TENDER DOCUMENT

TENDER NO.: DLI/C&E/WI-675/260

FOR

Tender for Design, Engineering, Supply, Supervision of Installation, Testing & Commissioning of “Flap Gates (3 nos.) & Diverter Gate (1 no.) and Associated Works” for the project of “Augmentation of Fuel and Flux Crushing Facilities (Package no. 064) of Bhilai Steel Plant (SAIL)”.

VOLUME – 2B

TECHNICAL SPECIFICATION
## CONTENTS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Documents/information to be furnished along with offer</td>
</tr>
<tr>
<td>2.</td>
<td>Scope of Supply</td>
</tr>
<tr>
<td>3.</td>
<td>Technical Specifications of Gates</td>
</tr>
<tr>
<td>4.</td>
<td>Technical Specification - Electrical, Control &amp; Automation</td>
</tr>
<tr>
<td>5.</td>
<td>Spares</td>
</tr>
<tr>
<td>6.</td>
<td>Technical data sheet (to be filled by the vendor)</td>
</tr>
</tbody>
</table>
1.0 DOCUMENTS / INFORMATION TO BE FURNISHED ALONG WITH OFFER

(i) Clear Scope of supply.

(ii) Exclusions, if any.

(iii) Type and quantity of oil, lubricants & consumables for initial fill till successful commissioning of equipment.

(iv) List of Commissioning spares and start-up spares with unit rates.

(v) List with unit rates of special tools and tackles, if any required.

(vi) Price Schedule for supply & erection work as per the format enclosed.

(vii) List of recommended spare parts for 2 (Two) years trouble free operation and maintenance alongwith unit rates as per the format enclosed in price schedule.

(viii) Technical Data sheets duly filled by the vendor (blank data sheets enclosed).

(ix) Weight of the equipment in Kgs.

(x) Catalogues/ Leaflets and O&M Manuals.


(xii) Reference list of your Customers for the similar supply of items.

(xiii) Quality Assurance Plan.

(xiv) Unpriced Copy (Furnish unpriced copy of Price Schedule alongwith the Technical Bid).
2.0 **SCOPE OF SUPPLY**

The scope of the supply includes Design, engineering, manufacture, shop fabrication, assembly, testing and inspection at manufacturer’s works, packing, dispatch, transportation, delivery to site, supervision of installation, testing & commissioning, performance guarantee testing of "**Flap Gates (3 nos.) & Diverter Gate (1 no.) and Associated Works**" as per specifications and scope defined in tender documents complete with all accessories and drive, which are not mentioned specifically but are required for the safe, reliable, efficient and trouble free operation of the equipment/system.

a) **Following items are also included in vendor’s scope.**

(i) All fixing bolts and nuts shall be included in the scope of supply of Tenderer.

(ii) Complete equipments / facilities as per the details given in the specifications.

(iii) Consumables like first fill of lubricating oils etc. for the initial operation of the equipment till handing over.

(iv) Commissioning spares and start-up spare parts.

(v) Special tools & tackles, if any required.

(vi) Painting of complete equipment (including final painting before handing over to the Employer) as per Clause no. 5 of Vol. 2A.

(vii) Supervision of Installation, testing & commissioning at site.

(viii) All drawings / documents along with operation and maintenance manuals as per requirement mentioned elsewhere in the tender document.

(ix) Getting approval of design/drawings and any other design calculation related to the equipment from BSP / MECON / EPI.

(x) System Voltage shall be 3 Phase, 415V (+10% -15%), 50Hz (+4% -6%), all system component shall be designed accordingly.

(xi) Carrying out any modifications/deletions/additions/alteration in design/drawings/documents as required by client & Client’s consultant and EPI for proper execution of works at site till completion and handing over of the project to the client.

**Exclusions:**

(i) Civil works including grouting.
b) **Tenderer to note the following:**

(i) BSP GTS and “Approved Preferred” make list shall be followed for parts/components/equipment/sub units.

(ii) Complete electrics including motors, LCS, field devices, power and control Junction Boxes, etc. for Gates as required.

(iii) Terminal Box of Motor shall be suitable for 4 core cable.

(iv) Flap/Diverter Gates for Coal Handling Plant shall be lined with 8mm thick SS 409M liner plates.

(v) Flap/Diverter/Split gate in Coke Sorting Plant shall be lined with 10mm thick ‘Hardox 500’ material with CSK bolting.

(vi) The two way flap gates in Coke Sorting Plant shall be of robust design and of wear resistant material for longer life.

(vii) Flap/Diverter gate in Coke Sorting Plant drives shall be of adequate rating to take care of dirty conditions of the chute’s interior.

(viii) All flap/diverter/split gates shall be motorized.

(ix) **Schedule of Flap & Diverter Gates:**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Area</th>
<th>Location</th>
<th>Gate Type</th>
<th>Inlet Chute Opening Size</th>
<th>Outlet Chute Opening Size</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coal Handling Plant</td>
<td>JH-4 (Mod.)</td>
<td>Flap Gate</td>
<td>1060 X 760 (Refer Drg. No. 00543)</td>
<td>760 X 760 (Refer Drg. No.: 00543)</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Coal Tower No. 7</td>
<td>Diverter Gate</td>
<td></td>
<td>950 X 1350 (Refer Drg. No.: 00736)</td>
<td>800 X 800 (Refer Drg. No.: 00429)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Coke Sorting Plant</td>
<td>JH-1</td>
<td>Flap Gate</td>
<td>860 X 1260 (Refer Drg. No.: 00551)</td>
<td>950 X 1000 (Refer Drg. No.: 00444)</td>
<td>2</td>
</tr>
</tbody>
</table>

Chute opening size given above is tentative and the same may vary during detail Engineering.
3.0 TECHNICAL SPECIFICATIONS OF GATES

3.1 Technical Specifications of Flap Gate

1. Only the broad specifications covering the technical requirements for the equipment to be supplied are indicated. It is not the intent of this specification to specify complete details of the equipment including design and manufacture. The Successful Tenderer shall carry out detailed design, engineering and manufacture in a manner that shall ensure smooth and trouble free performance of the equipment as a whole.

2. The Tenderer shall ensure that minimum amount of assembly is necessary for erection and commissioning of equipment at site. Site welding shall be avoided as far as possible.

3. All components shall be designed and tested in accordance with latest Indian Standards unless stated otherwise & agreed to.

4. All components shall be manufactured with material of approved quality & best of workmanship. The equipment shall be shop assembled for checking operation and accuracy of parts.

5. All working parts of the equipment shall be suitably located for convenient operation, inspection, lubrication, repairs & easy replacement.

6. The motor operated flap gates shall be provided in transfer chutes as specified and shall be complete with electrically operated actuators. The gates shall be of robust construction and suitable for trouble free operation.

   • The flap gates shall be used to divert the flow of material received from feeding conveyor to the receiving conveyors. The gates shall be operated by an electromechanical linear actuator. The actuators will be mounted on the chute body/ or on a working / maintenance platform. The exact mode of support will be intimated to the successful Tenderer.

   • The gate shall be fabricated out of 10 mm thick MS plates with wear resistant, replaceable liners. The liners will be bolted by counter sunk bolts. The thickness of the liners shall be adequate so as to give minimum 3 years operating life.

   • The gate shall be capable of changing the direction of material on remote mode of control even when the material is being discharged from the feeding conveyor pulley.

   • The equipment shall be capable of being operated for at least 15 switchings per hour at rated load and thrust and shall be suitable for 10 Nos. consecutive switchings at rated load and thrust. The equipment shall be shop tested to prove the requirement.

   • The motor rating for the actuator shall be so selected as to provide sufficient thrust (min. 2500 kg) for operation of the flap gates against the moving weight of material and/or flap gate.

   • The flap gate travel shall be in the range of 60° to 70°. Limit switches shall be provided to indicate extreme positions. Lever arm shall be provided between actuator and flap gate shaft for obtaining required thrust. Each gate shall be provided with a shaft, a hand lever and self aligning type antifriction bearings with adequate sealing for dust proofing.
The actuators shall be capable of preventing any over travel. Suitable travel dependent limit switches controlling the travel; of the flap gates on either direction shall provided. These shall be placed internal to the drive unit and shall be completely dust-proof. The limit switches shall be capable of adjustments to vary to total length of travel of the gates.

Suitable thrust dependent limit switches shall be provided. This shall trip off the actuator motor in case of excessive thrust due to jamming the gates during its travel in either direction.

Provision for alternative manual operation shall also be made using declutchable hand wheel. The diameter of hand wheel shall be selected considering a 25 kg (max.) force to be applied by a single operator.

Suitable stiffening arrangement shall be provided between the two faces of the gate plate. At the end of the travel the total length of edge of flap gate shall rest on a suitable projected surface from chute to prevent leakage of material through the available clearance between chute and flap gate.

Maximum feasible counterweights shall be provided for better utilisation of system. However for calculation of thrust required, the benefit of counterweight shall not be taken into consideration.

Suitable self aligned double row ball bearings of approved make in dust tight housing shall carry the gate shaft.

For standardisation purposes, only one standard type of actuator (of 2500 kg thrust load) of flap gates shall be provided. Flap gate actuator as a whole and individual component wise shall be completely interchangeable for all locations.

The material of shaft shall be EN-8 or equivalent material. The diameter of the shaft shall be suitable for motor stalled conditions and associated twisting.

The deflector plates fixed to the actuators through linkages shall be used to divert the flow of materials onto the chutes below. Details of the deflector plates will be furnished to the successful Tenderer.

3.2 Technical Specifications of Motorised Diverter Gate

3.2.1 The equipment shall be designed as per design criteria given below:

1. **Hierarchy of Specifications**
   a) Technical Specification
   b) IPSS & IS
   c) Indian Electricity Rules & statutory requirements of Central Govt. and State Govt.

   Equipment complying with other recognised Standards such as IEC, BS, VDE, and IEEE will also be considered if it ensures performance equivalent to or superior to Indian Standards.

2. **Design Basis**
   - Design capacity of equipment - 20% more than designed stream capacity of feed conveyor to be considered while calculating motor power.
Pillow blocks
a) Material - cast iron / cast steel
b) Bearing - Self aligning spherical roller bearing
c) Life - 40,000 working hrs (min.)
d) Construction - Horizontal split type (one end fixed and the other end expansion type)

Reducer
a) Service rating of 1.5 times the calculated shaft kW and thermal capacity of gear box shall be better or equal to that of motor.
b) Material - fabricated or cast steel
c) KW rating shall be not less than 1.25 times the motor kW. Higher value of ‘a’ or ‘c’ will be considered.
d) No worm gear except for travelling gate.

3.2.2 Technical Specifications

- All equipment shall be designed, manufactured, supplied, erected, tested and commissioned in accordance with relevant Indian Standards and International Standard where applicable in addition to the requirement mentioned herein.

- The Supplier shall make his own calculation in respect of motor kilowatt to ensure satisfactory performance of the equipment.

- Standardisation of components and assemblies shall be carried out to the maximum possible extent to ensure interchangeability.

- All equipment shall be designed such that all components are easily accessible for inspection, repair and maintenance.

- The gate shall be capable to allow half flow on to each receiving conveyor or full flow on to one conveyor or to the other conveyor.

- The gate casing shall be fabricated out of 6 mm thick MS plates with liners and conical portion of the diverter shall be made of 10 mm thick MS with 5 mm thick stainless steel/SAIL HARD liners. The gate shall move inside a totally enclosed steel framework mounted below the discharge hood of the feeding conveyor. Positive to and fro motion for the two positions shall be imparted to the gate supporting frame through rack and pinion arrangement driven by bevel geared drive. Material of construction of the pinion and rack shall be minimum C45 or EN8.

- The gate shall be capable of changing the direction of material on remote mode of control even when the material is being discharged from the conveyor pulley.

- The drive shaft shall be made of C45. Antifriction ball/roller bearings shall be used throughout.

- Speed of the gate shall be 30 mm/sec.

- Limit switches for positioning and position indication shall be provided.

- Provision for manual operation of the gate shall also be provided at the extended motor shaft. Manual force required shall not exceed 25 kg.

- Rubber buffers on the gate shall be provided at both ends inside the casing.
• The gate shall be supported on the steel floor beams.
• 2 numbers inspection windows (hinged type and dust tight) shall be provided on drive side of the casing.
• All bolts except those with nyloc nuts shall be provided with lock nuts or spring washers.
• No cast iron parts shall be used (except for pillow blocks).

3.3 DOCUMENTATION

1. List of drawings /data to be submitted along with tender

• General arrangement drawing of each type of gates showing overall dimension, profile, material of construction, weight etc.
• List of commissioning spares proposed by the Tenderer.
• List of spares for two years operation.
• Duly filled up questionnaire.

2. List of drawings to be submitted for approval by successful tenderer

Drawings listed hereinafter shall be submitted to the Purchaser/MECON for approval, starting within one month of issue of letter of intent and prior to the commencement of fabrication.

• General arrangement drawing of each type of gates showing overall dimension, profile, material of construction, weight, bill of materials etc.
• In addition to the above, the Purchaser/Consultant reserves the right to insist on submission of calculations/for component selection.

