TENDER DOCUMENT

NIT No.: DLI/C&E/WI-675/271

FOR

Tender for ‘Design, Engineering, Supply, installation, testing and commissioning of DFDS SYSTEM PACKAGE AND ASSOCIATED WORKS’ for the project of “Augmentation of Fuel and Flux crushing facilities (Package- 064) of Bhilai Steel Plant, (SAIL)”.

VOLUME – 2B

TECHNICAL SPECIFICATION

ENGINEERING PROJECTS (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)
Core-3, Scope Complex, 7, Institutional Area,
Lodhi Road, New Delhi-110003
TEL NO: 011-24361666  FAX NO. 011- 24363426
(A) **Bidder's Scope of Work :-**

1. Design and Engineering of total "DFDS PACKAGE AND ASSOCIATED WORKS" as mentioned in NIT & Tender Documents.

2. Supply of all materials / items except covered under (B) mentioned below i.e. Items/Materials excluded from Bidder's Scope of Work, from Sr. no. 1 to 8.

3. Supply of Commissioning Spares as mentioned in NIT & Tender Documents.

4. Erection (i.e. Installation, Testing and Commissioning) of all Equipment / Items covered under "DFDS PACKAGE AND ASSOCIATED WORKS" as mentioned in NIT & Tender Documents except cable laying and Termination.

(B) **Materials / Items excluded from Bidder's Scope of Work :-**

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>Item Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power &amp; Control Cable including of HT cable for Air Compressor, Earthing, Hardware and Cable tray.</td>
</tr>
<tr>
<td>2</td>
<td>Main Electrical Equipment comprising of Local Starter Panel, Local Push Button Station, Push Button Station, Controller and Power Distribution Box</td>
</tr>
<tr>
<td>3</td>
<td>Instrumentation comprising of Flow Meter, Level Transmitter, Level switch, Temperature Transmitter/Gauge and Pressure Transmitter/ Gauge</td>
</tr>
<tr>
<td>4</td>
<td>Compressed Air System comprising of Air Compressors, Main Air Receivers (outside Compressor house) and Cooling Towers.</td>
</tr>
<tr>
<td>5</td>
<td>Soft Starter Panel for Air Compressors</td>
</tr>
<tr>
<td>6</td>
<td>Air &amp; Water Pipe Line complete with necessary fittings (fittings mean bends, Tee, Flanges, and Reducers)</td>
</tr>
<tr>
<td>7</td>
<td>Isolation valves at Tapping points (from Client’s network) and Flow Transmitters</td>
</tr>
<tr>
<td>8</td>
<td>Mechanical Hose reel with drum, Quick release coupling etc. for service water</td>
</tr>
</tbody>
</table>
1.0 Technical Specifications of DUST SUPPRESSION SYSTEM

DUST SUPPRESSION SYSTEM

Dry fog dust suppression (DFDS) system shall be provided at different material transfer points as given below

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Location</th>
<th>Description of DFDS application points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>JH-2</td>
<td>Conveyor discharge Receipt on conveyor C3A-C1</td>
</tr>
<tr>
<td>2</td>
<td>JH-3CA</td>
<td>conveyor C3A-C1 Receipt on conveyor C3-C2 or C3-C1 from C3A-C1 Conveyor C3A-C2 discharge Receipt on conveyor C3-C2 from C3A-C2</td>
</tr>
<tr>
<td>3</td>
<td>JH-C3</td>
<td>Conveyor C3-C2 discharge Conveyor C4-C2 receipt from C3-C2 Conveyor C3-C1 discharge Conveyor C4-C1 receipt from C3-C1</td>
</tr>
<tr>
<td>4</td>
<td>JH-C4</td>
<td>Conveyor C4-C2 discharge Conveyor C5-C2 receipt from C4-C2 Conveyor C4-C1 discharge Conveyor C5-C1 receipt from C4-C1</td>
</tr>
<tr>
<td>5</td>
<td>JH-C5</td>
<td>Conveyor C5-C2 discharge Conveyor C7-C1 receipt from C5-C2 Conveyor C5-C1 discharge Conveyor C6-C1 receipt from C5-C1</td>
</tr>
<tr>
<td>6</td>
<td>JH-C6</td>
<td>Conveyor C6-C1 discharge Conveyor J127-C1 receipt from C6-C1</td>
</tr>
<tr>
<td>7</td>
<td>JH-127</td>
<td>Conveyor J127-C1 discharge Conveyor F101 receipt from J127-C1</td>
</tr>
<tr>
<td>8</td>
<td>JH-C7</td>
<td>Conveyor C7-C1 discharge Conveyor C102A receipt from C7-C1</td>
</tr>
<tr>
<td>9</td>
<td>Transfer stations of conveyor C1, C2 &amp; C7</td>
<td></td>
</tr>
</tbody>
</table>
### Coke crushing and screening and grinding facilities

