before starting of machine.

Following types of sequence control will be provided.

**A. Semi-automatic operation**

- Different process sequence will be automatic. Progress of a sequence will depend on limit switches or sensors corresponding to different positions.

- Each sequence will be controlled from control desk by push button/ HMI key board.

- A sequence will start only when all the preconditions and permanent requirements including healthiness of drives and circuit are met.
• It will be possible to switchover to interlocked step-by-step mode during the operation of the sequence.

B. Interlocked step-by-step operation

• Each sub-sequence of the main sequence will be controlled from control desk by separate push button / key board.

• The progress of sub-sequence will depend on the limit switch position or sensors.
• Each movement will be started only after ensuring the necessary interlocks.
• The progress of each sub-sequence will be displayed on the control desk and monitor of HMI.
• It will be possible to switchover to semi-automatic mode only after the completion of a sequence.

C. Annunciation and indications

An alarm will be available in case of any fault. An acknowledge push button and the fault display will also be provided.

Annunciation will be provided for all faulty condition including interlocking failure, safety system failure and abnormal condition like emergency tripping, failure of all drives, rail clamp not fully open, boom position low, over tension, slackness, fully unwound conditions for CRD’s, transformer over load, temperature high, hoisting alarm limits for boom, wind pressure high, hydraulic system failure etc.

07 Special Requirement

CRD (power & control) will be provided with declutching arrangement in the cable guide mechanism for easy adjustment of cable guide.

• Suitable structure beside yard conveyor to place the flexible cable during paying off from CRD.

• Layer counter will be provided for Stacker to count nos. of layers.
• Angular position of the boom of Stacker will be displayed in the Stacker cabin.
• All yard machines will have facility to control from operator cabin and also from Despatcher / Control Room. Normally operator desk in cabin will be used. Necessary radio communication between yard
machines and control room will be considered.

- Over speed protection will be provided for long travel of Stacker.
- Suitable overground structure at one side of the yard conveyor to place the flexible cable during paying off from CRD. Both CRD will be on one side of yard conveyor.
- Separate brake panel will be provided for individual motor in all yard machine.
- For all yard machines provision of 6.6 kV junction boxes will be made for connections in line with existing practice. This junction box gets supply from the ground isolator of the machine.
- Portable emergency lighting.

4.10.12.4 Motorised Damper, Switching Device, Slide Valve, Diverter Gate, Flap Gate Etc.

01 The motor will be 3 phase squirrel cage TEFC class F insulated (temperature rise limited to 70 deg. C over an ambient of 50 deg. C), IP-55 enclosure both for motor switches & its terminal box, and with high starting torque and high stalling torque. The duty cycle will be S2-10 min or S4/ S5-1200 cycles per hour or S4/ S5-600 cycles per hour depending upon the rating and application of the actuator.

02 Each actuator will be provided with extremely dependable both 'Open' and 'Close' torque and position limit switches. The torque and limit switches will be provided with suitable means like mechanical selection, end position latching etc. for easily and accurately setting at required end position. The torque switch should not unnecessarily trip during initial unseating

Hammer blow effect. The anti-hammer feature of the torque switch latch will be available throughout travel including at end positions. Once the torque switch has tripped in either direction, it can only be reset by operation of the actuator in the opposite direction. Each switch will have 2 NO + 2 NC potential free double break contacts. Switch contact ratings on inductive circuits will be 5A AC at 230 V AC.

Actuator will be provided with motor over-riding feature like hand wheel for emergency manual operation and a limit switch will be provided which contacts will be used in the motor control circuit to forbid the motorised operation during manual operation by hand wheel. Also when the motor is switched 'ON' the hand wheel connection will be disengaged automatically. Motor operation will always have priority over manual operation.
Internal wiring will be tropical grade PVC insulated, stranded copper conductor cable of 10A rating for control circuits and required ratings for motor. All wires will be clearly numbered at both the terminal block and component ends. The voltage grade of cables/wires will be 1100V. Power terminals will be separated from the control terminals by means of an insulating cover. Separate terminal block fitted to switching unit will be provided. The terminal box will be designed for the protection class or IP-65. A durable terminal identification card showing plan or terminals will be provided attached to the inside of the terminal box cover indicating serial number, external voltage values, wiring diagram number and terminal layout.

The actuator will be suitable for operation at specified ambient temperature. All actuators will be neoprene O-ring sealed water tight and dust proof to IP-67 protection and will at the same time have an inner watertight neoprene O-ring seal between the terminal box and the internal electrical elements of the actuator, fully protecting the switch mechanism, motor and all other internal electrical elements of the actuator from ingress of moisture and dust when the terminal box cover is removed on site for cabling/maintenance.

The actuators will be operated from the Remote Control Station and Local control station (LCS) will be provided separately for local operation of the actuator for testing and maintenance purpose. Isolator along with starter for the actuator motor will be located in the Contractor's MCC. Separate power cable will be used for motor wiring.

4.10.12.5 Belt Weigh Feeders

General Technical Specification (GTS) will be referred for detailed specification of Belt Weigh Feeders.

4.10.12.6 Belt Weigh Scales

General Technical Specification (GTS) will be referred for detailed specification of Belt Weigh Scale.

4.10.12.7 Suspended Electromagnet/ILMS

The magnet will be of high permeability cast steel as per IS : 4491 with an integral terminal box of adequate size. Leads will be brought to the terminal box through a water tight sealed gland. An earthing terminal will be provided inside the terminal box. The coil of the magnet will be
designed for continuous duty for full supply voltage. The magnet will be fed from 220V DC obtained through rectifier panels.

The magnet coil will be Fiber glass wound copper wire and class H insulation will be used.

Control panel will be free standing, floor mounted, front attended, made of CRCA sheet steel of thickness not less than 2mm with IP54 enclosure class. In-comer feeder will have load break switch interlocked with the door.

Panel will have air cooled control transformer, full wave, silicon diode Rectifier Bridge having 220V DC output and complete with RC circuit across each diode, PIV of diode will not be less than 1560V.

Complete safety and protection equipment against surge voltages, discharge resistance in DC load side will be provided. Electronic temperature sensing circuits for protection against excessive temperature in the magnet coil will also be provided.

For In Line Magnetic Separator necessary electrics will be included.

4.10.12.8 Dust Suppression System

Control Panel for DS system will have necessary starter for Pump motors and 24V DC power supply arrangement for Solenoid valves. Valves will be energised either by Local Push button station or by under belt switch depend upon selection of control mode. Necessary electrics will be provided for desired operation of pumps, compressors, valves etc. for DS system. DS system will be interlocked with corresponding conveyors / technological equipment. DS system will have local manual and remote auto mode control. Compressor may be connected to nearest MCC considering location of Compressor house.

4.10.12.9 DUST EXTRACTION SYSTEM

The Dust Extraction System will be started first and will be suitably interlocked with corresponding conveyors / technological equipment. The equipment of D.E. system will be operated in sequence as per requirement in the REMOTE mode from the HMI. Power supply to bag filter panel will be interlocked with the DE fan. Bypass arrangement will be provided such that technological equipment may be operated without operation of DE system in case need arises.
Electrics for Bag Filter System of DE System.

The bag filters of D.E. system will consist of pressure switches cum indicator in the compressed air line, differential pressure switches, solenoid valves, control panel and all other associated equipment. The brief specification of the major components will be as given below:

01 Control panel for Bag filter

The control panel will be free standing floor mounting fabricated from 2.5 mm thick CRCA sheet steel on a base channel or 250 mm height provided with cable gland plates, having synthetic rubber gasketting provided with double door & canopy and enclosure conforming to IP-55. The control panel will be factory assembled, wired with 1.1 kV grade PVC flexible wire of copper conductor (minimum size 2.5 sq.mm), factory painted. The control panel will be provided with following major equipment:

b) Incoming switch (minimum 30A, AC23 duty) with operating handle inter-locked with the door, HRC fuses, contactors, MCBs in the various circuits.

c) Control transformer or required VA rating having +/-5 percent and +/- 2.5 percent tapings in the primary side of the control transformer with Isolating switches/ MCBs in the primary & secondary sides.

c) 24V DC power pack complete with fitter and protective elements and also isolation cum short circuit protection both at AC and DC sides for power supply to solenoid valves.

d) Auxiliary contactor for control power supply monitoring interlocking, and controls etc.

e) Auto-manual selector switches, push button switches, indication lamps, various monitoring devices, terminals (with 20 percent spare terminals) and other circuit elements required for control and monitoring

f) Solid State Bag filter timers.