3. Drawing/data/calculation for reference to be submitted by successful tenderer

• Procedure for testing and commissioning.
• Instruction for storage /erection, testing & commissioning.
• Catalogues/literatures
• Operation and maintenance manual.
• Final test certificates
• For reference & records
  a) Part list, bill of materials and specification.
  b) Major sub-assembly drawings of drive, safety features, lubrication details etc.
  c) List of spares, consumables, special tools and tackles.
  d) Operation and maintenance manuals.
4.0 Technical Specifications - Electrical, Control & Automation

For Electrical, Control & Automation relevant clause of following Technical Specification will be applicable.

1. CHAP-04.09 Instrumentation & Control

2. CHAP-04.10 Electrical Power Distribution, Drives, Control & Illumination.

3. CHAP-04.11 Automation

The above Technical Specification shall be read in conjunction with General Technical Specification (GTS) of Bhilai Steel Plant, SAIL and General Specification. If there are any provisions in this Technical Specification, which are at variance with the provisions of General Technical Specification (GTS) of Bhilai Steel Plant, SAIL and General Specification, the provisions in this Technical Specification shall take precedence.
5.0 SPARES

1. Commissioning Spares and Insurance Spares

Supply of commissioning spares and insurance spares as required shall be in scope of supply of the Bidder along with the equipment. The list of commissioning spares and the insurance spares as per the format as given in SBD shall be furnished along with the tender. It shall cover requirements of erection, cold tests, startup and initial operation of the plant till integrated testing & successful commissioning and commencement of commercial production up to a period of six months. Any leftover commissioning spares shall be the property of the Purchaser. Any commissioning spares required over and above the list given by the Bidder shall have to be provided by the Bidder free of cost up to the successful commissioning & commencement of commercial production of the plant and equipment. The Bidder shall supply adequate insurance spares to ensure smooth operation and maintenance of the plant.

2. Consumables

The Bidder shall supply all consumables such as initial fill of lubricants, oils, grease, chemicals, refractories, resins etc. as required to complete the plant till commissioning and shall have a shelf life of minimum one year. The scope of consumables shall include electrodes, shims, packings, bolts, nuts, gaskets, rivets, washers etc. The Bidder shall fulfill the requirement given in SBD.

The Bidder shall also furnish Indian equivalent of oils, lubricants, refractories and other consumables along with necessary specifications, drawings, catalogues etc. to enable the Purchaser to procure them from indigenous sources.

The Bidder shall indicate the annual requirement of all such consumables.

3. Operating, Maintenance and Two Years’ Spares:

a) The Bidder shall ensure the interchangeability of the parts wherever possible. The Bidder shall furnish an itemized list of interchangeable spares as given in SBD.

b) The list of spares as necessary and recommended by the respective manufacturer for two years’ of reliable and trouble free operation and maintenance of all equipment under this package shall be in the scope of the Bidder. The same shall be quoted separately. In the event of order the successful Bidder shall furnish complete specification of the same.

c) Spares list giving complete list of the replaceable parts, fully illustrated shall be supplied. The list shall include the following information:

- Item designation
- Reference drawings
- Quantity installed
• Quantity recommended for two years’ normal operation including the insurance spares
• Weight of each spare part
• Supplier or sub-supplier’s catalogue number
• Recommended minimum stock
• Expected replacement time
• Installation instruction in detail shall be supplied both for original installation and future, for replacement of major electrical equipment, circuit wiring diagram shall be provided.

4. Special Erection / Maintenance Tools and Tackles:

a) The Bidder shall supply a complete and unused wet of all the special tools and tackles including required number of tool boxes as required for erection, maintenance, overhaul or complete replacement of the equipment and components required for the plant. The Bidder shall submit a list of such special erection and maintenance tools and tackles.

b) All the tools shall be supplied in separate containers clearly marked with the name of the equipment for which they are intended.

c) The Successful Bidder shall indicate list of construction machineries, handling equipment and other facilities including tower crane or equivalent for erection at high elevation required for the execution of work based on their previous experience, considering site conditions and other considerations of work and furnish resource deployment plan. The successful Bidder shall mobilize these equipment at site for the execution of work and this is an important requirement of the project. The availability of required facilities shall be ensured for completeness of the project in time.

d) For any fabrication / control assembly (necessary for erection) work to be done in the plant premises the plan shall be indicated by the Bidder. The necessary equipment such as plate bending machines, special purpose welding machines, fixtures, tools & tackles and other equipment required for fabrication shall be arranged by the successful Bidder.

e) The successful Bidder shall carry out the testing of welded joints by radiographic and ultrasonic methods. They must have only qualified / certified welders with them for completing all the welding jobs.

f) All the measuring instruments shall be calibrated having reference to NPL (National Physics Laboratory).

g) All tools and tackles, apparatus, special instruments required for erection, testing, commissioning and establishment of the Performance Guarantee Test, measurements required for establishing the pollution control norms and such other instruments, as required, shall be arranged by the successful Bidder. After commissioning, the successful Bidder shall handover all the special tools & tackles to the Purchaser as per the requirement given in SBD.
h) The successful Bidder shall supply all required consumables, initial fill, oil, lubricants, construction and erection materials including but not limited to shims, packing plates, joining compounds, kerosene, solvents, sealing compounds, tapes, connectors, brazing and soldering materials, welding and brazing gases and rods, electrodes and wires, erection bolts, nuts, rivets, piano wire, packing sheet and packing compounds, temporary supports, spacer templates, jute and cotton waste cloth, sand and emery paper etc. for the commissioning of the plant.

i) For load testing of handling equipment, loads shall have to be arranged by the successful Bidder. Electrical/operation tests, as per standard practice, shall also be arranged and completed by them.

j) All materials, equipment, tools, tackles etc. brought at site by the successful Bidder within the plant area shall not be removed without the written permission of the Purchaser. Similarly, all enabling works built/erected and/or acquired by them within the plant premises shall not be dismantled and removed without the written permission of the Purchaser.

5. Information/Data on Spares and Consumables

The list of Spares & consumables shall be furnished by the successful Bidder as required in SBD. However, the successful Bidder shall furnish various information regarding spares, consumables, tools & tackles etc. as per the schedules indicated in chapter 12 of this Technical Specification.
6.0 TECHNICAL DATA SHEET (To be filled by the vendor)

The Tenderer shall also furnish the following questionnaire and submit with his offer. This data shall form a part of the contract with Successful Tenderer.

6.1 Technical Data Sheet (Mechanical)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>Name and address of the Bidder</td>
</tr>
<tr>
<td>2.</td>
<td>Previous experience of the Bidder</td>
</tr>
<tr>
<td>3.</td>
<td>List of similar equipment supplied (along with user’s certificate)</td>
</tr>
<tr>
<td>4.</td>
<td>Is it the Bidder's intention, if awarded contract, to comply fully in all respects with Purchaser’s specifications covering the work? If not, he shall state specific exception in details.</td>
</tr>
<tr>
<td>5.</td>
<td>Location / Nos. off</td>
</tr>
<tr>
<td>6.</td>
<td>Type of feeder &amp; Designation</td>
</tr>
<tr>
<td>7.</td>
<td>Capacity through</td>
</tr>
<tr>
<td>8.</td>
<td>Material of construction of different parts</td>
</tr>
<tr>
<td>9.</td>
<td>Total weight and weight of individuals parts</td>
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<tr>
<td>10.</td>
<td>Type of liner and thickness</td>
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<tr>
<td>11.</td>
<td>Motors</td>
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<tr>
<td></td>
<td>a) KW rating</td>
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<td></td>
<td>b) RPM</td>
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<tr>
<td></td>
<td>c) Type</td>
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<tr>
<td></td>
<td>d) Bearing</td>
</tr>
<tr>
<td></td>
<td>e) Make</td>
</tr>
<tr>
<td></td>
<td>f) Expected life (hrs)</td>
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<tr>
<td>12.</td>
<td>Gear Boxes</td>
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<tr>
<td></td>
<td>a) Make</td>
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<td></td>
<td>b) Type</td>
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<tr>
<td></td>
<td>c) Reduction ratio</td>
</tr>
<tr>
<td></td>
<td>d) Torque rating (kg-m)</td>
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<tr>
<td></td>
<td>e) Overall efficiency</td>
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<tr>
<td></td>
<td>f) Wt. of Gear box (kg)</td>
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<tr>
<td>13.</td>
<td>Couplings</td>
</tr>
<tr>
<td></td>
<td>a) Make and type of high speed couplings</td>
</tr>
<tr>
<td></td>
<td>b) Make and type of low speed couplings</td>
</tr>
<tr>
<td></td>
<td>c) Weight (kg)</td>
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04.09 INSTRUMENTATION & CONTROL

04.09.01 GENERAL

01. This document is intended to define the basic requirements for instrumentation system for Coal Handling Plant & Coke Sorting Plant for COB #11 and Flux & Fuel Preparation and Plant Return Fines Handling for SP-III coming under the 7.0 MTPA expansion of Bhilai Steel Plant (BSP) with a view to achieve smooth, efficient, safe and reliable operation of the process.

02. This document, read together with the Instrumentation & Automation part of the General Technical Document (No.GS-03), General Conditions of Contract (GCC) and other commercial terms & conditions, will form the Contract document pertaining to Instrumentation & Control System of Coal Handling Plant & Coke Sorting Plant for COB #11 and Flux & Fuel Preparation and Plant Return Fines Handling which will be complied by the Contractor while executing the package.

03. Measurement and control equipment supplied for the process will be complete in all respect in line with this document. Any equipment / accessories not explicitly indicated in this document, but considered essential for proper functioning of technological equipment and process are included in Contractor's scope of work and supply.

04. Monitoring, sequential operation, alarm & interlock functions for the process & equipment of the Coal Handling Plant & Coke Sorting Plant for COB #11 and Flux & Fuel Preparation and Plant Return Fines Handling for SP-III will be achieved through automation system. All instrumentation facilities will be interfaced with automation system accordingly. The requirement regarding automation system has been separately described under 'Automation system (level-1)' chapter of this Document.

05. Instrumentation system of the plant will be in general, Field Bus compatible and will be interfaced with the automation system having Field Bus interface modules. However, in cases, where some instruments are not available with Field Bus compatible features, conventional instrumentation equipment (SMART & 4-20 mA DC signal output) will be supplied. Signals from these instruments will be interfaced through hardware input/ output modules of the automation system.

06. All field-mounted level transmitters will be radar type. Suitable enclosures will be provided at field for the controller/ electronic unit of the level transmitters. Other features of the instrumentation facilities will be as indicated in the Instrumentation part of General Technical Document (No.GS-03). Level transmitters will measure accurately & reliably the level of bulk solids and powders during fill cycle regardless of the dust or material variation in density or moisture.
For high level interlock, suitable contact type level switches to be considered.

07. If required, air purging of level sensor (radar type) will be provided. All necessary tubes/pipes, valves, pipe fittings etc. for the same will be provided by Contractor.

08. The field signals which are to be interfaced with the I/O system or Field Bus interface modules of automation system, will be connected to the nearest Remote I/O stations of the automation system considered for that area/unit. Suitable junction boxes will be considered as per the finalized requirement. The cabling activities will be carried out as per the finalised cable schedule and wiring & termination drawings of the Contractor.

09. All the instrumentation equipment will be brand new & supplied from the latest product ranges of reputed manufacturers as per the List of Preferred Makes, indicated at clause no. 04.09.06. Employer/ Consultant reserve the right of selecting particular make and model of instrumentation equipment with a view of standardisation of the whole plant. Contractor will comply with such requirements. In case, certain instruments to be supplied by Contractor as per his standard design and system requirement whose make has not been indicated in the document, Contractor will propose make of such items with credentials and catalogues for Employer/ Consultant’s consideration.

10. Contractor will execute complete instrumentation package on turnkey basis to the satisfaction of Employer/ Consultant. Contractor will comply with all the requirements indicated under General; Scope of Work and Supply; List of measurement, control, alarm & interlock; Submission of drawings & documents and other related clauses/annexure included in this document.

11. Temperature measurement under package units & motors will be connected directly to respective automation system’s temperature input card.

12. All correspondences / documents will be in English language and for all the data, drawings & documentation metric or SI units will be followed.

04.09.02 SCOPE OF WORK AND SUPPLY

Contractor’s scope of work and supply will include design; engineering; manufacture/procurement; assembly; calibration; shop testing; inspection at works & at site; painting; packing; transportation to site including loading, unloading, storage & handling of all instrumentation equipment including electrical accessories, cables, pipes, erection accessories, panels/ cabinets and all associated hardware, as required for completeness of
instrumentation system in all respect along with site fabrication, erection, testing, commissioning of the complete instrumentation system for completeness & satisfactory stable operation of Coal Handling Plant, Coke Sorting Plant for COB #11, Flux & Fuel Preparation and BF Return Fines Handling for SP-III. The scope of work will also include liquidation of defect points, participation in tests for establishment of plant performance guarantee (PG) and post commissioning activities till issue of final acceptance certificate (FAC) by BSP.