02 The bag filter timer will be solid state device suitable for dusty, tropical and specified aggressive environment. The bag filter- timer will be provided with internal semi-conductor fuse protection and will have provision for pulse frequency setting and pulse duration setting through independent operating knobs. The number of contacts in the timer will
be equal to number of solenoid operated valves so that the timer will energise only one solenoid valve at a time.

03  The Bag Fitter Timer will provide timed sequential energisation of 24V DC operated solenoid valves of bag filters LEDs for each solenoid energisation. Power ON in PCB feed back relay will be provided with potential free contacts which will close under following conditions:

a. Fault in the PCB.

ii) Open contact in the output side connected to individual solenoid valves. The contact will not close in the event of power failure to the controller.

iii) The sequential control (i.e. process) will start when the Differential Pressure (DP) switch is actuated at the first set point for normal operation. The process will continue till the pressure differential drops below the set value. When again the DP switch is actuated the process will continue from the previous position (i.e. next solenoid valve). However, when the power supply to sequential controller trips, the process will stop and sequential controller is reset to first load position enabling the process to start from the beginning.

iv) Sufficient space will be provided for installation of bag filter panel with required front clearances for operation and maintenance including side and back clearances as required.

04  Differential Pressure Switch

i) The differential pressure switch will have two sets of independent micro switches. The first set will be used for normal sequential cleaning operation of the bag filters as per lower set value of differential pressure. This set point will be independently adjustable.

ii) The second set of N.O. contact will close at upper set value of differential pressure representing clogging condition of bag filter and will be used for signaling and monitoring. This set point will also be independently adjustable. The contacts will be rated for 5 Amp, 240V AC.

iii) The DP switch will be suitable for outdoor installation. The DP switch casing will be made of pressure die cast Aluminium with enclosure conforming to IP-65.

iv) One number differential pressure switch with two set points will
be provided for each module of the Bag filter. Alternatively, two numbers of DP switches may be provided for each module one for initiation of bag cleaning operation and other for signaling and monitoring of clogging condition.

05 Solenoids
The solenoid coil will have encapsulated coil (class 'F' insulated with a waterproof (IP-65) plug-on connector. The coil will be suitable for 24V DC. The coil will be made of copper conductor.

06 Air Pressure Switch cum indicator
One number compressed air pressure switch cum indicator will be provided for each DE system in the incoming compressed air pipe line of the bag filter. The pressure range will match with the operating pressure. The switches will be snap action type with 1 NO + 1 NC contacts of SA, 230 V AC. These contacts will be wired up to terminals in the bag filter control panel. The enclosure of the air pressure switch will be pressure die cast aluminium conforming to IP-55.

4.10.12 Type of Light Fittings and Illumination Levels

Illumination level and light fittings will be provided for different units as indicated below:

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>UNITS</th>
<th>ILLUMINATION LEVEL (LUX)</th>
<th>TYPE OF LIGHT FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Electrical rooms, substations, MCC Rooms etc.</td>
<td>200</td>
<td>Trough type, 2x40W, fluorescent tube light fittings with reflectors.</td>
</tr>
<tr>
<td>2.</td>
<td>Junction Houses and Conveyor Galleries / tunnels</td>
<td>100</td>
<td>70W/150W, HPSV, well glass fittings and 250W High bay as required.</td>
</tr>
<tr>
<td>3.</td>
<td>Crusher house, other process and Technological Building</td>
<td>150</td>
<td>70W/150W, HPSV, well glass fittings and 250W High bay fitting as required.</td>
</tr>
<tr>
<td>4.</td>
<td>Office rooms</td>
<td>300</td>
<td>Trough type/Decorative recessed type, 2x40W, fluorescent tube light fittings.</td>
</tr>
</tbody>
</table>
## CHAP-4.10 ELECTRICS

### DRAWINGS AND DOCUMENTS

Contractor's scope of work for all design drawings and documents will be as given below.

The Contractor will submit a list of all drawings and documents he proposes to submit within 2 weeks of LOI. The list will be approved by Client / MECON and may be modified if necessary. Each

---

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>UNITS</th>
<th>ILLUMINATION LEVEL (LUX)</th>
<th>TYPE OF LIGHT FITTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>Corridors, walkways, staircase</td>
<td>100</td>
<td>Trough type, 2x40W fluorescent tube light fittings with reflectors.</td>
</tr>
<tr>
<td>6.</td>
<td>Control room, laboratories, instrumentation rooms</td>
<td>300</td>
<td>Decorative type, 2x40W fluorescent tube light fittings with mirror optics.</td>
</tr>
<tr>
<td>7.</td>
<td>Battery room</td>
<td>100</td>
<td>Corrosion/Vapour proof, 2x40W fluorescent tube light fittings.</td>
</tr>
<tr>
<td>8.</td>
<td>Battery Charger/ UPS room</td>
<td>200</td>
<td>Decorative type, 2x40W fluorescent tube light fittings with mirror optics.</td>
</tr>
<tr>
<td>9.</td>
<td>Periphery of buildings and cooling towers</td>
<td>50</td>
<td>Well glass fittings with 70W, HPSV Lamp.</td>
</tr>
<tr>
<td>11.</td>
<td>Area lighting through flood light towers</td>
<td>20</td>
<td>Flood light fittings with 250 / 400W, HPSV Lamp.</td>
</tr>
</tbody>
</table>

Number of light fittings will be decided on the basis of specified lux level, maintenance factor 0.6 and appropriate co-efficient of utilization as per manufacturer's recommendation.
drawing/documents in the list will be identified with a serial number, description and scheduled date of submission.

Contractor will also furnish soft copies of all the drawings indicated below and drawings of technological layout/units.

All design, engineering and manufacturing drawings will be required to be approved by Employer/Consultant.

Work will be carried out exactly as indicated on the approved drawings and specification. No alterations will be made without prior written approval by Employer / his consultant.

The Contractor will check all the drawings prepared by them and/or received from their vendors/supplier/sub-supplier and satisfy themselves about the correctness of drawings before issuing to Employer / Consultant. After checking, properly stamped drawings will be sent to Employer/Consultant for approval / clearance.

Comments on all drawings will be forwarded to the Contractor for incorporation and resubmission.

The approval of drawings by Employer or their authorised representative does not absolve or relieve the supplier from any of his obligations under this contract and he will be wholly and solely responsible for the satisfactory operation and guaranteed performance of equipment / system / plant.

A. Basic Engineering drawings (To be Submitted For Approval in 6 sets)

1. List of drawings (Basic Engg /Detailed Engg/ Reference) and drawing numbering system along with schedule of submission.

2. Single line diagrams of MCCs /Control Panels, PDBs, MLDBs, LDBs, SLDBs, Main fire detection and alarm panel etc. with rating of components, cable sizes and details of protection and metering etc.

3. HT & LT Motor and component list including field mounted electrics

4. HT and LT Motor data sheets as per enclosed format.

5. Type-II Co-ordination chart as per IS: 13947-1993 for MPCB/ MCCB, Contactor and Overload relay.

6. Schematic drawing of different feeders, control, alarm, indications, interlocking and other schematics.

7. Shop/Unit wise Maximum Demand calculations
8. Relay settings with calculations for total network to ensure proper co-ordination.

9. Busbars sizing calculation with respect to temperature rise & short circuit withstand capacity.

10. Design Calculations for selection of main equipment such as transformers drive motors, AC drives, bus bars, cables, batteries etc.

11. Typical schemes of DOL, RDOL feeders indicating inputs & outputs applicable to the various feeders indicated in SLDs.

12. Power and regulation schemes of AC drives.

13. Calculation for temperature rise of busbars.

14. Layout of substations, electrical rooms and control rooms including ventilation and air-conditioning rooms, handling facilities. The layout drawings indicating cable trench, wall openings, conduit inserts, plate inserts, Minimum clearances from electrical panels for installation of panels, cable trays, conduits for concealed wiring etc.

15. Electrical Equipment Layout of all electrical rooms, control rooms indicating panel dimensions, space available for future expansion with building dimensions.

16. General arrangement of equipment with plan, front view and sectional views, comprehensive bill of materials with description, quantity, make and type.

17. Cable layout drawings in cable tunnel, cable channels, overhead cable structures/bridge and incoming cable route etc.