The scope of work and supply will also include, but not limited to, the following:

1. Instrumentation equipment as per the measurement list covered under clause number 04.09.03 of this document.
2. Field bus devices, Field bus interface modules, Field bus cables, terminators, couplers, connectors, power supply modules, power conditioners, surge suppressors, repeaters, Field bus junction boxes, T devices, pull boxes, etc., required for completeness of implementation of Field Bus based system.
3. All maintenance, diagnostic tools & devices required for implementation, maintenance & trouble-shooting of Field Bus system.
4. For air purging of instruments to remove/avoid dust accumulation (if required), all required with piping, pipe, fittings valves etc.
5. Supply of testing equipment, tools & tackles as per clause no. 04.09.05.
6. All electrical accessories for instrumentation system including UPS and other instrument power supply equipment as applicable.
7. All types of control, signal, LT power & special cables, as required for this package.
8. Fully wired cabinets/ panels, junction boxes, pull boxes, transmitter cabinets, etc. Suitable panels for electronics units of the level transmitters and transmitter cabinets/ junctions boxes for the transmitters & connectors for the field bus based instruments, etc., will be provided and properly located at the field/ rooms.
9. Galvanized trays, conduits, protection pipes, fittings, steel structures & frames, erection hardware & accessories, as required for this package.
10. Submission of drawings and documents as defined in this document.
11. Erection, testing, calibration and commissioning of the total equipment included in this document. Contractor will arrange tools, tackles and consumables as may be required for erection, testing, calibration and commissioning activities.
12. One no. hand held universal type calibrator (Lap top based) having sufficient memory capacity and with battery & battery charger as required for calibration of all level transmitters. All the necessary software will be loaded in the calibrator.
13. Preparation of earthing pit, supply of earthing materials including cables and installation of separate earthing system for case earthing, power and instrument signal earthing.
14. Arrangement of and participation in inspection of Instrumentation equipment by Employer/Consultant. Inspection and Testing will be carried out in compliance with the Quality Assurance Plans, to be approved during detailed engineering stage.

15. Scope includes arranging visits by respective instrumentation equipment manufacturer’s representatives at site, as & when required, during erection & commissioning.

16. Providing training to Client’s personnel on special instrumentation equipment, at manufacturer’s works and also at site.

17. Two years maintenance spares, if the order is separately placed by Employer.

18. Commissioning spares and three months consumables.

19. Supply of all instrumentation items from “list of preferred makes” as indicated at clause no. 04.09.06. From the list, for any particular type of instrument, only those vendors will be selected which are field bus compatible. However, for a particular type of instrument, if no vendor can provide field bus compatible instrument, then conventional type can be supplied.


04.09.03. LIST OF MEASUREMENTS

An indicative list of measurements, alarms & interlocks for Coal Handling Plant, Coke Sorting Plant for COB #11, Flux & Fuel Preparation and Plant Return Fines Handling for SP-III is given below. However, Contractor will supply all the measurements, alarms & interlocks as may be required for efficient & satisfactory operation of the system. Unless specifically mentioned, all monitoring of the process parameters will be achieved in level-1 automation system and displayed in HMI stations and field instrumentation equipment will be supplied accordingly.

A) Coal Handling Plant:

The measurements for Coal Handling Plant will include, but not limited to, the following:

i. Level measurement of coal towers (18 nos.): For each tower minimum one no. of level transmitter (radar type) and one no. of high level switch will be provided. These signals will be hooked up with the automation system for alarms and necessary interlocks. The required no. of level transmitters will be provided as per the bunker design. For interlocks, separate high level switches for each bunker will be provided as per the process requirement, no. of feeding points etc.

ii. Level measurement of new silos (5 nos.): For each silo, 2 numbers of radar type level transmitters and 4 numbers of level switches per silo will
be provided. These signals will also be hooked up with the automation system for alarms and necessary interlocks.

**B) Coke Sorting Plant:**

The measurements for Coke Sorting Plant will include, but not limited to, the following:

i. Level measurement of bunkers (4 nos.): For each bunker one no. of level transmitter (radar type) and one no. of high level switch will be provided. These signals will also be hooked up with the automation system for alarms and necessary interlocks.

**C) Fuel & Flux Crushing & Screening system:**

The measurements for Fuel & Flux Crushing & Screening system will include, but not limited to, the following:

i. Level measurement of bunkers (6 nos.): For each bunker one no. of level transmitter (radar type) and one no. of high level switch will be provided. These signals will also be hooked up with the automation system for alarms and necessary interlocks.

ii. Level measurement of bunkers (1 no.): For this bunker two nos. of level transmitters (radar type) and two nos. of high level switches will be provided. These signals will also be hooked up with the automation system for alarms and necessary interlocks.

**04.09. 04. LIST OF DRAWINGS & DOCUMENTS**

Following drawings and documents will be submitted by the Contractor for Instrumentation system:

I) **For Approval:**

01. Finalised process and instrumentation (P & I) diagram indicating all local & remote measurements, alarms and interlock functions, using ISA symbols and using suitable tag numbers against each instrumentation equipment.

02. Finalised list of measurements, alarms & interlocks, along with BOQ and document of each instrumentation item indicating make, model number, scale range, quantity, application and tag number (as per P&I diagram).

03. Detailed specification datasheet for each instrumentation item, filled in as per the format finalized for this plant.

04. Overall general arrangement drawings & sectional views of various cabinets, panels, consoles, etc., showing internal disposition of all components/ units, with dimensional details and bill of materials.
05. Single line power supply diagram with document and bill of quantities of electrical accessories along with that of UPS.
06. Quality assurance plan for each instrument & control system.

II) FOR SCRUTINY AND RECORDS

01. Detailed technical literature/ catalogue for each instrumentation item.
02. Instrument Installation/ Hook up diagrams with bill of materials.
03. Instrumentation layout drawings showing location of instruments and route of cables from these upto control room.
04. Wiring and termination diagrams with details of termination of field signals to local JBs/ panels and from JBs to panels/ marshalling racks/ cabinets including internal wiring drawings.
05. Cable schedule.
06. Manufacturer’s test, calibration and guarantee certificates for all instruments.
07. Operation and maintenance manuals for instruments.
08. ‘As-built’ documentation.
09. Soft copy of all the above drawings & documents in CD-ROMs/ DVDs.

04.09. 05 LIST OF TESTING EQUIPMENT

Following testing equipment pertaining to Instrumentation will be supplied by the Contractor:

1. 4-1/2 Digit Digital Portable Multimeter

<table>
<thead>
<tr>
<th>Make</th>
<th>Fluke/ Yokogawa/Philips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>Type</td>
<td>Portable &amp; handheld type</td>
</tr>
<tr>
<td>Display</td>
<td>4-1/2 digit, LCD</td>
</tr>
<tr>
<td>Range:</td>
<td></td>
</tr>
<tr>
<td>DC Voltage --</td>
<td>Selectable upto 1000 V min.</td>
</tr>
<tr>
<td>DC Current –</td>
<td>Selectable upto 10 A min, and will be capable to measure mA signals for instrument use</td>
</tr>
<tr>
<td>AC Voltage –</td>
<td>Selectable upto 1000 V min.</td>
</tr>
<tr>
<td>AC Current –</td>
<td>Selectable upto 10 A min</td>
</tr>
<tr>
<td>Resistance—</td>
<td>Selectable upto 50 M Ohm min.</td>
</tr>
<tr>
<td>Capacitance—</td>
<td>Selectable upto 10 mF min.</td>
</tr>
<tr>
<td>Frequency--</td>
<td>10.00 KHz to 199.99 KHz.</td>
</tr>
<tr>
<td>Other facilities</td>
<td>The multimeter will have the facilities like Diode testing, Continuity testing, Data hold facility, Auto hold facility, Auto power off facility, and with alligator clips, holster, temperature probe, battery, user manual &amp; operator’s guide. Multimeter will be suitable for true</td>
</tr>
</tbody>
</table>
2. Laptop based programmer for level transmitters: 1 no.

3. Tools & Tackles

<table>
<thead>
<tr>
<th>Make</th>
<th>Taparia/ Everest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tester</td>
<td>5 nos.</td>
</tr>
<tr>
<td>Allen key set, Size: 1.5 mm to 10 mm (one set consisting of 8 pieces)</td>
<td>1 set</td>
</tr>
<tr>
<td>D Spanner set, Size: 6 mm to 20 mm (one set consisting of min. 8 pieces)</td>
<td>1 set</td>
</tr>
<tr>
<td>Ring Spanner set, Size: 6 mm to 20 mm (one set consisting of min. 8 pieces)</td>
<td>1 set</td>
</tr>
<tr>
<td>Screw drivers (champion set)</td>
<td>1 set</td>
</tr>
<tr>
<td>Combination Pliers, Size: 6” &amp; 8”</td>
<td>1 set</td>
</tr>
<tr>
<td>Nose Pliers Size: 6”</td>
<td>1 no.</td>
</tr>
<tr>
<td>Hammers</td>
<td>1 no.</td>
</tr>
<tr>
<td>Files, Size: 12” flat, 12” half round, 12” round</td>
<td>1 set</td>
</tr>
<tr>
<td>Slide (adjustable) wrench, Size: 8”, 12”, 18”</td>
<td>2 sets</td>
</tr>
<tr>
<td>Pipe wrench, Size: 8”, 12”, 18”</td>
<td>1 set</td>
</tr>
<tr>
<td>Wire stripper</td>
<td>1 no.</td>
</tr>
<tr>
<td>Cutting plier Size: 6”</td>
<td>2 nos.</td>
</tr>
</tbody>
</table>

**04.09. 06 LIST OF PREFERRED MAKES**

**PREFERRED VENDOR LIST OF INSTRUMENTATION EQUIPMENT**

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>ITEM DESCRIPTION</th>
<th>PREFERRED MAKES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PRESSURE INSTRUMENTS</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Pressure / Differential Pressure Gauge</td>
<td>1. WIKA,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Ashcroft,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Forbes Marshall</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Budenberg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Waaree instruments,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Hirlekar (DP gauge)</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>1. Ifm. 2. WIKA, 3. Kobold</td>
<td></td>
</tr>
</tbody>
</table>

1.3 Pressure / Differential Pressure Transmitters


2. **TEMPERATURE INSTRUMENTS/SENSORS**

2.1 Temperature gauges

|   | |

2.2 Thermocouple & RTD / thermo well

|   | |

2.3 Temperature Switch

|   | |

2.4 Temperature transmitter

|   | |

2.5 Infrared radiation pyrometer/portable

<p>|   | 1. Land, 2. Ircon, 3. Raytek, |</p>
<table>
<thead>
<tr>
<th>3</th>
<th><strong>FLOW INSTRUMENTS</strong></th>
</tr>
</thead>
</table>
| 3.1 | Rotameters | 1. Forbes-Marshall,  
2. Chemtrols,  
3. Rota Instruments.  
4. Eureka instruments  
5. *SMC*  |
| 3.2 | Orifice Plate & flanges Assembly/ Venturi, Flow nozzle | 1. Engineering Specialties,  
2. Micro-precision,  
3. Instrumentation ltd,  
4. *Uni-control*  |
| 3.3 | DP type Flow / Level Transmitters | 1. Emerson (Rosemount),  
2. Honeywell,  
3. Yokogawa,  
4. Siemens,  
5. ABB  
6. *E&H*  |
| 3.4 | Flow Switch | 1. Ifm.  
2. *Kobold*,  
3. *Mobrey*  
4. *Sitron*  |
| 3.5 | Electromagnetic flow meter | 1. Yokogawa,  
2. Emerson (Rosemount),  
3. Forbes -Marshall,  
4. Endress & Hauser.  |
| 3.6 | Vortex Flow meter | 1. Emerson (Rosemount)  
2. Forbes –Marshall  
3. Yokogawa  
4. *Endress & Hauser*  |
| 3.7 | Mass (coriolis) flow meter | 1. Emerson (Rosemount)  
2. Yokogawa  
3. Forbes –Marshall  
4. Endress & Hauser,  |
| 4 | **LEVEL INSTRUMENTS** |
|   | Level gauge (magnetic & reflex type) | 1. Chemtrol  
|   |                                      | 2. Forbes Marshall  
|   |                                      | 3. Mobrey  
|   |                                      | 4. Hi-Tech (levelstat)  
| 4.1 | Level Switch (Conductivity type) | 1. Vega  
|     |                                      | 2. Endress & Hauser  
|     |                                      | 3. Pepperl &Fuchs  
| 4.2 | Level Switch (Capacitance/RF type) | 1. Vega  
|     |                                      | 2. Endress & Hauser  
|     |                                      | 3. EIP Bulk  
|     |                                      | 4. Sapcon  
| 4.3 | Level Switch (Tuning fork/Rod type) | 1. Chemtrol (Vega)  
|     |                                      | 2. Endress & Hauser  
|     |                                      | 3. Pepperl &Fuchs  
| 4.4 | Level Switch (Float type) | 1. Emerson  
|     |                                      | 2. Forbes Marshall  
|     |                                      | 3. V-Automat  
|     |                                      | 4. Mobrey  
| 4.5 | Level Switch/Transmitter (Displacer type) | 1. Emerson  
|     |                                      | 2. Chemtrols (Eckard)  
|     |                                      | 3. Mobrey  
|     |                                      | 4. Masoneilan  
| 4.6 | Level Switch/Transmitter (Ultrasonic type) | 1. Endress & Hauser  
|     |                                      | 2. Forbes –Marshall  
|     |                                      | 3. Siemens (Miltronics)  
|     |                                      | 4. Sick  
|     |                                      | 5. Pepperl &Fuchs  
| 4.7 | Level Switch/Transmitter (Radar type) | 1. Emerson (Rosemount)  
|     |                                      | 2. Endress & Hauser  
|     |                                      | 4. Sick  
|     |                                      | 5. Mobrey  
| 4.8 | Level Switch/Transmitter (Nucleonic type) | 1. Concord International (Dr. Berthold)  
|     |                                      | 2. Emerson (Kay Ray)  
|     |                                      | 3. E&H  
<p>| 4.9 |                          | 5 | CONTROL VALVES AND ACCESSORIES |</p>
<table>
<thead>
<tr>
<th>Section</th>
<th>Type</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Control valve</td>
<td>Fisher-Xomox</td>
<td>Instrumentation Ltd</td>
<td>Masoneilan</td>
<td>Valflo</td>
<td>Samson Controls</td>
<td>Forbes Marshall (Arca)</td>
</tr>
<tr>
<td>5.2</td>
<td>Electrical Actuator</td>
<td>Auma</td>
<td>Limitorque</td>
<td>Instrumentation Ltd(Bernard)</td>
<td>Beck</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.3</td>
<td>Pneumatic Actuator</td>
<td>Fisher-Xomox</td>
<td>Instrumentation Ltd</td>
<td>Masoneilan</td>
<td>Valflo</td>
<td>Samson Controls</td>
<td>Forbes Marshall (Arca)</td>
</tr>
<tr>
<td>5.5</td>
<td>Self- regulating pressure control valve</td>
<td>Samson Controls</td>
<td>Forbes Marshall</td>
<td>Instrumentation Ltd</td>
<td>Nirmal Industries</td>
<td>Fisher-Xomox</td>
<td></td>
</tr>
<tr>
<td>5.6</td>
<td>I/P converters</td>
<td>Forbes Marshall (Moore products)</td>
<td>ABB</td>
<td>Emerson</td>
<td>Honeywell</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.7</td>
<td>Pneumatic Positioner,</td>
<td>Instrumentation Ltd</td>
<td>Dresser Industries (Masoneilan)</td>
<td>Samson Controls</td>
<td>Forbes Marshall (Arca)</td>
<td>SMC</td>
<td>Fisher Xomox</td>
</tr>
<tr>
<td>5.8</td>
<td>Electro- pneumatic positioner</td>
<td>Fisher-Xomox</td>
<td>Siemens</td>
<td>Masoneilan</td>
<td>Samson Controls</td>
<td>Instrumentation Ltd</td>
<td></td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>
| 5.9 | Solenoid Valve | 1. Herion,  
2. Rotex  
3. Schrader-Schovill  
4. Asco  
5. Mac  
6. Burkert |
| 5.10 | Air filter regulator | 1. Shavo-Norgren  
2. Marsh-Bellofram  
3. Placka  
4. Schrader-Schovill. |
| 6 | CABLES |   |
| 6.1 | Instrumentation Cable | 1. Universal Cables  
2. Delton  
3. Lapp cables  
4. Brooks Cables  
5. Asian cables  
6. Belden  
7. MEM |
| 6.2 | Thermocouple Compensating Cable | 1. Toshniwal Cables  
2. Paramount Cables  
3. Udey pyro-cables  
4. Brooks  
5. MEM |
| B. | CONTROL ROOM INSTRUMENTATION |   |
| 7.1 | Distributed Control System (DCS) | 1. Yokogawa (CS 3000)  
2. Honeywell ((Experion +C 300)  
3. Emerson (Delta-V) |
| 7.2 | Programmable Logic Controllers. | Refer Electrical  |
| 7.3 | Digital Indicator | 1. PEPL  
2. Masibus  
3. Lectrotek  
4. Honeywell.  
5. Yokogawa |
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| 7.4 | Bar graph Indicator | 1. Masibus Instruments  
2. Lectrotek  
3. ABB.  
4. Yokogawa |
| 7.5 | Recorders (Chart less) | 1. Eurotherm  
2. Yokogawa  
3. Honeywell  
4. ABB. |
| 7.6 | Microprocessor based controller | 1. Yokogawa  
2. Siemens  
3. Honeywell  
4. Eurotherm  
5. Forbes Marshall  
6. Toshiba |
| 7.7 | Digital scanners | 1. Masibus Instruments  
2. Lectrotek  
3. Radix  
4. Micro Controls  
5. PEPL |
| 7.8 | DC Power Supply Unit | 1. Aplab  
2. Phoenix  
3. Schneider  
4. P&F  
5. Siemens |
| 7.9 | IS Interface/Zenner Barrier | 1. Pepperl & Fuchs  
2. MTL  
3. Stahl |
| 7.10 | Signal isolators | 1. Pepperl & Fuchs  
2. MTL  
3. Yokogawa  
4. Forbes Marshall (Protech)  
5. Phoenix |
| 7.11 | Annunciation system | 1. IIC  
2. Minilec  
3. Procon  
4. Digicont  
5. MTL  
6. BETA instruments |
| 7.12 | Instrument Panels/ Control Desk | 1. Rittal  
2. Pyrotech  
3. Instrumentation Ltd. |
| 7.13 | Manual loaders | 1. Masibus  
2. PEPL  
3. Lectrotek |
| 7.14 | Totalizer | 1. Masibus  
2. PEPL  
3. Lectrotek  
4. Bivak |

C. **ANALYTICAL / SPECIAL INSTRUMENTS**

| 8.2 | Gas Detectors | 1. Dragger  
2. Crowcon  
3. MSA  
4. BW Technologies  
5. Reiken-Keiki Japan  
6. Bieler & Lang |
| 8.4 | Moisture Analyzers (Nucleonic) | 1. Concord International (Dr. Berthold)  
2. Emerson (Analytical)  
3. Sick  
4. Thermo Electron |
| 8.6 | IR type Moisture analyzer | 1. Moistech  
2. NDC(EMC) |
<table>
<thead>
<tr>
<th>Section</th>
<th>Topic</th>
<th>Manufacturers</th>
</tr>
</thead>
</table>
| 8.8     | Vibration sensors & monitors | 1. Bentley Nevada  
2. *Shinkawa (Forbes –Marshall)* |
| A.      | For turbines and other high speed critical machines |  
1. SPM  
2. Rockwell  
3. *Vibro-meter*  
4. *Shinkawa (Forbes –Marshall)* |
| B.      | For other applications |  
1. *Bentley Nevada*  
2. *Shinkawa (Forbes –Marshall)* |
| 8.9     | Opacity/Dust concentration meter | 1. Codel (Forbes- Marshall)  
2. Durag  
3. Emerson  
4. Land  
5. GESensing  
6. Chemtrol |
| 8.11    | SPM analyzer | 1. Emerson  
2. Yokogawa  
3. Durag  
4. ABB  
5. Honeywell  
| 8.12    | SOx- NOx analyzer | 1. Emerson  
2. Yokogawa  
3. ABB  
4. Siemens  
5. Honeywell  
| 8.13    | Moisture Sensor & Transmitter | 1. Invensys (Foxboro)  
2. Bartec  
3. GE-Panametrics |
04.10 ELECTRICAL POWER DISTRIBUTION, DRIVES, CONTROL & ILLUMINATION

04.10.01. 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 Coal Handling Plant (CHP) & Coke Sorting Plant (CSP), Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III (FFP).

The Contractor will refer to General Technical Specification for Electrics (GS-03) 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(Tools & Tackles), E-02(Commissioning Spares), E03, E-04, E-05 considered, 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.

04.10.02. HT Power Supply System & Battery Limit

Power supply for the Coke Sorting Plant and Coal Handling Plant will be made available from the 11/6.6 kV switchboards proposed to be installed at HT substations (HTSS) near COB#11(HTSS-48), under a separate package by EMPLOYER (package no. 071).

Power supply for the Augmentation in Flux - Fuel Preparation And Plant Return Fines Handling for SP III of SP-3 Complex will be made available from the 11/6.6 kV HTSS for SP-III -HTSS-43 and HTSS-45 (beside HTSS-42) Complex under a separate package by EMPLOYER (package no. 071).

Refer typical power distribution drawing no.MEC/S/9101/11/E1/06/00/00/064.01/R1 for HTSS

The scope of work of the Contractor will commence from the outgoing terminals of 11/6.6 kV switchboard located at HTSS-48, HTSS-45 and HTSS-43 Complex for the respective facilities.

This 11/6.6 kV Switchboards at HTSS will be used to supply power to all LT substations (LTSS) and all 6.6 KV HT Motors under the scope of this package. Supply, laying and termination (at both ends) of all HT & Control Cables from HT switchboard to LTSS & HT motors 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 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.

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.

04.10.03. Scope of Work

The scope of work of Contractor will cover design, basic and detailed engineering, submission of drawings for approval, manufacture, testing, inspection by EMPLOYER/Consultant, packing, loading, forwarding, delivery at Plant site, loading/unloading, storage, handling of material/equipment for erection, erection, no-load and load testing, commissioning, PG test, PAT/FAT and liquidating the defects and handing overall electrics related to Power Distribution, drives & control, illumination for complete & satisfactory operation of Coal Handling Plant(CHP) & Coke Sorting Plant(CSP), Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III (FFP) on Turnkey basis.

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

The scope of work for this package will include but not limited to the following:

I) Power Distribution Equipment

1. Adequate numbers of Double ended 11/0.433 kV or 6.6/0.433 kV LT substations(LTSS )
2. Each double ended substation will comprise of 11/0.433 kV or 6.6/0.433 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 11/6.6 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. Contractor to provide 2 feeders of 400A each in the CSP LTSS for EMPLOYER’s use.

**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 415V AC, 3ph, 50 Hz will be made available at the nearest construction power substation by the EMPLOYER for each Coal Handling Plant, Coke Sorting Plant and additional Flux & Fuel crushing & Fines handling system respectively.

Supply, erection, testing and termination at both ends of incoming power cable to Contractor’s construction power distribution board, further distribution and regular maintenance of the construction power supply network will be under the scope of Contractor.

**II) DRIVES, CONTROLS AND 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.
   - For HT motor, surge suppressor to be installed near the motor.
Generally Squirrel Cage Induction Motor with DOL starter / VFD / Soft Starter will be provided.

Suitable Rotor contactor panels and SS-grid Resistance Boxes will be provided for starting and speed control of slip ring motors wherever required as per Technological requirement.

All HT conveyor motors will be S1 duty.

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.

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

- Motor Control Centres for Coal Handling Plant and Coke Sorting Plant area 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.

- Motor Control Centres for Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III will be Conventional, drawout type with two incomers and bus coupler for control of drives of rating up to 90kW, of various technological units.

- For control of drives of rating from 110kW to 200kW of various technological units, Intelligent type Motor control panels (MCPs) for CHP, CSP and FFP area having communication with Plant Automation System.

- Control panel for Tripper car, crane, hoist, small machines and Auxiliaries will be conventional type, non draw-out control panel. All control panels on the mobile machines will be mounted on anti vibration pad.

- Electronic over load relay for motors upto 90kW and Motor Protection Relays for motors above 90 kW will be used in conventional type (non-intelligent) MCC / Control panel. The electronic overload relay will be of Manual Reset type.

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

- Motor feeders up to 45 kW rating will have MPCB and MCCB beyond 45 KW rating.

- Current monitoring for all drives of rating above 30kW

- Conveyors feeding to Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III (FFP) C7-3.5KW, C1-30KW & C2-45KW will be fed from new MCC under the scope of package. Contractor will consider Power cable for feeding the same. These Conveyors will be connected and controlled by new PLC envisaged.
in this package of FFP. Suitable control cable and other accessories will be considered.

3. VVVF converters:
   - 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.
   - VVVF Converter having communication capability as above at medium voltage (like 690 V) complete with 3 winding Converter transformer (for 12 pulse configuration) & incoming ACBs for higher rated motors.
   - VFD will have following features:
     - Minimum rating of AC drives and reactors will be 150% of the full load 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.

4. Soft Starter:
   - All HT Motors for conveyor drives will be provided with Flux Compensated Magnetic Amplifier (FCMA) Soft starter for low starting current. FCMA soft starter will have suitable By-pass contactors and controls to ensure running of the motor at full speed. 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.

5. Dual parallel redundant 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.

6. Local control stations housing push buttons, indication lamps etc. for all drive. LCS for HT motor will have Ammeter also. All Local control stations will have double doors. LCS for conveyors will have belt sway switch bypass. Local/Remote selector switch will be mounted on MCC & Control Panel and not on LCS.

7. 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. Enclosure Class will be IP54.

8. Main Lighting Distribution Boards (MLDB) with two incomers and one bus coupler for Power supply to various Lighting distribution Boards (LDB). Enclosure Class of MLDB & LDB will be IP54. Adequate nos. of LDBs and Sub Lighting distribution boards for providing power to light fittings.