18. Interplant cable route drawings.

19. Type tests certificates of all major equipment like transformers, switchgear etc.

20. Level-1 automation system configuration & I/O lists, Belt Scale, Belt Weigh feeder, UPS & VVVF single line diagrams.

21. Functional description, control philosophy for the plant indicating start up, shut down, control locations, interlocking and annunciation system, mimic pages, report/data formats (for reference).

22. Scheme for Illumination system & emergency lighting system indicating sizes, ratings & locations of various LDBs & SLDBs.
23. Tentative Dimensions of panels.
24. Earthing and lightning protection scheme and layout of earthing and lightning protection network with calculations.
25. Quality assurance plan for various electrical equipment.

B. Detailed engineering drawings. (To be Submitted For Approval in 6 sets)

1. Civil/Structural engineering design drawings of Electrical buildings, Electrical rooms, Control rooms, Motor foundations, Cable tunnels, Overhead cable structures/Bridge etc.
2. General arrangement of all electrical equipment/electronic panels/controllers with plan, front view and sectional views, comprehensive bill of material with description, quantity, make and type.
3. Equipment and cable layout drawings in LT Substation, Electrical premises, Control rooms etc.
4. Schematic drawing of different feeders, control, alarm, indications, interlocking, inputs/outputs to PLC and other schematics.
5. Single line diagrams of all PCCs, MCCs/ Control Panels, PDBs, MLDBs, LDBs, SLDBs, UPS, other equipment Control panel for sump pump, magnet and other auxiliary system etc. Module wiring diagrams indicating all interlocks, terminal numbers. Wiring terminal plan drawings with cable connections.
6. Single line diagram of VVVF Drives, Soft Starter etc.
7. GA, BOQ, Layout drawings, dimensional details for LT switchgear equipment, MCCs/Control Panel, PDBs, MLDB, LDBs, SLDBs, Main fire detection and alarm panel etc. with rating of components, cable sizes and details of protection and metering etc.
8. Level-1 automation system software and graphic displays.
9. I/O listing in specified format to be finalised during engineering.
10. Sizing calculation of the UPS and the backup battery. UPS panel wiring diagram and circuit diagrams.
11. Wiring terminal plan drawings with cable connections.
12. Technical data sheets for Motor, Brake, Proximity switches & all field mounted electrics, GA drawings.
13. Interplant cable route drawings.

14. Layout of cable trays in cable cellars inside the substation & other electrical premises, cable channels, cable tunnel, overhead cable structures, cable shafts etc.

15. Cable layout drawings in cable tunnel, cable channels, overhead cable structure (as applicable), and incoming cable route etc.

16. Power & control cable schedules

17. GA drawing for erection accessories like cable trays, supporting structures etc.

18. Installation drawings of all equipment with layout of equipment, cables.

19. Illumination layout of all the indoor & outdoor premises. Layouts at each floor of Electrical/Technological building with details and numbers & locations of light fittings, Lighting distribution boards etc. SLDs of Lighting distribution board.

20. Earthing and lightning protection scheme and layout of earthing and lightning protection network with calculations including special electronics earthing

21. Relay settings with calculations for total network to ensure proper co-ordination.

22. Communication cable (Field bus) routing and procedure for laying of communication cable.

23. QAP for all items covered in this specification

C. For Reference/Erection purposes

1. Schedule of electrics, and their location.

2. HT/LT feeder requirement with individual maximum demand.

3. Control circuit diagrams.

4. Static and dynamic loading of all major equipment

5. External connection diagram (panel wise and scheme wise).

6. Composite drawings showing circuitry of switch-gear remote panels, and other items pertaining to complete circuit for its proper functioning.
7. Power & regulation schemes for AC drives, UPS, soft starter including FCMA type.

8. Motors & field devices.

9. Speed-torque, current vs. time, thermal withstands characteristics for motors.

10. List of interfaces between Contractor's equipment and Employer's equipment.

11. Cable termination plans with terminal block arrangement and markings.

12. Interconnection diagrams.

13. Internal wiring diagrams of equipment.


15. Motor and electric consumer list.


17. Procedure for testing and commissioning of the entire plant, electrical & automation equipment. This will also be furnished in soft copy.

18. Erection specification with bill of materials of erection materials, earthing materials, junction box, GI conduits etc. This will also be furnished in soft copy.

19. Spare part list and drawings.

20. Instruction for storage /erection, testing & commissioning.


22. Detailed technical literature / catalogue of manufacturers.

23. Graphic display sheets, report/data generation, fault listing etc.

24. Terminal plan drawings

25. System grounding/ earthing scheme.

26. Application software program listings with detailed documentation.

27. Ladder Logic diagram /Statement Lists and software details.
28. Formats and work sheets for generation and display of overview, groups, loops, graphics, alarms, operator’s guide messages, real time and historical trends Log and shift formats.

29. List of drawings & spare parts.

30. Final test & calibration certificates and guarantee certificate / warrantee certificate.

31. As built Control description with Operational instruction use of various commands, instruction for control of plant and equipment from Operator workstation.

32. Drawings/documents for inspection of equipment:

   a) Type test certificate for identical equipment.
   b) Sub-supplier’s/vendor’s catalogue/technical literature.
   c) Test reports for internal inspection.
   d) Test certificate of components.
   e) Technical specification & data sheets of equipment.
   f) All “Approved” drgs./ “Commented” drgs as applicable.

33. Automation systems.

   a) Software including media and documentation.
   b) Description of all components of the user system with functional description, overview flow diagram, interface listing, mathematical models, and fault message lists, operator commands, simulation facilities, etc.
   c) Source code of the user system.
   d) Object code of the user system.
   e) I/O listing
   f) Ladder/block diagrams, etc.
   g) Factory Acceptance Tests & procedures for PLC/DCS

34. Other Drawings/documents:

   a) Operation & maintenance manual.
   b) Catalogues and manuals.
   c) All "As-built" drawings.
   d) Soft copies of all drawings.
   e) Technical specification/data sheet of equipment.
   f) Instructions for storage/erection/testing/commissioning
   g) Commissioning report.
D. As built drawings

Upon installation and commissioning supplier will incorporate revisions/ modifications if any in the reproducible and submit 'as built' drawings for Employer's record as per general condition of contract.

Complete and comprehensive instruction manuals for operation and maintenance of the equipment with drawings. This will include the following:

1. Log sheets indicating daily/hourly recordings of power system parameters to be noted down by customers operating personnel. The parameters will indicate loading of various electrical equipment, quality of power supply, energy consumption of various units, energy consumption and maximum demand of the plant.

2. Preventive maintenance schedule for equipment.

3. Procedure for shut down and energisation.

4. Safety procedures for safe operation of equipment and complete system.

5. Specification of equipment installed.

6. Test procedure for site tests.

7. All as built drawings.

8. Spares list for each equipment for 2 year operation and maintenance.

9. Soft copies of all as built drawings along with hard copies will be submitted during commissioning.
4.10.12 FORMAT FOR MOTOR DATA SHEET

1. PROJECT : 
2. MAKE : 
3. DRIVEN EQUIPMENT : 
4. MOTOR TAG NO. : 
5. QUANTITY : 
6. VOLTAGE WITH VARIATION : 
7. NO. OF PHASES/CONNECTION/NO OF TERMINALS :
8. FREQUENCY WITH VARIATION : 
9. FAULT LEVEL (MVA) & DURATION : 
10. MOTOR TYPE AND DUTY : 
11. KW RATING/POLE :
   • AT 40 DEG. C. :
   • AT SPECIFIED AMBIENT TEMP. :
   • WITH DERATING. :
   • BHP/BKW OF DRIVEN EQPT. :
   AT RATED LOAD
12. FRAME SIZE/MOUNTING :
13. INSULATION CLASS WITH TEMP RISE:
14. ENCLOSURE TYPE :
15. FULL LOAD SPEED :
16. FULL LOAD TORQUE (FLT) :
17. STARTING TORQUE AS % OF FLT :
18. PULLOUT TORQUE AS % OF FLT :
19. FULL LOAD CURRENT (FLC) :
20. STARTING CURRENT AS % OF FLC :
21. STARTING TIME ON RATED LOAD AT :
- RATED VOLTAGE : 
- 85 % OF RATED VOLTAGE : 

22. LOCKED ROTOR WITHSTAND TIME 
- COLD : 
- HOT : 

23. ROTATION VIEWED FROM DRIVING END 
24. GD SQUARE OF MOTOR : 
25. GD SQUARE OF DRIVEN EQUIPMENT: 
26. WEIGHT OF MOTOR : 
27. POWER FACTOR AT 
- 50 % LOAD : 
- 75 % LOAD : 
- 100 % LOAD : 

28. EFFICIENCY AT 
- 50 % LOAD : 
- 75 % LOAD : 
- 100 % LOAD : 

29. SPACE HEATER WATTS/VOLTS : 
30. TERMINAL BOX TYPE & 
NO. OF TERMINALS 
31. NO. OF STARTS PER HOUR : 
32. NOISE LEVEL AT A DISTANCE OF 1M : 
FROM THE MOTOR 
33. THERMAL WITHSTAND TIME : 
34. COOLING : 
35. APPLICABLE STANDARD : 
36. LOCATION : 
37. HAZARDOUS AREA CLASSIFICATION :

STEEL AUTHORITY OF INDIA LIMITED
BHILAI STEEL PLANT (BSP)
CONTRACT AGREEMENT FOR
Augmentation of Raw Material Receipt & Handling
facilities with new OHP, Part-B
(PACKAGE No. – 061)
38. BEARING DETAILS
   - TYPE OF DE/NDE :
   - SIZE OF DE/NDE :
   - MAKE :

39. LOCATION OF TERMINAL BOX :
    POSITION FROM DE SIDE :

40. LUBRICATION TYPE :

41. CABLE SIZE :

42. PAINT SHADE :

43. G.A., DIMENSIONS & MOUNTING : YES/NO
    DETAIL DRAWINGS ENCLOSED

44. DETAILS DRAWINGS FOR T.B. : YES/NO

45. PERFORMANCE CHARACTERISTICS : YES/NO
    CURVES VIZ. SPEED V/S CURRENT &
    SPEED V/S TORQUE ENCLOSED
### ANNEXURE - E-01

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The HT and control cable from HTSS to the respective technological package will be routed through covered structural overhead cable gallery only.</td>
</tr>
</tbody>
</table>
| 2.      | All circuit breakers used for 6.6 KV and 11 KV unearthed system should be  
|         | 1. VCB’s  
|         | 2. They will be horizontal isolation type, trolley mounted and ground operated (non cassette type)  
|         | 3. The jaw contacts (female) will be mounted on the breaker and will be drawout along with the breaker.  
|         | 4. The male contact will be of flat type with mounting on bus side  
|         | 5. Type tests pertaining to BIL requirements (7.2/28/60KV for 6.6 KV and 12/35/75 KV for 11 KV) will be witnessed by Employer.  
|         | 6. Minimum panel width will be 800 mm. |
| 3.      | Continuous current of Variable speed AC drives will be 150% of motor full load rated current at continuous duty operation. |
| 4.      | Insulation level for MCC & MCP : One minute power frequency withstand voltage will be 1500V for control circuit. |
| 5.      | Contact rating for Push Button will be  
|         | AC15, 6A at 230V  
|         | DC13, 4A at 230V |
| 6.      | Conveyor motor will be suitable for S -6 duty operation. |
| 7.      | MCB short circuit rating capacity will not be less than 10 KA at 0.8 power factor |
| 8.      | Roller bearings will be provided at DE end for motor of rating 30KW and above |
| 9.      | LT Switchboard Incomer & Bus-coupler Circuit Breaker ratings will be 2000A for 1000KVA transformer |
| 10.     | Control terminal block will be ELMEX type suitable for terminating 2 cores of 2.5 sq mm wire. |
| 11.     | Electro-magnet will be of welded construction. |
| 12.     | Control cable will be with PVC insulation. |
| 13.     | Terminal type  
|         | Power terminal : Stud type- with maximum 2 connection on one terminal.  
|         | Control terminal for CT: Disconnecting type |
| 14.     | All pull chord switches and belt sway switches will be addressable type. |
**ANNEXURE - E-02**

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>All HT motors will have FCMA based soft starter facility</td>
</tr>
<tr>
<td>2.</td>
<td>For HT motor surge suppressor to be installed near the motor.</td>
</tr>
<tr>
<td>3.</td>
<td>All HT motors will have fluid coupling.</td>
</tr>
<tr>
<td>4.</td>
<td>HT motors less than 2.0 MW, condition monitoring equipment (temperature monitoring, vibration monitoring etc.) will be provided. For more than 2.0 MW, condition monitoring equipment (temperature monitoring, vibration monitoring and partial discharge monitoring etc.) will be provided.</td>
</tr>
<tr>
<td>5.</td>
<td>Isolation transformer will be provided for VVVF drive of more then 90 KW and series rector will be provided for VVVF drive of less than 90 KW.</td>
</tr>
<tr>
<td>6.</td>
<td>Copper cable will be used for imported motors, crane and moving equipment.</td>
</tr>
<tr>
<td>7.</td>
<td>For all LT motors for more than 75KW soft starter will be provided.</td>
</tr>
<tr>
<td>8.</td>
<td>All HT cable will be of FRLS type.</td>
</tr>
</tbody>
</table>
ANNEXURE - E-03

SCHEDULE OF MINIMUM COMMISSIONING SPARES FOR ELECTRICAL EQUIPMENT:

The Contractor will supply following minimum commissioning spares along with the main equipment. However, during testing and commissioning of the plant, in case of requirement of any additional commissioning spares, same will be supplied by Contractor without any extra cost to the Employer. The Contractor will hand-over / deliver these spares directly at the Employer's stores. During testing and commissioning in case of requirement of any commissioning spares, same will be brought by the Contractor from Employer's stores. All unused commissioning spares will remain with the Employer.

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td><strong>Transformer</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>HT Bushing</td>
<td>1 No.</td>
</tr>
<tr>
<td>2</td>
<td>Winding temperature indicator with alarm &amp; trip contacts</td>
<td>1 No.</td>
</tr>
<tr>
<td>3</td>
<td>Gasket</td>
<td>1 No.</td>
</tr>
<tr>
<td>II.</td>
<td><strong>LT Switch Gear</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Auxiliary Contact Set</td>
<td>5% of each type &amp; rating. (minimum 1 set/No. of each type &amp; rating)</td>
</tr>
<tr>
<td>2</td>
<td>Closing Coils</td>
<td>- DO -</td>
</tr>
<tr>
<td>3</td>
<td>Tripping Coils</td>
<td>- DO -</td>
</tr>
<tr>
<td>4</td>
<td>Ammeters</td>
<td>- DO -</td>
</tr>
<tr>
<td>5</td>
<td>Voltmeters</td>
<td>- DO -</td>
</tr>
<tr>
<td>6</td>
<td>Coils for the Contactors &amp; Aux. Contactors</td>
<td>- DO -</td>
</tr>
<tr>
<td>7</td>
<td>Control Isolating &amp; Selector Switch</td>
<td>- DO -</td>
</tr>
<tr>
<td>8</td>
<td>Push Button of Various Colours</td>
<td>- DO -</td>
</tr>
<tr>
<td>III.</td>
<td><strong>MCCs, PDBs, MLDB/LDBs</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td><strong>Air Circuit Breakers</strong></td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>Fixed arcing contact</td>
<td>- DO -</td>
</tr>
<tr>
<td>b)</td>
<td>Moving arcing contacts</td>
<td>- DO -</td>
</tr>
<tr>
<td>c)</td>
<td>Arc chute</td>
<td>- DO -</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Status</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>d</td>
<td>Cluster contacts</td>
<td>DO</td>
</tr>
<tr>
<td>e</td>
<td>Arc barriers</td>
<td>DO</td>
</tr>
<tr>
<td>f</td>
<td>Trip coil assembly</td>
<td>DO</td>
</tr>
<tr>
<td>g</td>
<td>MWS complete kit</td>
<td>DO</td>
</tr>
<tr>
<td>h</td>
<td>Closing coil assembly</td>
<td>DO</td>
</tr>
<tr>
<td>2</td>
<td>MPCB of different ratings</td>
<td>DO</td>
</tr>
<tr>
<td>3</td>
<td>MCCB of different ratings</td>
<td>DO</td>
</tr>
<tr>
<td>4</td>
<td>Handles of MCCB of different ratings</td>
<td>DO</td>
</tr>
<tr>
<td>5</td>
<td>Power contactors of different ratings</td>
<td>DO</td>
</tr>
<tr>
<td>6</td>
<td>Moving contacts of Power contactors of different ratings</td>
<td>DO</td>
</tr>
<tr>
<td>7</td>
<td>Fixed contacts of Power contactors of different ratings</td>
<td>DO</td>
</tr>
<tr>
<td>8</td>
<td>Coil for Power contactors of different ratings</td>
<td>DO</td>
</tr>
<tr>
<td>9</td>
<td>Auxiliary contacts for Power contactors</td>
<td>DO</td>
</tr>
<tr>
<td>10</td>
<td>MPR Overload relays of different ranges</td>
<td>DO</td>
</tr>
<tr>
<td>11</td>
<td>Microprocessor based Over load relay for Conventional type MCC</td>
<td>DO</td>
</tr>
<tr>
<td>12</td>
<td>Intelligent module/cards for intelligent MCC / MCP</td>
<td>DO</td>
</tr>
<tr>
<td>13</td>
<td>Auxiliary contactor (2NO+2NC)</td>
<td>DO</td>
</tr>
<tr>
<td>14</td>
<td>Coils for auxiliary contactors</td>
<td>DO</td>
</tr>
<tr>
<td>15</td>
<td>Add on block for auxiliary contactors</td>
<td>DO</td>
</tr>
<tr>
<td>16</td>
<td>CTs</td>
<td>DO</td>
</tr>
<tr>
<td>17</td>
<td>PTs</td>
<td>DO</td>
</tr>
<tr>
<td>18</td>
<td>Voltmeters</td>
<td>DO</td>
</tr>
<tr>
<td>19</td>
<td>Ammeters</td>
<td>DO</td>
</tr>
<tr>
<td>20</td>
<td>Ammeter selector switch</td>
<td>DO</td>
</tr>
<tr>
<td>21</td>
<td>Voltmeter selector switch</td>
<td>DO</td>
</tr>
<tr>
<td>22</td>
<td>Control switches</td>
<td>DO</td>
</tr>
<tr>
<td>23</td>
<td>Control MCBs</td>
<td>DO</td>
</tr>
</tbody>
</table>
24. Indicating lamps (LED) with holder  - DO -
25. Busbar support insulators  - DO -
26. Push buttons switches (start & stop)  - DO -
27. Contact block (2NO+2NC) for start & stop PB  - DO -
28. Actuator head for start & stop PB  - DO -
29. Local-off-Remote selector switch  - DO -
30. Control switch spring return type  - DO -