9. Emergency lighting distribution boards (ELDBs) with two incomers and one bus coupler for Power supply to various Emergency Sub Lighting distribution Boards (ESLDBs) and feeding arrangement will be as per GTS. Adequate nos. of Emergency Sub Lighting Distribution Boards (ESLDBs) for providing power to emergency light as given below:
   - 20% Emergency lighting in all Junction houses, Process / technological buildings, pump houses, compressor houses, conveyor tunnels, underground premises, LTSS, Despatcher / 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.

10. Exit light from UPS distribution board for the following areas:
   - LTSSs / Electrical premises.
   - Dispatcher / Control rooms.

11. Portable Emergency lights will also be provided in strategic areas like LTSSs, Electrical premises, control rooms, staircases, entrance of cable tunnels / basements, escape routes, attendant / operators room in the technological buildings etc.

12. DCEM Brakes with economizing resistance will be used for Conveyors and brake panels will be housed in MCC room. A Brake panel will not feed power to more than 2 nos. of brakes.

13. Surge protection device will be provided at the incoming side of MCCs, VFDs, Soft starters, 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, level sensors, relays, limit switches, 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, Addressable type BSS, ZSS and Belt rupture protection switches will be provided for all new and existing conveyors being upgraded.
• Proximity type Limit switches will be used for shuttle conveyors, tripper car etc.
• Sensing distance of proximity in the Zero Speed Switch will be 60 mm.
• RF admittance type chute clogging switches flush with chute body will be provided.
• Infrared type Belt rupture protection switches will be provided in all conveyors. The minimum set of belt rapture switches will be provided as given below:
  ▪ 1 set for conveyors of length up to 50m.
  ▪ 2 sets for conveyors of length above 50m and below 100m.
  ▪ 3 sets for conveyors of length above 100m.
• Chute Jamming switches in all chute including chute in Tripper Car.

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.
  • Minimum size of Control cables will be 2.5 sq. mm.
  • Copper cable will be used for imported motors, crane and moving equipment.

16. 415V, 100A interlocked switch socket outlets for repair network, welding sockets at different floor, premises, buildings and other areas. 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.

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 will be made up of SS sheet with weatherproof enclosure 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 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 yard, outdoor area lighting, peripheral lighting, coal tower top, shuttle conveyor floor, Road in and around the proposed units, Sub- stations, 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.

New 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. Illumination, AC, Ventilation, 240V, 5A/ 15A sockets, Exhaust fan for toilet etc. for office building etc.

24. 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 required.

25. Complete electrics including motors, control panel, LCS, Brakes with panel, field devices, cables etc. for Shuttle conveyors, Tripper cars, Cranes, Hoists etc.

26. Complete electrics and load cell for Weigh feeders, Weigh hoppers, Belt scales etc. as required.

27. Complete electrics required for Suspended magnets, In Line Magnetic Separators, Metal presence detectors etc.

28. 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 as required.

29. 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.

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

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

32. Complete electrics for sampling systems covering motors, control panels, cables LCS etc.

33. Complete electrics for all Crushers including the followings:
   - Motors for main and auxiliary drives with necessary accessories and brakes as required.
   - Rotor contactor panels, Resistance boxes for Slip ring motors / VFD or DOL or Soft starter for Squirrel Cage motors as required.
   - Control Panel, Local control stations, field devices, safety devices, Limit switches, speed relays, solenoids, Power & Control Junction Boxes etc. as required.
   - Power and control panel for roll grinding attachment including drive motors for roll crusher.
   - Control panel for hydraulic and lubrication system including drive motors as required.
   - All power, control and special / instrument cables etc.
   - Earthing.
   - Hammer crusher will have local control station in which necessary Push buttons, Ammeter, Temperature Monitoring facility, indication lamp, hooter etc. will be provided to operate locally as well as from control desk.
   - Hammer crusher will be operated from Local Control Post. Apart from LCS, Local Control Post will be provided which will be kept in same crusher building. AC for Local Control Post will be provided. Extensive monitoring of HT drive will be done from Local Control Post and the information will be sent to Dispatcher for monitoring.

34. All LCS for outdoor application will be made of SS sheet. All control Push Button will be covered with Silicon Rubber Boot to prevent dust ingress.

35. Scope of work and Battery limit for Electrics and Automation for up gradation, modification, integration of existing drives / mechanism is defined in the Clause No. 04.10.11.

36. Automation system:
   a) PLC based Automation system of proposed Coal Handling Plant...
Pkg-064, will be interfaced with Automation system of Coal Transportation Plant (Pkg-062) being arranged by the EMPLOYER through a separate package (as indicated in Automation Configuration Drawing enclosed) so that entire coal transportation from silos to all coal towers can be operated in an integrated way from a common despatcher / control room D2 (under EMPLOYER’s scope). The PLC based Level-1 automation system of CHP will be provided as mentioned in the automation chapter.

b) PLC based Level-1 automation system of proposed Coke Sorting Plant will be provided as mentioned in the automation chapter for running the new Coke Sorting Plant from a new control room/ despatcher under the scope of Contract.

c) PLC based Level-1 automation system of Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III which will be connected to existing PLC through suitable gateway. The new PLC & HMIs will be housed in existing Control Room 1(CR-1). The existing HMIs will suitably be upgraded to match the new HMIs for operation of the entire existing and new FFCS plant.

37. Contractor to provide following feeders for EMPLOYER’s use in Electrical Premises near Coke Dedusting unit of Coke Sorting Plant:
   • 2 no. feeders of 100A each in MLDB/LDB.
   • 2 nos. of power supply feeder of 100A each in PDB.

38. CCTV camera with cleaning facility will be provided in the following tentative locations with monitors at Despatcher / Control room for extensive monitoring of given below areas:
   a) Coke Sorting Plant.
      • 2 Nos. for Coke storage area.
      • 2 Nos. at Coke Screening Station.
      • 2 Nos. at Coke Crushing Station
   b) Coal Handling Plant
      • 2 nos. for new silos
      • 2 nos. at New Coal Tower no.-7
   Final location will be decided during detailed engineering.

39. 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 trenches, MCC Rooms, Despatchers/Control rooms, Electrical premises etc. including their associated utility areas like Ventilation rooms, Stairs, Toilet etc.

2. Control for the proposed Coal Handling Plant will be from Despatcher (D2) building being arranged by EMPLOYER under separate package (62). The Contractor will furnish space requirement and assignment to the EMPLOYER for making the provision in the Despatcher-D2.

3. Control of Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III will be done from existing Control Room 1(CR-1). Necessary modification, if required for laying of cables and mounting equipment in the existing control room, the same will be provided by the Contactor.

4. Control of Coke Sorting Plant will be done from a new control room/despatcher under the scope of Contract.

5. Cable Tunnels / Structures for overhead cable bridge as required.

6. Intelligent, microprocessor based, addressable type automatic fire detection and alarm system for all MCC rooms, Electrical Premises, Cable cellar, Despatcher cum Control room using smoke detectors, heat detectors with cross zoning.

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

8. 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.

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

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

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

12. Cable cellar for all Electrical premises/ LTSS/ MCC room etc.

13. MCC room and LTSS can be combined building with a separation wall and with a door for interconnection.

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

15. The tentative location of LTSS: **CHP** –LTSS opposite 5 silos, **CSP**-LTSS near JH-11 and Coke Screening station and **FFP**-LTSS near JH-117 and Coke breeze storage yard. If the nos. of LTSSs increases during Basic Engineering to suit the technological requirement in line with GTS, the same will be proposed by Contractor during Basic Engineering.

**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 as per their manufacturer’s recommendation. It will be distinct and separate from the power and lightning equipment earthing system.

**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. Arranging construction power supply including PDB, power (both incoming and outgoing) and control cables, cable trays, cable laying etc.

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 will be supplied as per attached Annexure E-02.

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-01.

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 LTPCCs, MCCs, PDBs, MLDBs, LDBs, SLDBs keys and key boxes etc.

11. 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.

12. 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.

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

14. Intershop outdoor cable route will be through only walkable Overhead Cable Bridge/ conveyor gallery/ cable tunnel. No underground buried cable will be provided. Concrete cable trench covered with pre cast slab is accepted only in covered shed or indoor area.
15. Cables of one area/conveying route will not cross and will not be laid through conveyor of other area/conveying route.

16. Minimum 1 No. electrical area repair shop (Min. size –18M X9M X 6M) in Coke Sorting Plant will be considered with a facility of rest room, repair area, store, provision to keep tools and tackles, measuring instruments/testing instrument including megger, clamp tester, hand held tachometer, CRO, multimeter, vibrometer etc.

17. Furniture for the monitor, control rooms etc.

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

19. 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.

04.10.04. **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.

04.10.05. **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.
Design basis for equipments & installations

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</td>
<td>+ 45 Deg. C</td>
</tr>
<tr>
<td></td>
<td>(Pressurized ventilation)</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>MCC rooms (housing intelligent MCCs, VFD panels, TR</td>
<td>+ 35 Deg. C</td>
</tr>
<tr>
<td></td>
<td>controllers, RI/Os etc.)</td>
<td></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 derating 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 offered 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).

04.10.07. Design basis for electrical premises for the proposed units

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.

04.10.08. 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.

- 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 24Hrs Timer & Contactor 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.

- 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.

- 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:
  - At each floor of building at every 30 m intervals or minimum one for each row/side.
  - 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 sufficient no. of 24V, 5A sockets will be provided for maintenance lighting by hand lamp.

04.10.09. **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>EMPLOYERs’s HT Substations to Contractor’s LTSSs</td>
<td>Walkable Cable Bridge</td>
</tr>
<tr>
<td>2.</td>
<td>Inter shop cable routing</td>
<td>Through walkable overhead cable bridge/ structure/Cable Tunnel/ Conveyor gallery. No underground buried cable will be provided. Concrete cable trench covered with pre cast slab is accepted only in covered shed or indoor area.</td>
</tr>
<tr>
<td>3.</td>
<td>Bottom most level of cable trench in MCC room</td>
<td>Above ground level</td>
</tr>
</tbody>
</table>
04.10.10. 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.
   a) PLC based Automation system of proposed Coal Handling Plant Pkg-064, will be interfaced with Automation system of Coal Transportation Plant being arranged by the EMPLOYER through a separate package (Pkg-062) (as indicated in Automation Configuration Drawing enclosed) so that coal transportation from silos to coal tower can be operated in an integrated way from a common dispatcher / control room. The PLC based Level-1 automation system of CHP will be provided as mentioned in the automation chapter.
   b) PLC based Level-1 automation system will be provided as mentioned in the automation chapter for running the new Coke Sorting Plant from a new control room/ despatcher which is to be provided by the Contractor.
   c) PLC based Level-1 automation system will be provided as mentioned in the automation chapter for running the Flux - Fuel Preparation and Plant Return Fines Handling for SP III from a existing Control room CR-1 as indicated in the automation configuration diagram.

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 / MCP. 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 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 color 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. Current monitoring for drives of rating above 30KW.

8. Drainage/sump/slurry pump 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.

04.10.11. ELECTRICS AND AUTOMATION FOR EXISTING DRIVES

Scope of work for Electrics and Automation for upgradation, modification and integration of existing conveyors to be upgraded as per technological requirements and will consist of Complete new MCC, PLC, field switches, LCS, Power and control cables and New Brake panel and associated cables.

Gallery lighting of existing conveyors under up-gradation will be in the scope of Contractor. Dismantling of the existing light fittings, cables etc. will also be under the scope of the Contractor.

Contractor will provide new PLC based automation system for new and
existing drives (to be upgraded as per technological requirements) for integrated operation of the overall CHP, CSP, and FFP with respective existing/new units as shown in configuration diagram and elsewhere.

The approval / clearance of BSP / their representative will be taken before carrying out new installation for upgradation 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.

**Scope of work:**

- Except MCC, Contractor will dismantle existing motor, LCS, safety and limit switches, associated power and control cables, Jn. Boxes, earth wire, GI strip etc. related to the particular drives. The same will be removed from site to facilitate new installation as per requirement of TS and GTS and for running the equipment.

- Contractor will provide complete new electrics including motor, suitable intelligent type motor feeder in MCCs/MCPs, brake panels, all safety and limit switches, local control station (LCS), Junction boxes, necessary hardware and software for PLC based automation (including power supply, input, output and communication cards etc.) all power, control and signal cables, earthing.

**04.10.12. ELECTRICS AND AUTOMATION FOR ADDITIONAL FLUX AND FUEL CRUSHING AND FINES HANDLING SYSTEM**

All the equipments for this facility will be new.

**04.10.13. TECHNICAL SPECIFICATION**

**04.10.13.01. General**

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

**04.10.13.02. Non intelligent type Control Panel**

01. Control panel for Tripper car, crane, hoist and small machine will have conventional non draw-out type and mounted on anti vibration
02. **Constructional Features**
- Non-Draw out type.
- All other features will be similar to Intelligent type indicated in GTS.