### IV. LOCAL CONTROL STATIONS

1. Push buttons (start)  5% of each type & rating. (minimum 1 set/No. of each type & rating)
2. Push buttons (stop)  - DO -
3. Contact block (2NO+2NC) for start & stop PB  - DO -
4. Actuator head for start & stop PB  - DO -
5. Ammeters  - DO -

### V. MOTORS (OF EACH RATING)

1. Bearing (DE)  5% of each type & rating. (minimum 1 set/No. of each type & rating)
2. Bearing (NDE)  - DO -
3. Cooling Fan  - DO -
4. Terminal Block  - DO -
5. Grease Nipple & Plug, Grease pump with motorised.  - DO -

### VI. PLC/Automation

1. Digital input module with connection unit if applicable.  10% of each type & rating. (minimum 1 set/ No. of each type & rating)
2. Digital output module with connection unit if applicable.  - DO -
3. Analog input module with connection if applicable.  - DO -
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Analog output module with connection if applicable.</td>
<td>-DO-</td>
</tr>
<tr>
<td>5.</td>
<td>Processor card</td>
<td>-DO-</td>
</tr>
<tr>
<td>6.</td>
<td>Power supply unit for PLC</td>
<td>-DO-</td>
</tr>
<tr>
<td>7.</td>
<td>Memory board (Part of CPU Board)</td>
<td>-DO-</td>
</tr>
<tr>
<td>8.</td>
<td>Communication modules</td>
<td>-DO-</td>
</tr>
<tr>
<td>9.</td>
<td>Control modules of any other type</td>
<td>-DO-</td>
</tr>
<tr>
<td>10.</td>
<td>Control fuse set consisting of 3 nos.</td>
<td>-DO-</td>
</tr>
<tr>
<td>11.</td>
<td>Fan unit</td>
<td>-DO-</td>
</tr>
<tr>
<td>12.</td>
<td>Fused terminals with LED</td>
<td>-DO-</td>
</tr>
<tr>
<td>13.</td>
<td>Special connectors/cables/ TERMINATORS</td>
<td>-DO-</td>
</tr>
<tr>
<td>14.</td>
<td>Racks / Chassis</td>
<td>-DO-</td>
</tr>
<tr>
<td>15.</td>
<td>Interposing relays</td>
<td>-DO-</td>
</tr>
<tr>
<td>16.</td>
<td>Ethernet switches</td>
<td>-DO-</td>
</tr>
<tr>
<td>17.</td>
<td>Media converter</td>
<td>-DO-</td>
</tr>
<tr>
<td>18.</td>
<td>Radio comm. Equipment including antena</td>
<td>-DO-</td>
</tr>
<tr>
<td>19.</td>
<td>Load power supply</td>
<td>-DO-</td>
</tr>
<tr>
<td>20.</td>
<td>Special cards in PC / servers/ clients / PG</td>
<td>-DO-</td>
</tr>
</tbody>
</table>

**VII. UPS**

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Thyristors cell (Complete assembly)</td>
<td>-DO-</td>
</tr>
<tr>
<td>2.</td>
<td>Semiconductor fuses set consisting of 3 Nos.</td>
<td>-DO-</td>
</tr>
<tr>
<td>3.</td>
<td>Diodes</td>
<td>-DO-</td>
</tr>
<tr>
<td>4.</td>
<td>Regulation &amp; pulse generation modules</td>
<td>-DO-</td>
</tr>
<tr>
<td>5.</td>
<td>Static bypass control module</td>
<td>-DO-</td>
</tr>
<tr>
<td>6.</td>
<td>Capacitors</td>
<td>-DO-</td>
</tr>
<tr>
<td>7.</td>
<td>Resistors, varistors</td>
<td>-DO-</td>
</tr>
<tr>
<td>8.</td>
<td>CTs</td>
<td>-DO-</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Quantity</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>9.</td>
<td>Surge suppression unit</td>
<td>5% of each type &amp; rating. (minimum 1 set/No. of each type &amp; rating)</td>
</tr>
<tr>
<td>10.</td>
<td>Power transistors/IGBT</td>
<td>-DO-</td>
</tr>
<tr>
<td>11.</td>
<td>DC MCCB</td>
<td>-DO-</td>
</tr>
<tr>
<td>12.</td>
<td>Indication LED</td>
<td>- DO -</td>
</tr>
<tr>
<td>13.</td>
<td>Pulse transformer unit</td>
<td>- DO -</td>
</tr>
<tr>
<td>14.</td>
<td>Trigger pulse generator</td>
<td>- DO -</td>
</tr>
</tbody>
</table>

**VIII. VVVF DRIVES / SOFT STARTER**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IGBT of each type</td>
<td>5% of each type &amp; rating. (minimum 1 set/No. of each type &amp; rating)</td>
</tr>
<tr>
<td>2.</td>
<td>Diode of each type</td>
<td>-DO-</td>
</tr>
<tr>
<td>3.</td>
<td>Fuses of each type</td>
<td>- DO -</td>
</tr>
<tr>
<td>4.</td>
<td>Regulation Cards of VVVF, each type</td>
<td>- DO -</td>
</tr>
<tr>
<td>5.</td>
<td>Pulse transformer unit</td>
<td>-DO-</td>
</tr>
<tr>
<td>6.</td>
<td>Trigger Pulse Generator</td>
<td>-DO-</td>
</tr>
<tr>
<td>7.</td>
<td>RC Snubber Unit</td>
<td>-DO-</td>
</tr>
<tr>
<td>8.</td>
<td>HRC Fuse Link</td>
<td>- DO -</td>
</tr>
<tr>
<td>9.</td>
<td>Push Button actuator with contact element</td>
<td>-DO-</td>
</tr>
<tr>
<td>10.</td>
<td>Mushroom head push button actuator</td>
<td>-DO-</td>
</tr>
<tr>
<td>11.</td>
<td>LED indication lamp (Red, Green, Yellow)</td>
<td>-DO-</td>
</tr>
</tbody>
</table>