03. **Incoming Feeder**
The incoming feeder will have:
- MCCB
- Ammeter and voltmeter with selector switch.
- 3 nos. current transformers
- 3 nos. indicating LED type lamps (R, Y, B)
- 3 nos. indicating LED type lamps (ON, OFF, TRIP)

04. **Outgoing Feeders**

**Each outgoing motor feeder will have following:**
- MCCB (above 45 kW motor) / Motor Protection Circuit Breaker (up to 45 kW motor)
- Three pole contactor
- Ammeter with CT & Selector switch.
- Stop & Test Push Buttons
- ON/ OFF/ Trip indication LEDs
- Digital microprocessor based overload relay with SPP & manual reset facility
- Motor Protection Relays for motors above 90 kW rating.

**Each outgoing non motor feeders will have following:**
- MCCB.
- ON/OFF indication LEDs.

05. All motors will be operable from Control desk, pendant or LCS. Only the facilities for testing the control circuit by-passing the power circuit will be provided.

06. Two number of DC power pack feeders complete in all respects with change over scheme will be provided for DC power supply to solenoid valves etc as required.

07. Ammeters for essential drive motors will be provided.

08. Major components will conform to General Technical Specification (GTS).
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.

Each actuator will be provided with 'Open' and 'Close' torque and position limit switches. 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. Cable ferrules will be robust and numbers will be indelible in nature.

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.

04.10.13.04. **Belt Weigh Feeders**

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

04.10.13.05. **Belt Weigh Scales**

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

04.10.13.06. **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.

04.10.13.07. **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.

Control panel for outdoor application will have weatherproof enclosure.

**04.10.13.08. 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:

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

b) 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 Filter 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:

i) 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 water proof (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.

04.10.13.09. 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</td>
<td>100</td>
<td>70W/150W, HPSV, well glass fittings and 250W</td>
</tr>
<tr>
<td>SL. NO.</td>
<td>UNITS</td>
<td>ILLUMINATION LEVEL (LUX)</td>
<td>TYPE OF LIGHT FITTINGS</td>
</tr>
<tr>
<td>--------</td>
<td>-------</td>
<td>--------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>1</td>
<td>tunnels</td>
<td></td>
<td>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>
<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>70W, well glass fittings with HPSV lamps.</td>
</tr>
<tr>
<td>10</td>
<td>Pump Houses</td>
<td>200</td>
<td>70W/150W, well glass fittings with HPSV lamps.</td>
</tr>
<tr>
<td>11</td>
<td>Area lighting through flood light towers</td>
<td>20</td>
<td>400W, flood light fittings with HPSV lamps.</td>
</tr>
<tr>
<td>12</td>
<td>Area and road lighting</td>
<td>20</td>
<td>250/400W, flood light fittings with HPSV lamps and 250W, street light fittings with HPSV lamps.</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.

**04.10.14. 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 drawing/documents in the list will be identified with a serial number, description and scheduled date of submission. All the drawings will have complete forward & backward reference.

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)

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

2. Single line diagrams of HT/LT switchgear equipment, PCCs, 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. Basic interconnection scheme for FDA, Telecommunication & PA system.

26. Quality assurance plan for various electrical equipment.

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

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 ACDBs, 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. Detail scheme of FDA system, List of annunciation/alarm points (location wise) & wiring scheme

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

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

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

24. 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. The control circuit diagram should be available on / inside of respective panel / LCS.

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 drive, 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:

- Operation & maintenance manual.
- Catalogues and manuals.
- All "As-built" drawings.
- Soft copies of all drawings.
- Technical specification/data sheet of equipment.
- Instructions for storage/erection/testing/commissioning
- Commissioning report.

The Contractor will submit all the drawings in Si-graph or equivalent format along with the multi user system software.

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. At least two sets of clearly legible site corrected drawings will be submitted after commissioning.
10. As built drawings will be first Copy / Clear photo copy and will be properly arranged in suitable folders. The folders will have a list of all the drawings it contains on the front inside cover. Different folders will be used for different major categories like 11 kV switchgears, MCC / PDB, Drives etc.

04.10.15. 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:

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
   DETAIL DRAWINGS ENCLOSED
44. DETAILS DRAWINGS FOR T.B.
45. PERFORMANCE CHARACTERISTICS
   CURVES VIZ. SPEED V/S CURRENT &
   SPEED V/S TORQUE ENCLOSED

### TOOLS & TACKLES (ANNEXURE-E01)

<table>
<thead>
<tr>
<th>SI, No.</th>
<th>Item</th>
<th>Quantity (Nos.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>True RMS Digital Multimeter (hand held)</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Digital tong tester (hand held)</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Quantity</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>3</td>
<td>Testing Jig for PLC (OEM supplied)</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Low range ohm meter</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Megger (0– 500V)</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>Megger (0-1000V)</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Megger (0-2500V)</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>Earth Meggar</td>
<td>4</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>6</td>
</tr>
<tr>
<td>12</td>
<td>Hand drills (pistol)</td>
<td>8</td>
</tr>
<tr>
<td>13</td>
<td>Allen key</td>
<td>6 Sets</td>
</tr>
<tr>
<td>14</td>
<td>Ratcher Spanner Set</td>
<td>6 Sets</td>
</tr>
<tr>
<td>15</td>
<td>Ring Spanners of different sizes</td>
<td>7 Sets</td>
</tr>
<tr>
<td>16</td>
<td>DE Spanners of different sizes</td>
<td>8 Sets</td>
</tr>
<tr>
<td>17</td>
<td>Vibration monitor (hand held)</td>
<td>6</td>
</tr>
<tr>
<td>18</td>
<td>Soldering / de-soldering station</td>
<td>3</td>
</tr>
<tr>
<td>19</td>
<td>Testing table / bench for installation of testing / repair equipment complete</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>with single phase / three phase power supply points and separate electronic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>earthing</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Blower cum vacuum cleaner (portable)</td>
<td>5</td>
</tr>
<tr>
<td>21</td>
<td>Tool kit (screw driver set, spanner set etc.)</td>
<td>8 sets</td>
</tr>
<tr>
<td>22</td>
<td>Component storage steel rack (pigeon hole)</td>
<td>3</td>
</tr>
<tr>
<td>23</td>
<td>Steel Almirah for storage of test equipment</td>
<td>10</td>
</tr>
<tr>
<td>24</td>
<td>Bench vice</td>
<td>6</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 Preparation &amp; Termination Toolkit (for special cables), including</td>
<td>1 set</td>
</tr>
<tr>
<td></td>
<td>Crimping Tool</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>HT Line Tester</td>
<td>5 Nos.</td>
</tr>
<tr>
<td>28</td>
<td>Steel chairs</td>
<td>12</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>Field bus Analyzer</td>
<td>1 Set</td>
</tr>
<tr>
<td>33</td>
<td>Radio communication Analyzer</td>
<td>1 Set</td>
</tr>
<tr>
<td>34</td>
<td>Tools for backup &amp; storage</td>
<td>50 Nos</td>
</tr>
<tr>
<td></td>
<td>• DVD-RW</td>
<td></td>
</tr>
</tbody>
</table>
### ANNEXURE – E-02

**SCHEDULE OF MINIMUM COMMISSIONING SPARES FOR ELECTRICAL EQUIPMENT FOR PKG.-064**

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>1.</td>
<td>Transformer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Item</td>
<td>Quantity</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------</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>LT Switch Gear</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></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>MCCs, PDBs, MLDB/LDBs</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Air Circuit Breakers</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>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></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</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>
<tr>
<td>24.</td>
<td>Indicating lamps (LED) with holder</td>
<td>- DO -</td>
</tr>
<tr>
<td>25.</td>
<td>Busbar support insulators</td>
<td>- DO -</td>
</tr>
<tr>
<td>26.</td>
<td>Push buttons switches (start &amp; stop)</td>
<td>-DO-</td>
</tr>
<tr>
<td>27.</td>
<td>Contact block (2NO+2NC) for start &amp; stop PB</td>
<td>- DO -</td>
</tr>
<tr>
<td>28.</td>
<td>Actuator head for start &amp; stop PB</td>
<td>-DO-</td>
</tr>
<tr>
<td>29.</td>
<td>Local-off-Remote selector switch</td>
<td>- DO -</td>
</tr>
<tr>
<td>30.</td>
<td>Control switch spring return type</td>
<td>- DO -</td>
</tr>
<tr>
<td>IV.</td>
<td>LOCAL CONTROL STATIONS</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Push buttons (start)</td>
<td>5% of each type &amp; rating. (minimum 1 set/No. of each type &amp; rating)</td>
</tr>
<tr>
<td>2.</td>
<td>Push buttons (stop)</td>
<td>- DO -</td>
</tr>
<tr>
<td>3.</td>
<td>Contact block (2NO+2NC) for start &amp; stop PB</td>
<td>- DO -</td>
</tr>
<tr>
<td>4.</td>
<td>Actuator head for start &amp; stop PB</td>
<td>-DO-</td>
</tr>
<tr>
<td>5.</td>
<td>Ammeters</td>
<td>-DO-</td>
</tr>
<tr>
<td>V.</td>
<td>MOTORS (OF EACH TYPE &amp; RATING)</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Bearing (DE)</td>
<td>5% of each type &amp; rating. (minimum 1 set/No. of each type &amp; rating)</td>
</tr>
<tr>
<td>2.</td>
<td>Bearing (NDE)</td>
<td>-DO-</td>
</tr>
<tr>
<td>3.</td>
<td>Cooling Fan</td>
<td>-DO-</td>
</tr>
<tr>
<td>4.</td>
<td>Terminal Block</td>
<td>-DO-</td>
</tr>
<tr>
<td>5.</td>
<td>Grease Nipple &amp; Plug, Grease pump with motorised.</td>
<td>-DO-</td>
</tr>
<tr>
<td>VI.</td>
<td>PLC/automation</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Digital input module with connection unit if applicable.</td>
<td>10% of each type &amp; rating. (minimum 1 set/ No. of each type &amp; rating)</td>
</tr>
<tr>
<td>2.</td>
<td>Digital output module with connection unit if applicable.</td>
<td>- DO -</td>
</tr>
<tr>
<td>3.</td>
<td>Analog input module with connection if applicable.</td>
<td>- DO -</td>
</tr>
<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></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</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 / Relay Boards</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 antenna</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**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Thyristors cell (Complete assembly)</td>
<td>5% of each type &amp; rating. (minimum 1 set/No. of each type &amp; rating)</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>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**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></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 (Red &amp; Green)</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**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></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>
</tbody>
</table>
### X. SAFETY AND LIMIT SWITCHES

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></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>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>
</tbody>
</table>

### XI. HYDRAULIC UNIT

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<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>2.</td>
<td>Oil Seals</td>
<td>-DO-</td>
</tr>
<tr>
<td>3.</td>
<td>O-rings</td>
<td>-DO-</td>
</tr>
</tbody>
</table>

### XII. ILLUMINATION

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<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>
## ADDITIONAL POINTS FOR AUTOMATION 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), 1.02.15.01.A.2.0</td>
<td>For all equipment with redundant power supply, supply from two separate sources will be drawn.</td>
</tr>
<tr>
<td>4.</td>
<td>Ch-3 (Elect), 1.01.15.02.A</td>
<td>No mode selection at LCS.</td>
</tr>
<tr>
<td>5.</td>
<td>Ch-3 (Elect), 1.02.21.02 (10)</td>
<td>Conduits carrying special cables will be painted, coded, marked as per plant norms.</td>
</tr>
<tr>
<td>6.</td>
<td>Ch-3(Elect), 1.02.15.01.B.16.0</td>
<td>Provisions to be made for off-line testing of Level-I systems prior to actual deployment.</td>
</tr>
<tr>
<td>7.</td>
<td>Max CAT-6 length of 30m for shop floor installations.</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Necessary facility/software will be supplied for remote management and monitoring of the entire network.</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Network teams from multiple switches to be employed for all the important machines (computers).</td>
<td></td>
</tr>
</tbody>
</table>
### ANNEXURE-E04

<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 frequencies withstand voltage will be 1500V for control circuit. |
| 5.      | Contact rating for Push Button will be  
  AC15, 6A at 230V  
  DC13, 4A at 230 V |
| 6.      | MCB short circuit rating capacity will not be less than 10 KA at 0.8 power factor |
| 7.      | LT Switchboard Incomer & Bus-coupler Circuit Breaker ratings will be 2000A for 1000KVA transformer |
| 8.      | Control terminal block will be ELMEX type suitable for terminating 2 cores of 2.5 sq mm wire. |
| 9.      | Terminal type  
  Power terminal: Stud type- with maximum 2 connections on one terminal.  
  Control terminal for CT: Disconnecting type |

### ANNEXURE-E05

<table>
<thead>
<tr>
<th>SL.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>CHAP-04.10 ELECTRICAL POWER DISTRIBUTION, DRIVES, CONTROL &amp; ILLUMINATION.doc ELECTRICAL</td>
</tr>
<tr>
<td>NO.</td>
<td>Description</td>
</tr>
<tr>
<td>-----</td>
<td>-------------</td>
</tr>
<tr>
<td>1.</td>
<td>All HT motor will have FCMA based soft starter.</td>
</tr>
<tr>
<td>2.</td>
<td>For HT motor surge suppressors 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.) to be envisaged. For more than 2.0 MW, condition monitoring equipment (temperature monitoring, vibration monitoring and partial discharge monitoring etc.) to be envisaged.</td>
</tr>
<tr>
<td>5.</td>
<td>Isolated transformer will be provided for VVVF drive of more then 90 KW, and series reactor will be provided for VVVF drive 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>
04.11 AUTOMATION SYSTEM (LEVEL-1)

04.11.01 GENERAL

01. This specification is intended to define the basic requirements for Automation (Level-1) system of the Coal Handling Plant (CHP) and Coke Sorting Plant (CSP) and Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III (FFP) coming under the 7.0 MTPA Expansion of BHILAI Steel Plant (BSP) with a view to achieve smooth, efficient, safe, integrated and reliable operation of the process.