**IX. BELT SCALES**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Load Cell</td>
<td>5% of each type &amp; rating. (minimum 1 set/No. of each type &amp; rating)</td>
</tr>
<tr>
<td>2.</td>
<td>Electronic cards</td>
<td>-DO-</td>
</tr>
<tr>
<td>3.</td>
<td>Display Units</td>
<td>-DO -</td>
</tr>
</tbody>
</table>

**X. SAFETY AND LIMIT SWITCHES**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>All Types of Limit Switches</td>
<td>5% of each type &amp; rating. (minimum 1 set/No. of each type &amp; rating)</td>
</tr>
<tr>
<td>No.</td>
<td>Item Description</td>
<td>Quantity</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>2.</td>
<td>Level Sensor / Switches</td>
<td>DO</td>
</tr>
<tr>
<td>3.</td>
<td>Photo Electric Sensor</td>
<td>DO</td>
</tr>
<tr>
<td>4.</td>
<td>Transducers</td>
<td>DO</td>
</tr>
<tr>
<td>5.</td>
<td>Flow Switches</td>
<td>DO</td>
</tr>
<tr>
<td>6.</td>
<td>Temperature Switches</td>
<td>DO</td>
</tr>
<tr>
<td>7.</td>
<td>Proximity Switches</td>
<td>DO</td>
</tr>
<tr>
<td>8.</td>
<td>Encoders</td>
<td>DO</td>
</tr>
<tr>
<td>9.</td>
<td>Magnetic Switches</td>
<td>DO</td>
</tr>
<tr>
<td>10.</td>
<td>Code Reader for Oven identification</td>
<td>DO</td>
</tr>
<tr>
<td></td>
<td><strong>XI. HYDRAULIC UNIT</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Solenoid Valves</td>
<td>5% of each type &amp; rating. (minimum 1 set/No. of each type &amp; rating)</td>
</tr>
<tr>
<td></td>
<td><strong>XII. ILLUMINATION</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MCBs</td>
<td>5% of each type &amp; rating. (minimum 1 set/No. of each type &amp; rating)</td>
</tr>
<tr>
<td>2.</td>
<td>Ballast for High bay, well glass, street light fittings etc.</td>
<td>DO</td>
</tr>
<tr>
<td>3.</td>
<td>Chokes, starter, holder for fluorescent tubular fittings</td>
<td>DO</td>
</tr>
<tr>
<td>4.</td>
<td>Igniter for Flood light, High bay, well glass, street light fittings etc.</td>
<td>DO</td>
</tr>
<tr>
<td>5.</td>
<td>Capacitor, holder, control gear for Flood light, High bay, well glass, street light fittings etc.</td>
<td>DO</td>
</tr>
<tr>
<td>6.</td>
<td>Fluorescent fixture</td>
<td>DO</td>
</tr>
<tr>
<td>7.</td>
<td>Well glass HPSV lamp fittings</td>
<td>DO</td>
</tr>
<tr>
<td>8.</td>
<td>Flood light, High bay, Street light fittings etc.</td>
<td>DO</td>
</tr>
<tr>
<td>9.</td>
<td>40W fluorescent lamps</td>
<td>DO</td>
</tr>
<tr>
<td>10.</td>
<td>70W, 150W, 250W, 400W HPSV lamps</td>
<td>DO</td>
</tr>
<tr>
<td>11.</td>
<td>Terminal blocks</td>
<td>DO</td>
</tr>
</tbody>
</table>
### ANNEXURE - E-04

#### TOOLS & TACKLES

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Item</th>
<th>Quantity (Nos.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Digital Multimeter (hand held)</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>Digital tong tester (hand held)</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>Testing Jig for PLC (OEM supplied)</td>
<td>1</td>
</tr>
<tr>
<td>4.</td>
<td>Low range ohm meter</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>Megger (0– 500V)</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>Megger (0-1000V)</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>Megger ( 0-2500V)</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>Earth Meggar</td>
<td>2</td>
</tr>
<tr>
<td>9.</td>
<td>Milli ohm meter</td>
<td>2</td>
</tr>
<tr>
<td>10.</td>
<td>Combination pliers</td>
<td>4</td>
</tr>
<tr>
<td>11.</td>
<td>Nose pliers</td>
<td>4</td>
</tr>
<tr>
<td>12.</td>
<td>Hand drills (pistol)</td>
<td>4</td>
</tr>
<tr>
<td>13.</td>
<td>Allen key</td>
<td>4 Sets</td>
</tr>
<tr>
<td>14.</td>
<td>Ratcher Spanner Set</td>
<td>4 Sets</td>
</tr>
<tr>
<td>15.</td>
<td>Ring Spanners of different sizes</td>
<td>4 Sets</td>
</tr>
<tr>
<td>16.</td>
<td>DE Spanners of different sizes</td>
<td>4 Sets</td>
</tr>
<tr>
<td>17.</td>
<td>Vibration monitor (hand held)</td>
<td>2</td>
</tr>
<tr>
<td>18.</td>
<td>Soldering / de-soldering station</td>
<td>2</td>
</tr>
<tr>
<td>19.</td>
<td>Testing table / bench for installation of testing / repair equipment complete with single phase / three phase power supply points and separate electronic earthing</td>
<td>1</td>
</tr>
<tr>
<td>20.</td>
<td>Blower cum vacuum cleaner (portable)</td>
<td>1</td>
</tr>
<tr>
<td>21.</td>
<td>Tool kit (screw driver set, spanner set etc.)</td>
<td>4 sets</td>
</tr>
<tr>
<td>22.</td>
<td>Component storage steel rack (pigeon hole)</td>
<td>2</td>
</tr>
<tr>
<td>23.</td>
<td>Steel Almirah for storage of test equipment</td>
<td>2</td>
</tr>
<tr>
<td>24.</td>
<td>Bench vice</td>
<td>2</td>
</tr>
<tr>
<td>25.</td>
<td>Power saw suitable for bakelite / hilem board cutting</td>
<td>1</td>
</tr>
<tr>
<td>26.</td>
<td>Cable lug crimping tool (geared)</td>
<td>2</td>
</tr>
<tr>
<td>27.</td>
<td>HT Line Tester</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>28.</td>
<td>Steel chairs</td>
<td>6</td>
</tr>
<tr>
<td>29.</td>
<td>Steel tables</td>
<td>4</td>
</tr>
<tr>
<td>30.</td>
<td>Radio communication Equipment testing Jig</td>
<td>1 Set</td>
</tr>
<tr>
<td>31.</td>
<td>F.O Cable Testing Kit including OTDR</td>
<td>1 Set</td>
</tr>
<tr>
<td>32.</td>
<td>Radio communication Analyzer</td>
<td>1 Set</td>
</tr>
<tr>
<td>33.</td>
<td>Tools for backup &amp; storage</td>
<td></td>
</tr>
</tbody>
</table>
### CHAP-4.10 ELECTRICS