02. Monitoring, Control, Interlocking and Sequential functions for the entire Coal Handling Plant and Coke Sorting Plant and Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III will be achieved through PLC based Level-1 automation system.

03. Coal Handling Plant

- A common dispatcher cum control room (D-2) under package no. - 062, is being arranged by the employer for operating the entire coal blending, crushing and transportation from existing & new silos to existing batteries (10 nos.) and new battery (1 no.) with a provision to install the automation equipment of proposed CHP package-064 as shown in the attached Automation Configuration Drg. No. - MEC/S/9101/11/E9/55/01/064.01/R1). Contactor will provide PLC-4 with all hardware and software and integrate the offered system with that of Pkg 062(New Coal Handling Plant).

- To understand the interfacing points, enclosed Material flow diagram (Drg No.-MEC/S/9101/11/17/55/01/064.12, Sheet 1&2) and a schematic drg (Drg. No.-MEC/S/9101/11/E9/0/00/00/064.03) may be referred.

- The Contactor will furnish assignment drawing and space requirement to the employer to keep the provision in the Despatcher-D2.

04. Coke Sorting Plant

- Control, Monitoring, Interlocking and Sequential functions of new drives and equipment proposed for Coke sorting plant covered under this specification as per technological layout and material flow diagram with new automation. Proposed CSP will receive material from CDCP (for COB#11), Existing Coke Sorting Plants CSP-1 through Conveyor KA1 and KA2 which in turn after crushing & screening material will transport to Stock House of BF#8 and SP-III through C-line conveyor (Pkg064) in line with technological material flow diagram.

- For operation of Coke sorting plant, a separate new Dispatcher will be provided by the Contactor with dedicated PLC based automation.
system as per Automation Configuration Diagram (MEC/S/9101/11/E9/55/01/064.02/R1).

- In the new Automation system, provision will be kept for interfacing employer’s PLC and/or Remote I/O stations for all source and destination conveyors.

05. Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III - Control, Monitoring, Interlocking and Sequential functions of new drives and equipment proposed for Augmentation of Flux and Fuel crushing and screening circuit as described below in line with material flow diagram:

i. Feeding of coke breeze from coke breeze bunker of coke sorting plant (CSP4) to existing conveyor C102

ii. BF fines from existing BFs through conveyor C7, new conveyor C3A-C1 to existing Conveyor F101 in junction house JH 127.

iii. Feeding of sinter /ore fines from BF8 fines storage bins to existing conveyor F101 in junction house JH 127

iv. Feeding of coke fines from BF8 fines storage bins to existing conveyor C102.

v. New Fuel & Flux Crushing and Screening system

vi. New Conveyor route starting from C104 through Rod Mill feeding to existing Proportioning building.

vii. New Conveyor route starting from L105 through Hammer Crusher feeding to existing Proportioning building.

The above will be achieved by providing new hot redundant PLC with suitable remote I/O station. New PLC will be integrated to the existing PLC based Automation system by providing suitable gateway as shown in the enclosed Automation Configuration Diagram. For interfacing with New Sinter machine suitable gateway also will be provided for establishing interlocking, signal, monitoring etc.

- The Automation system facilities will be generally offered inline with the basic ‘Automation System Configuration’ diagram (Drg. No: MEC/S/9101/11/E9/55/01/064.04/R3) enclosed with this specification for Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III.

- Contractor will provide gateways, all hardware and software required for integrated operation of the new drives defined above along with the existing equipments for flux and fuel crushing & screening facility and the associated conveyors in existing Rockwell make 5-60/5-80 series PLC based Automation system.
Conveyors feeding to Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III i.e. C7-3.5KW, C1-30KW & C2-45KW will be fed from new MCC under the scope of package. These Conveyors will be connected from new PLC of Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III. Suitable control cable and other accessories will be considered.

Necessary modification, if required for laying of cables and mounting equipment in the existing control room CR1, the same will be provided by the Contractor.

06. This specification should be read together with the General Technical Specification (No. GS-03) separately attached with this specification, General Conditions of Contract (GCC) and other commercial terms & conditions.

07. Automation equipment considered for the process will be complete in all respect in line with this specification. Any equipment / accessories, not explicitly indicated in this specification, but considered essential for proper functioning of technological equipment and process (including utilities) will be included by Contactor in their scope of work and supply.

08. All the automation equipment will be supplied brand new & from the latest product ranges of reputed manufacturers as per the List of Preferred Makes, furnished in this Contract document. Employer/ Consultant reserve the right of selecting particular make and model of Automation equipment with a view of integration with employer’s Automation system and standardization of the whole plant. Contactor will comply with such requirements.

09. Contactor will execute the entire automation work as part of turnkey package of the CHP and CSP, Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III to the satisfaction of Employer/ Consultant. Contactor will comply with all the requirements indicated under General; Salient Features of Automation system, Scope of Work and Supply; Submission of Drawings & Documents and other related clauses/ annexure stipulated in this specification. Design aspects and selection criteria of PLC systems and also other hardware/ peripheral units have been elaborated in GTS. The GTS (GS-03) is being issued as a separate document along with this Contract, which will also be complied with.

10. Interfacing:

Coal Handling Plant: -Automation systems of CHP (Pkg-062), new Coke Oven Battery-11, etc. will be separately arranged by Employer along with its technological package. The proposed PLC based automation system of Coal Handling Plant (Pkg-064) will be interfaced.
with CHP (Pkg-062), new Coke Oven Battery-11 & existing plants / shops as per Technological Material Flow Diagram for information exchange, interlocking and monitoring of the plant. Contactor will provide required hardware & software for interfacing of the offered automation system with the automation system of the above plants. The required communication bus from the PLC of the above plants to respective Despatcher / Control Room of the Contactor’s offered Coal Handling Plant will be included under this package. Details of interfacing requirement will be finalised during detailed engineering stage.

- **Coke Sorting Plant:** Automation systems of CDCP (for Coke Oven Battery-11), Stock House of Blast Furnace # 8, etc. will be separately arranged by Employer along with its technological package. The PLC based automation system of CSP (Pkg-064) will be interfaced with CDCP (for Coke Oven Battery-11), Stock House of Blast Furnace # 8, Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III (Pkg-64) & existing CSP 1 plant as per Technological Material Flow Diagram for information exchange, interlocking and monitoring of the plant. Contactor will provide required hardware & software for interfacing of the offered automation system with the automation system of the above plants. The required communication bus from the PLC of the above plants to respective Despatcher / Control Room of the Contactor’s offered Coke Sorting Plant will be included under this package. Details of interfacing requirement will be finalised during detailed engineering stage.

- **Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III:** Automation systems of Blast Furnace #8, Sinter Plant#3 etc. will be separately arranged by Employer along with its technological package. The PLC based automation system of Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III (Pkg-064) will be interfaced with stockhouse of Blast Furnace #8, Sinter Plant #3, CSP (Pkg-64), Existing Coke handling, crushing and screening facility, Existing Flux crushing and screening facility, etc. as per Technological Material Flow Diagram for information exchange, interlocking and monitoring of the plant. Contactor will provide required hardware & software for interfacing of the offered automation system with the automation system of the above plants. The required communication bus from the PLC of the above plants to respective Despatcher / Control Room of the Contactor’s offered Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III will be included under this package. Details of interfacing requirement will be finalised during detailed engineering stage.

11. The Automation system facilities for CHP, CSP and Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III of this package (064) will be generally offered inline with the basic ‘Automation System Configuration’ diagram (Drg. No: MEC/S/9101/11/E9/55/01/064.01/R1) for CHP & Drg. No: 05 CHAP-04.11 AUTOMATION.doc Page 4 of 15
12. Automation system of proposed plants will have three level Ring Architecture type communication buses as follows:

a) HMI-level Ethernet for HMI Stations, MIS Servers, MIS Clients, Higher-level systems etc. Contactor to provide for CSP in line with Automation Configuration drawing.

b) Control-level Ethernet for connecting PLCs, Servers, Emergency Work Stations, Engineering Stations etc. Contactor to provide for CSP in line with Automation Configuration drawing.

c) I/O level communication bus. Contactor to provide for CHP & CSP in line with Automation Configuration drawing.

13. 1 No. field programming unit for CHP, 2 Nos. field programming units for CSP and 2 Nos. field programming units for Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling For SP III will be in the scope of Contactor. Apart from standard features, these field programming units will be capable of connection from every Remote I/O station for engineering and troubleshooting purposes.

14. 2 Nos. MIS servers each will be included in the Automation system of CSP and Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III.

15. All printers provided with PCs will be laser jet type.

16. The design will be done in such a manner that involvement of cabling and wiring is minimum.

17. All the automation equipment will be configurable to a user configurable fail-safe state to avoid dangerous situations in case of any failures due to power failure, communication failure etc.

18. Different levels of networks will be inter-connected through intelligent devices which are capable of high speed switching at least at Layers 3 & 4 with access control. For all important systems firewall will be provided, taking care at Layers 3 to 7.

19. Temperature monitoring of all remote I/O stations will be provided through respective PLC.
20. Power & Control Supply monitoring of all mechanisms will be provided through PLC.

21. Status of UPS to be monitored through PLC / HMI.

22. All new PLCs supplied in this package, will be interfaced to Main PLC on Ethernet. Apart from main PLC as described in automation configuration drg., other PLCs (if) coming under this package shall interface with main PLC of CHP/CSP/FFP

23. The communication networks will be dully tested & certified by authorized agency.

24. For better co-ordination, the complete automation system will be ordered on one sub-vendor i.e. the OEM of PLC system.

25. Ethernet network (FO and UTP)
   - GTS GS-12 shall be referred for specifications related to ethernet network
   - FO link from CSP IV control room to main control room of COB#11(Battery and CDCP) and from existing SP3 CR1 to main control room of SP 3 machine 2 for exchange of needed information.
   - FO link to be used (Not UTP) if link taken outside building or shop floor.
   - All FOC/UTP carrying conduits/pipes to be paint marked as per standard color code specified by employer

04.11.02 SCOPE OF WORK AND SUPPLY

Contactor’s scope of work and supply will include design, engineering, manufacture/ procurement, assembly, calibration, shop testing, inspection at works & at site, painting, packing, transportation to site including loading, unloading, storage & handling of all Automation equipment including electrical accessories, cables, GI pipes, erection accessories, panels/ cabinets and all associated hardware, as required for completeness of Automation system in all respect along with site fabrication, erection, testing, commissioning of the complete automation system and interfacing with different PLCs as described else where in the contract for completeness & satisfactory operation of the entire Coal Handling Plant, Coke Sorting Plant and Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III as per technological layout and material flow diagram. The scope of work will also include liquidation of defect points, participation in tests for establishment of plant performance guarantee (PG) and post commissioning activities till issue of final acceptance certificate (FAC) by BSP.
The scope of work and supply will include but not limited to the following:

1. Automation system as per the facilities indicated in the Automation System Configuration diagram (Drg. No: MEC/S/9101/11/E9/55/01/064.01/R1) for CHP & Drg. No: (MEC/S/9101/11/E9/55/01/064.02/R1) for CSP and (Drg. No: MEC/S/9101/11/E9/55/01/064.04/R3) for Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III and as described in 'General' and 'Salient Features of CHP, CSP and Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III'.

   a. For CSP this will mainly include independent PLC systems with redundancy in: - processors, power supply modules, communication modules, network interface modules, MIS servers etc. for plants/units. Number of operator’s station and engineering work station shall be as automation configuration diagram. Communication bus will be ring architecture type. The automation system will be client-server based configuration. All the required facilities & features for interfacing of PLC systems will be considered and provided accordingly.

   b. For CHP, the Contactor will provide PLC based automation system, with redundancy in: - processors, power supply modules, communication modules etc in line with GTS. Number of operator’s station and engineering work station shall be as automation configuration diagram. Remote I/O stations, I/O Level communication Bus, necessary gateway (associated hardware and software) for interfacing with employer Automation network, Engineering station, HMI shall be as shown in Automation Configuration drawing.

   c. For Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III, the Contactor will mainly provide PLC based automation system, with redundancy in: - processors, power supply modules, communication modules, network interface modules as per GTS. Number of operator’s station and engineering work station shall be as automation configuration diagram. Operator’s and engineering workstations, Remote I/O stations, I/O Level communication Bus, Control-level bus, necessary gateway (associated hardware and software) for interfacing with employer Automation network, Engineering station, HMI shall be as shown in Automation Configuration drawing.

2. Required nos. of local/remote I/O panels with adequate quantity of various types of I/Os cards, i.e. Digital, Analogue, RTD, Thermocouples, Pulse, power supply cards, communication cards, Relays with NO contacts for outputs etc. at different locations.
Contactor will also consider input interposing relays for field mounted proximity switches in the I/O chassis.

3. Preferred Makes of individual equipment i.e. PLC systems, Workstations, Servers, Engineering stations, printers etc., will be in line with GS-13. All the Hardware in Individual Systems will be from the same product series.

4. All required software i.e. System software, HMI software, Application programmes etc. for PLC, Workstations, Servers, communication interface amongst various automation systems etc. Required number of software licenses will also be provided.

5. All maintenance, diagnostic tools & devices required for implementation, maintenance & trouble shooting.

6. 1 No. field programming unit for CHP, 2 Nos. field programming units for CSP and 2 Nos. field programming units for Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III will be in the scope of Contactor. Apart from standard features, these field programming units will be capable of connection from every Remote I/O station for engineering and troubleshooting purposes.

7. All Network components like Gateways / interfacing modules, cables, multi-port switches (if applicable) etc., as required for interfacing.

8. Optical Link Modules, Light Interface Unit, Redundant link modules, Power supply Cards, Converters, Terminators etc. as per requirements.

9. Other than the PLC systems specified in the configuration diagram, if any separate PLC systems are required for operation of the auxiliary units of the proposed CHP, CSP and Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III the same will also be offered and suitably interfaced with the main automation system.

10. All types of system cables, communication cables, LT power cables, special cables, etc., as required. This will also include the required communication interface and cable for interfacing with the PLCs of conveying system of COB#11, Blast Furnace Stock House, Sinter Plant, CDCP etc. (as described in ‘Interfacing’ in CTS), located at respective control rooms.

11. Necessary co-ordination with employer / Mecon for establishing interfacing and integration requirement by providing new PLC, multiplying relays as required, interconnecting cabling between employer’s MCC/ other panels and Contactor’s PLC/ Remote I/o stations etc.
12. Fully wired cabinets/ panels, etc with MCBs, Fuses, CFL Lamps, Universal type service sockets, Earth strips, etc.

13. Control room furniture for CSP dispatcher

14. In existing Control Room/Dispatcher –CR1 of Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III, existing 4 monitors will be replaced by new TFT monitor of size 22”, identical to new monitors for aesthetic looks.

15. Submission of drawings and documents as per mentioned at clause no. 06.11.05 of this CS.

16. a) In the automation system for CHP, few facilities from Pkg-062 are proposed to be used. These facilities include Fault-tolerant HMI server, Fault-tolerant history and process support server, Fault-tolerant MIS server, Network at Despatcher-D2, etc. Contactor will be responsible for all necessary activities, including coordination, with the supplier of Pkg-062 towards licensing requirements, development of application for Pkg-064, deployment of clients, network etc.

   b) Erection, testing, calibration and commissioning of the total Automation equipment / system of CHP, CSP and FFP included in this specification. Required interfacing with employer’s PLCs by providing necessary hardware and software and interconnecting cables. This will also include laying and termination of system bus cables as required.

17. Contactor will arrange tools, tackles and consumables as may be required for erection, testing, calibration and commissioning activities.

18. Contactor will arrange inspection of Automation equipment by Employer/ Consultant. Inspection and Testing will be carried out in compliance with the Quality Assurance Plans and FAT document, to be approved during detailed engineering stage.

19. Contactor will arrange visit by respective Automation manufacturer’s representatives at site, as & when required, during erection & commissioning.

20. Testing tools & equipment for automation system

21. Special tools will be provided in sufficient number for tracing, location, testing, jointing, fault location & rectification, termination etc. for all cables including special cables.
22. Contactor will involve Employer / Mecon in control philosophy development, design of application software and hardware, drawing up of software specifications, software development, off-line testing etc.

23. All tests on software, hardware, network, communication etc. will be carried on the basis of a pre-agreed protocol clearly listing out steps involved in testing with its responsibility and minimum expected results as per specifications, engineering and other documents.

24. Troubleshooting manual for all application software, system software, configuration, hardware, network etc. will be provided clearly spelling out possible causes, checks and measures for corrective action.

25. Contactor will arrange training for Employer’s personnel on the automation system at manufacturer’s works and also at site.

26. Two years maintenance spares, if the order is separately placed by Employer.

27. Commissioning spares and three months consumables.

04.11.03 SALIENT FEATURES OF CONTROL & AUTOMATION SYSTEM FOR COAL HANDLING PLANT, COKE SORTING PLANT AND AUGMENTATION IN FLUX - FUEL PREPARATION AND PLANT RETURN FINES HANDLING FOR SP III

01. For monitoring, control, interlocking and sequential operation of CHP, CSP and FFP, PLC based automation systems will be provided. Considering information exchange & operational requirement all the systems will be suitably interfaced. All the printers will be provided with network connectivity.

02. In Client server based Automation system, hot redundant servers will be considered. This architecture will have 3 level ring type bus system. The PLC systems will communicate with each other and the servers through a common ring tropology bus. All the HMI stations will be interfaced with the servers through a separate higher level bus. Respective PLCs will have independent engineering station. Suitable communication cards will be provided in respective I/O panels for interfacing with HT switch-boards; Intelligent MCCs, Remote I/O station, Weighing Controllers, TR controllers etc.

03. Each Operator Workstations will have 22” Flat dual TFT Monitor as shown in Configuration drawings.

04. The automation system will be powered from UPS of suitable rating. Details of UPS have been separately indicated in this TS and GTS.
05. All the new MCCs of CHP and CSP and MCPs of CHP, CSP and FFP will be of Intelligent Type. i.e. every controller (DOL/RDOL feeder) will have an intelligent relay having capability to communicate directly with PLC Controller. Power supply feeders in MCC need not to communicate with PLC except of those feeders which feed to other Process MCCs & ACB/MCCB incomers.

06. All the HT breakers & LT breakers in PCC will also have communication ability to Automation system.

07. All the weighing controller/Indicator panels, VFD etc. will communicate directly with PLC Controller.

08. Optical link module will be used for converting Electrical bus to Optical bus.

09. Contactor will consider Remote I/O panels at each electrical premises with all kinds of Remote I/Os.

10. Additional Engineering spare Remote I/Os will be carefully planned at each location in such a way that they can be used in the unlikely event of non-establishment of communication with field devices having bus communication.

11. One Remote I/O panel (with required numbers interface modules/types of I/Os) will be planned in each electrical premises, each electrical floor (in case of multi-story rooms) & junction houses / Technological Buildings for interfacing of field switches.

12. All the communication cables will be laid in GI pipes. Separate pipes with separate routes (to the extent possible) will be used for ring tropology type communication bus.

**GENERAL CONTROL REQUIREMENT**

13. All the drives will generally be provided with following modes of operation and control:

- Local De-interlock
- Local interlock
- Remote

Mode of selection will be carried out for all drives with the help of selector switch provided on the MCCs / MCPs and required nos. of wall mounted boards / boxes for HT motors.

14. For local operation of drives, permission from Operator at Despatcher Control room will be obtained which will be named as
automation permission. For this purpose, specific menu will be provided with operator workstation for such drives.

15. Local De-interlock mode of operation will be used only for adjustment, maintenance and testing purpose. After the selector switch at MCC / MCP is selected to Local De-interlock mode and Operator/PLC permission is obtained from Control room, the drives/valves can be started/opened/closed from Local control stations using start/open/close push buttons. Under this mode of operation, all safety interlocks (Pull Chord Switches, motor over load, Emergency switch etc.) will be provided through hardwire in the circuit.

The stop push button provided in Local Control station will stop the drive under all mode of operation. In case of emergency Stop, alarm will be provided at the Operator workstation at control room to warn the operator. Hooter PB will be provided in LCS for pre start warning.

16. Local interlock mode for running the drive in sequence interlocked mode from LCS. Selector switch will be put in local interlocked position and permission from operator / PLC will be pre requisite condition. In this mode start, stop, motor over load, emergency stop, Pull Chord & Belt Sway Switches, Zero Speed Switch, chute jamming switches will be in the circuit through hardwire in addition to interlock with successive conveyor / equipment.

17. Under remote mode of operation, following control modes for all drives will be provided through Operator workstation.

   i. Remote Manual
   ii. Automatic

Selection of remote manual or automatic mode of operation will be carried out using command menus through Operator workstations. **Remote Manual mode**

Under remote manual mode of operation, individual drives will be started/stopped from Operator workstation. However, necessary safety interlocks will be provided by automation system. This mode can be used for testing of individual drives from Control room. **Automatic mode**

Under Automatic mode, the plant/equipment will be controlled, started/stopped automatically in sequence by automation system using various command menus from any of the Operator workstations.

04.11.04 CONTROL ROOM / DESPATCHER ROOMS

A. COAL HANDLING PLANT:-
Route wise operation of offered CHP (under Pkg-064) of the Contactor and Coal transportation system (under Pkg-062) of the employer will be operated from a common dispatcher D2. The Despatcher D2 building is located near COB#11 and is in Employer’s scope covered under Package 062. The Contactor will supply PLC, Engineering Station, Work Station, Emergency Work Station etc. as per Automation Configuration Drawing (No.- MEC/S/9101/11/E9/0/00/00/064.01/R1) of CHP. The Contactor will furnish assignment drawing and space requirement to the employer to keep the provision in the Despatcher-D2.

B. COKE SORTING PLANT:-
One no. Despatcher will be provided by the Contactor for control of transportation of coke from JH-1 to various destination as per Material Flow Diagram & Technological layout. Despatcher will be a new building near Coke Screening Station under Contactor’s scope. Civil, Structural, floor & Ceiling requirements for the Despatcher / Control Building are described elsewhere in the TS.

C. New PLC with RIO’s will be provided for Augmentation in Flux - Fuel Preparation and Plant Return Fines Handling for SP III which will be connected to existing PLC through suitable gateway. The new PLC & HMIs will be housed in existing Control Room 1(CR-1). The existing HMIs will suitably be upgraded to match the new HMIs for operation of the entire existing and new Flux & Fuel Crushing & Screening plant.

D. COMMON POINTS:-
01. The Despatcher / Control Buildings will be air-conditioned and provided with false ceiling & false flooring. The respective rooms will have following suitable aluminum framed glass partitions as listed below:

   a. At one partition called as operator room will house the operator workstations, printers and other peripherals of the automation system along with Control desk (for work stations/printers) & operator chairs.

   b. A separate partition in the control room / Despatchers will be used for installation of Engineering Stations, Servers (if applicable) & Software/Hard-ware related documentation.

   c. A separate partition will be used for installation of PLC Panels, I/O panels, Instrumentation panels, Weighing panels, & all other electronic panels as per the detail engineering.

02. All the above partitions will be accessible directly from a common walkway.
03. Control room and Despatcher will also have facility of Toilet block. Central control room will have one conference room (with Table & Chairs for 12 persons) & Pantry. However Contactor may accommodate some of these facilities on floor below Control room also, during detail engineering.

04. Control desk (for installation of HMIs & Engineering Stations etc) will be of most modern & aesthetic design with Cable Management system.

04.11.05 LIST OF DRAWINGS & DOCUMENTS

Following drawings and documents will be submitted by the Contactor:

A. TO BE SUBMITTED BY THE CONTACTOR DURING DETAILED ENGINEERING

I) FOR APPROVAL:

01. Finalised system configuration diagram for the automation system along with its peripherals with list of hardware and write-up on the system.

02. Bill of Materials & Data Sheets of all the hardwares i.e. Processors, Communication modules, Power supply cards, RLM, OLM, Operator stations, Eng Stations, Servers, Bus cables etc.

03. Overall General arrangement drawings & sectional views of various cabinets, panels, consoles, etc., showing internal disposition of all components/ units, with dimensional details and bill of materials.

04. Interconnecting diagram between existing MCCs & other panels of employer and PLC / Remote I/O stations of the Contactor.

05. Single line power supply diagram with specification and bill of quantities of electrical accessories.

06. Quality assurance plan & Factory Acceptance Test procedures for Automation system.

07. Control room layout drawing showing disposition of panels, consoles, desks, etc with dimensional details.

II) FOR SCRUTINY AND REFERENCE

01. Detailed technical literature/ catalogue for Automation system with peripherals, highlighting the model number.
02. Input/ Output list.

03. Terminal diagram of all the RI/O & Marshalling panels.

04. Cable schedule and specification.

05. System grounding scheme.

06. Formats and work sheets for generation and display of overview, groups, loops, graphics, alarms, operator’s guide messages, real time & historical trends, log & shift formats.

07. Detailed listing of application software, system software, HMI software, etc and the number of licenses.

08. Application software formats and details in documentation and CDs.

09. Manufacturer’s test, calibration and guarantee certificates for all instruments and automation system.

10. Operation and maintenance manuals for Automation system.

III As-built drawings and documents.

1. Drawings and documents of complete automation systems

2. Soft copy of all the above drawings & documents in CDs/DVDs.