In Electrical Repair Shop, one air conditioned room with test bench will be provided for testing / repairing electronic card / equipment.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.</td>
<td>Hydraulic fan puller</td>
<td>1 Set</td>
</tr>
<tr>
<td>35.</td>
<td>Box Spanner Set</td>
<td>1 Set</td>
</tr>
<tr>
<td>36.</td>
<td>Hydraulic Coupling Puller</td>
<td>1 Set</td>
</tr>
<tr>
<td>37.</td>
<td>Hydraulic Bearing Puller</td>
<td>1 Set</td>
</tr>
<tr>
<td>38.</td>
<td>Motorised torque range</td>
<td>1 Set</td>
</tr>
<tr>
<td>39.</td>
<td>PCB Cutter</td>
<td>1 Set</td>
</tr>
<tr>
<td>40.</td>
<td>Motor Checker</td>
<td>1 Set</td>
</tr>
<tr>
<td>41.</td>
<td>Current Recording meter</td>
<td>1 Set</td>
</tr>
<tr>
<td>42.</td>
<td>1.5 mm/ 2.5 sq.mm Crimping Tool</td>
<td>1 Set</td>
</tr>
<tr>
<td>43.</td>
<td>AC/DC Digital tongue testor</td>
<td>1 Set</td>
</tr>
<tr>
<td>44.</td>
<td>Signal Generator 0-10V, 4-20mA</td>
<td>2 sets</td>
</tr>
<tr>
<td>45.</td>
<td>Crimping tools for cable up to 120mm</td>
<td>2 Nos.</td>
</tr>
</tbody>
</table>
## ADDITIONAL POINTS FOR AUTOMATION POINTS WITH RESPECT TO GTS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>GS Clause</th>
<th>Additional Points for Automation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ch-1, 06.03.01</td>
<td>Drawings of all listed categories (except fabrication drawings) will be submitted to Employer in minimum 6 sets.</td>
</tr>
<tr>
<td>2.</td>
<td>Ch-1, 06.03.03</td>
<td>Original hardcopy documentation and manuals are to be supplied, for all relevant hardware, software, network, technology, etc.</td>
</tr>
<tr>
<td>3.</td>
<td>Ch-3(Elect), 1.01.13.02 And 1.02.24.03</td>
<td>Temperature will not be more than 35°C</td>
</tr>
<tr>
<td>4.</td>
<td>Ch-3(Elect), 1.02.15.01.A.2.0</td>
<td>For all equipment with redundant power supply, supply from two separate sources will be drawn.</td>
</tr>
<tr>
<td>5.</td>
<td>Ch-3(Elect), 1.02.15.01.B.1.0</td>
<td>Ethernet based fieldbus is preferred.</td>
</tr>
<tr>
<td>6.</td>
<td>Ch-3(Elect), 1.02.15.01.B.15.0</td>
<td>• All drives, soft starters, etc. to be connected on fieldbus.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Level-1 – High Speed (1msec scan) recorder to be provided for real time recording of data for important equipment.</td>
</tr>
<tr>
<td>7.</td>
<td>Ch-3(Elect), 1.02.15.01.B.16.0</td>
<td>All the important drives (HT drives) should be provided with suitable CBM systems such as vibration monitoring, current signature, temperature etc. Information from CBM systems to be interfaced to HMI system as well as plant-wide CBM system.</td>
</tr>
<tr>
<td>8.</td>
<td>Ch-3(Elect), 1.02.15.01.B.3.0</td>
<td>Automation system will take care of sequential start/stop of all drives with all necessary hierarchical data acquisition and logging. In case of failure of a sequential start or stop, the operator should be able to accurately pinpoint the cause of failure based on automatic analysis of acquired and logged data for the operation.</td>
</tr>
<tr>
<td>9.</td>
<td>Ch-3 (Elect), 1.02.15.01.B.16.0</td>
<td>All equipment to have extensive diagnostic capability. This information to be used for generation of relevant diagnostic information on working and problems in the system.</td>
</tr>
<tr>
<td>10.</td>
<td>Ch-3 (Elect), 1.02.15.01.B.16.0</td>
<td>Comprehensive status monitoring from respective central control room, through main automation system, to be provided for all utilities (water, compressed air, nitrogen, oxygen, hydraulics etc.), auxiliaries, pollution control measures like dusting, temperature of areas under AC or</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td>---</td>
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<td>---</td>
</tr>
</tbody>
</table>
| 11. | Ch-3 (Elect), 1.01.15.02.A | ventilation systems, etc. as applicable.  
No mode selection at LCS. |
| 12. | Ch-3 (Elect), 1.02.21.02 (10) | Conduits carrying special cables will be painted, coded, marked as per plant norms. |
| 13. | Ch-3 (Elect), 1.02.15.06 | Protocol analyzer for all types of field bus employed need to be included in the supply, as applicable. |
| 14. | Ch-3 (Elect), 1.02.15.06 | Required test and maintenance equipment to be provided for maintenance and troubleshooting of FO and wireless communication. |
| 15. | Ch-3 (Elect), 1.02.15.07 | All drawings, designs, configurations, software, numbers, models, etc. listed in CS and GTS are indicative and minimum only. Contractor may suggest a better and more comprehensive solution. |
| 16. | Ch-3 (Elect), 1.02.15.01.B.16.0 | Employer’s involvement in design of control philosophy development, application software and hardware combined, drawing up of software specifications, software development, off-line testing, etc. for both Level-I and Level-II systems. |
| 17. | Ch-3(Elect), 1.02.15.01.B.16.0 | Provisions to be made for off-line testing of Level-I and Level-II systems prior to actual deployment. |
| 18. | Ch-12, 1.3.4.9 | Tools for software and data backup in sufficient quantity to be included, as applicable. |
| 19. | Ch-12, 01.3.1, Server Type-II | Number of HDD should be 3, as applicable. |
| 20. | Ch-12, 01.3.1, Storage Area Network (SAN) | Minimum 1:2 HBA ports for SAN Box to servers (i.e. for every 2 ports from server the storage should have 1 front end port), as applicable. |
| 21. | Ch-12, 01.3.2, Network Configuration | Max CAT-6 length of 30m for shop floor installations, as applicable. |
| 22. | Ch-12, 01.3.2, Network Configuration | Necessary facility/software will be supplied for remote management and monitoring of the entire network – Level-I and Level-II, as applicable. |
| 23. | Ch-12, 01.3.2, Network Configuration | Network teams from multiple switches to be employed for all the important machines (computers), as applicable. |
| 24. | Ch-12, 01.3.2.2, Utility Software | Language compilers like Java/JSP for servers/clients for development of application software (wherever required) should be provided apart from C/C++. The languages for which compilers and IDE will be supplied and will be as per Level-II application software, as applicable. |
| 25. | Ch-12, 01.3.4.1 | • Level-II system will provide platform for User-initiated run-time configurable analysis using tools like charts, plots, trends, Co-relation Displays, Frequency Distribution Displays, |
quality parameter monitors, etc. and Reporting-by-exception.

- All the models to include simulation as well as optimization. System generated set-points may be automatically taken up for control after scrutiny by the technologist or operator.
- Operator Guidance System (answering ‘What if?’) for various technological units of the plant.
- Level-II will be designed to cater to special campaigns of operation also.

<p>| | | |</p>
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>26. Ch-12, 01.3.10</td>
<td>Aesthetically designed metallic consoles will be provided for clients / work stations, in place of tables. Servers and switches will be housed in rack type standard enclosures, as applicable.</td>
<td></td>
</tr>
<tr>
<td>27. Ch-12, 01.3.13</td>
<td>Required test and maintenance equipment to be provided for maintenance and troubleshooting of FO and wireless communication, as applicable.</td>
<td></td>
</tr>
<tr>
<td>28. Ch-12, 01.5.12</td>
<td>Employer will be involved in design of control philosophy development, application software and hardware combined, drawing up of software specifications, software development, off-line testing, etc. for Level-II system, as applicable.</td>
<td></td>
</tr>
<tr>
<td>29. Ch-12, 01.3.7.2 (1)</td>
<td>Conduits carrying special cables will be painted, coded, marked as per plant norms, as applicable.</td>
<td></td>
</tr>
</tbody>
</table>
In the middle of the run between two expansion joints and at sectionalising gaps, the rails shall be rigidly fastened/supported.

009  
**Resistance boxes**

The resistance boxes shall be installed on frames to be welded to civil inserts already provided.

010  
**Cables Installations**

Interplant cabling shall be done in cable tunnel. Overhead cable bridges / concrete cable channels can be considered in case of lesser number of cables. Cables laid overhead using separate structural cable bridge with suitable walkway of minimum 800mm wide for laying of cables. Cables of small in numbers and cables for drives/field switches inside shop units shall be laid along the structures and columns of the shop / buildings. Cables may run partly in walkable cable tunnels or underground trenches and/or surface ducts in the shops and partly along the structures and columns of the buildings.

In case of space constraints/ restrictions, cable shall be laid in walkable cable tunnels. Where the number of cables to be laid calls for walkable tunnels and cable shafts, same shall be provided. Underground walkable cable tunnels shall have hydro sealing to prevent water seepage.

For multi-layer installation, overhead cable bridge/walkable cable tunnels shall be used depending upon the number of cables to be laid.

Laying of cables directly in underground or in trenches shall be avoided. However, it may allowed in special case with permission from site in charge. In such case, cable shall be laid in one layer only, more than one layer is not permissible.

Cables in trenches shall be laid on 8 cm of riddled sand and covered with 8 cm of riddled sand. RCC slabs shall be provided for covering these trenches. The maximum trench depth shall normally be 1.5 m and thickness of top cover of 75 mm. If the trench is to cross railway tracks/roads or any load bearing area the cables shall be taken through suitable GI conduits/pipes/ducts.

For crossing the road / rail track, cables shall be laid in concrete cable ducts, heavy duty GI pipes . 25% spare conduits / pipes / duct openings shall be provided.

Installation of cables directly buried in ground shall generally conform to the requirements given in IS: 1255 –1983.

011.1  
**Laying in tunnels/surface ducts/on structures**

Cable racks for cable trays shall be fixed at a maximum interval of 1.5 m.

Cables leaving the ground/floor shall be protected upto 2-m height by conduits/metallic guards.
Ladder type cable racks and trays shall be provided to lay cables in tunnels/shafts/cable basements. Cables shall be laid in separate racks according to the voltage / application classification. Fireproof partitions such as asbestos sheets shall be provided between trays carrying LT & HT power cables, control and screened cables, communication cables, instrumentation cables & telecommunication cables. The cables shall be laid from top to bottom in order of HT on top rack followed by LT cables and other cables on lower racks.

All communication cables shall be laid through separate conduits to be installed in different routes with suitable separation from the other electrical cables. Conduits carrying special cables shall be painted, coded, marked as per plant norms.

All necessary frame works and fixings for the support of cables and accessories shall be supplied.

Cables shall be suitably protected against heat, and mechanical damages.

Cables at fire partition wall crossings shall be painted with heat resistant paint 2 m on either side of wall.

011.2 Structures for cable laying

Power cables shall be laid on ladder type cable trays. Ladder type cable trays shall be selected from sizes 300 mm, 450 mm & 600 mm and shall be fabricated from 50x50x6 mm MS angles for longitudinal members and 25x5 mm flats for cross members placed at an interval of 250 mm along the length of cable tray. Control cables shall be laid on perforated trays.

Supporting vertical racks and horizontal hooks shall be of 50x50x6 mm MS angles. Cable racks and hooks shall be of welded construction.

To avoid damage during cable laying, cable structures shall have no scales, abrasive or rough surfaces or cutting edges.

The over head cable bridge structure shall be designed considering future cable laying and shall have 30% spare space for installation of future cable trays.

Walkway of minimum 800mm wide shall be provided for laying of cables.

Two numbers additional cable trays and 20% extra space on each cable tray for future use shall be provided as far as possible.

Cable shall be fixed to racks or trays or cleats as required for proper support, accessibility and neatness of installation. Hanging of cables racks over panels shall not be permitted rather no cable shall be laid/pass over any electrical equipment e.g. transformer, switchboards etc. Cable tags shall be provided at a regular interval of 30M. For cable run shorter than 30M one cable tag shall be provided in the middle. These tags shall be in addition to end cable tags. The cable tags shall be marked with cable number, size and voltage grade. Middle tag shall be indicated with destination. The end tag shall be with second terminal point.
Cables shall be clamped rigidly at an interval of not more than 1000 mm in horizontal, and 500 mm in vertical & inclined run and at bends.

In the cable basement/cable galleries, cable structures shall be properly arranged giving sufficient clearance for movement of personnel from one part of the basement/gallery to the other. It shall also be possible to escape easily in case of fire. Cable passing through water/scale pit/acid fume etc. shall be laid in PVC pipe with PVC junction boxes and pull boxes etc. Where cable racks or trays cannot be erected or the number of cables on the route does not justify their use, cables shall be cleated direct to walls or structural steel work. Perforated trays shall only be used where necessary for the support of a number of small cables. Each tray shall be firmly supported at suitable intervals and shall carry the weight of its cables without sagging. Trays shall be painted and where the surfaces or edges are cut or otherwise impaired during erection, they shall be made good by coating with aluminium paint.

Small cables may be bunched together under one saddle provided that in any bunch all cables have sheaths of the same material. The number of cables shall not exceed four wide and two deep.

Not more than one cable shall be drawn into one conduit unless otherwise agreed. After the cable has been drawn in, the conduit shall be sealed by an approved means.

After complete installation of racks and trays etc. it shall be painted with a primer of red oxide(zinc chromate) and a top coat of finishing paint as approved.

Fire protection barrier as approved by purchaser shall be provided between HT cables on racks laid on top and LT cables on racks below the HT cable rack.

All cables shall be tested for proper insulation before start of laying work. Cables shall be laid in conduits, racks/trays, cable tunnels/trenches, along with structures or buildings, as per cable routing drawing and cable list.

Suitable adjustment shall be made in cable routes, if required at site, with a view to avoid any interference with any part of building, structures, equipment, utilities and services with the approval of the purchaser.

While laying cables, care shall be taken that kinks, twists or mechanical damage do not occur to the cable.

All bends in cables shall be made with due consideration to the minimum permissible bending radius of the cables.
Loops shall not be allowed to be formed during the laying of the cables. When being pulled, the cable shall not be allowed to drag drawing along the ground or over a second cable already laid. Special care shall be taken while pulling through an opening where other cables have already been laid. Only approved cable pulling devices shall be used.

No joints shall normally be made at any intermediate point in through run of cables unless the length of the run is more than the standard drum length. In such cases where jointing is unavoidable, the same shall be made inside proper bases having plastic moulds and shall have moulded epoxy resin construction. Provision shall be made for earthing continuity at the joint. Cable splicing and jointing shall be done in accordance with the relevant IS, code of practice and manufacturer's instructions. Insulation resistance of cables shall be checked before cable jointing.

Adequate length of cables shall be pulled inside the switch boards, control panels, control desks, etc. so as to permit neat termination.

All cables shall be neatly dressed without interlocking or cross overs. While laying the cable vertically, these shall be clamped at suitable intervals. Horizontal runs shall be rigidly secured to trays on racks/hangers in all the places where the direction of the route changes as well as at cable terminations or joints. The clamps shall not be done up so tight that the insulation is damaged or deformed.

Cable markers shall be provided on either side of road crossing at each turning and at 30 m intervals at straight runs for underground cables.

Where cables are required to cross roads, surface drains and water, oil, gas or other pipe lines, they shall be taken through reinforced spun concrete or steel pipes.

Entry of cables from underground to the buildings or trenches shall be through pipe sleeves. After laying of cables, the sleeves shall be sealed with bitumen or epoxy compound with sand matting and cement plaster to make them fully water tight. Special consideration shall be given for protection of cables against chemical and mechanical damage.

All cable entry openings in the equipment shall be sealed and made vermin proof. All cable openings in walls and floors shall be sealed after laying of cables by a weak mixture of asbestos and cement mortar.

All cables shall be provided with identification tags indicating the cable number in accordance with cable lists. Tags shall be fixed at both ends of the cable and at 15 m spacing for straight runs as well as on both sides wherever cables are crossing walls/floors. The tags shall be of aluminium/PVC with numbers punched/painted on them and securely attached to the cables by non-corrosive wires. The shape of tags
shall be round, triangular and rectangular for control, medium voltage and high voltage cables respectively.
Glanding shall be done for direct entry of both power and control cables into the panels by the contractor. Compression type brass or aluminium alloy cable glands shall be used.
The cables shall be terminated in accordance with relevant connection diagram. Termination and clamping shall be carried out in such a manner as to avoid strain on the terminals.

All power cable terminations shall be by means of crimping type cable lugs. For flexible conductors, soldered termination shall be adopted. In case of aluminium power cables termination on copper bus bars, suitable aluminium copper bimetallic washers shall be used. Corrosion inhibiting grease shall be used for aluminium cable terminations. All 1.5 sq.mm screened cable/ 2.5 sq.mm control cable termination shall be made by crimping using pin / fork type (as decided during engineering stage) insulated copper lugs. The 1.5 / 2.5 sq.mm copper lugs shall be supplied by the contractor.

Suitable numbered and coloured letter interlocking type ferrules shall be provided for end termination of power and control cables. Cross ferruling shall be used for control termination as far as possible

Control cable entering switch boards, control panels, control desks etc. shall be neatly bunched and strapped with PVC perforated straps and suitably supported to keep it in position at the terminal blocks. All spare cores of each cable shall be segregated, marked spare, neatly dressed and suitably tapped at both ends.
When the cores of two or more multicore cables take a common route in side equipment, cores of each cable shall be separately bound and the separate bundles neatly bound together.
Individual cores of control cables shall have plastic interlocked type coloured ferrules with engraved numbers at both ends of the circuit for identification.

The contractor shall be responsible for correct phasing of motor power connections and shall interchange connections at the motor terminals box, if necessary, during each motor is test run.
The trays shall be earthed and rendered electrically continuous by welding the trays to the grounding strip at not less than two places from both sides of the tray.

011.3 Cable Joint/termination accessories

The cable accessories shall include end termination kits, straight through joints and also any special tool and tackles and accessories required for making the joints/terminations.