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Location</th>
<th>Description of DFDS application points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>JH-CK1</td>
<td>Conveyor RC-106 discharge Receipt on conveyor C106A from RC-106</td>
</tr>
<tr>
<td>2</td>
<td>JH-CK2</td>
<td>Conveyor C-106A discharge Bunker Receipt on conveyor RC-CK2 Receipt on conveyor C107A from roll crusher or RC-CK2</td>
</tr>
<tr>
<td>3</td>
<td>JH-CK3</td>
<td>Conveyor RC-107A discharge Receipt on conveyor C107B</td>
</tr>
<tr>
<td>4</td>
<td>Screening building</td>
<td>Discharge of conveyor 107B Screen Receipt on conveyor C111A Bunker Receipt on conveyor C110A</td>
</tr>
<tr>
<td>5</td>
<td>Coke Grinding Bldg.</td>
<td>Conveyor C111A discharge Receipt on conveyor C112A Bunker Belt feeder receipt Belt feeder discharge Receipt on conveyor C114 from rod mill Bunker Belt feeder receipt Belt feeder discharge Receipt on conveyor C114 from C113A</td>
</tr>
</tbody>
</table>

### CONVEYOR STREAM FEEDING TO COAL TOWER-7

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Location</th>
<th>Description of DFDS application points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>JH-4</td>
<td>Discharge point of conveyor Y-14 Reciving point on conveyor Y11-131 or Y-15</td>
</tr>
<tr>
<td>2</td>
<td>JH-11A</td>
<td>Discharge point of conveyor Y11-131 Reciving point on conveyor Y11-132</td>
</tr>
<tr>
<td>3</td>
<td>JH-11B</td>
<td>Discharge point of conveyor Y11-132 Reciving point on conveyor Y11-133</td>
</tr>
</tbody>
</table>
### Additional silos, junction houses & final crushing station

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Location</th>
<th>Description of DFDS application points</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>JH-2C</td>
<td>Discharge point of conveyor Y7-49</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receiving point on conveyor Y11-125 or Y7-50</td>
</tr>
<tr>
<td>(ii)</td>
<td>JH-11C</td>
<td>Discharge point of conveyor Y11-125</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receiving point on conveyor Y11-126</td>
</tr>
<tr>
<td>(iii)</td>
<td>5 nos. new mixing bin</td>
<td>Discharge point of belt feeder (5 point)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receiving point on conveyor Y11-127 (5 point)</td>
</tr>
<tr>
<td>(iv)</td>
<td>JH-11D</td>
<td>Discharge point of conveyor Y11-127</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receiving point on conveyor Y11-128</td>
</tr>
<tr>
<td>(vi)</td>
<td>JH-11E</td>
<td>Discharge point of conveyor Y11-128</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receiving point on conveyor Y7-35</td>
</tr>
<tr>
<td>(vi)</td>
<td>JH-3C</td>
<td>Discharge point of conveyor Y7-35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receiving point on conveyor Y7-36</td>
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<tr>
<td></td>
<td></td>
<td>Discharge point of conveyor Y7-36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receiving point on conveyor Y11-129 or Y7-51</td>
</tr>
<tr>
<td>(vii)</td>
<td>JH-11F</td>
<td>Discharge point of conveyor Y11-129</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receiving point on conveyor Y11-130</td>
</tr>
<tr>
<td>(viii)</td>
<td>Crushing station</td>
<td>Discharge point of conveyor Y11-130</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receiving point on conveyor Y7-12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Discharge point of conveyor Y7-12</td>
</tr>
<tr>
<td>(ix)</td>
<td>Mixing station</td>
<td>Discharge point of conveyor Y7-13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receiving point on conveyor Y-18 or Y-14</td>
</tr>
</tbody>
</table>
There shall be minimum 2 nos. DFDS system, one for re-routing of existing sinter fines conveyors, coke crushing, coke screen facilities and the other for conveyor streams feeding to coal tower-7 and additional silos, junction houses and final crushing station. In each DFDS pumping station 2 nos. pumps (1W + 1S) shall be provided. DFDS system will also be provided at transfer stations of conveyor C1, C2 & C7.

1.2 INSTRUCTIONS TO CONTRACTOR

The dust suppression system vendor shall have experience of execution of at least 2 installation of DFDS system, already commissioned and under operation successfully from last one year. DFDS system vendor shall be from M/s. F Harley/ TPS/ Spraying System

1.3 APPLICABLE CODES AND STANDARDS

The execution of the work covered under this specification shall conform to the latest Indian Standards specification where the same are available or the reputed standards acceptable to the owner / consultant. In case such specifications are not available, the work shall be according to good engineering practice and norms acceptable to owner / consultant.

1.4 DESIGN CRITERIA

1. Work zone dust concentration (at 5-7m distance from source) shall not be more than 5 mg/Nm3 above ambient condition.

2. Water line velocity shall be maintained less than 1.5 m/sec. Water pipe line shall be supported at regular interval. Make-up water, quick fill, drains and overflow connection shall be included at each pump station tank. Duplex strainer shall be included at inlet to dust suppression system pumps. IS-1239 heavy class, ERW, G.I pipe line shall be used in the water line. Water pipe line shall be preferably be laid over ground along conveyor gallery. In case of non-availability of same suitable supporting scheme shall be provided to suit site. Underground pipeline (wherever provided) shall have wrapping and coating as per IS – 10221 (preferably wrapping coating shall be coal tar based). Hume pipe protection shall be laid at road crossing area.

3. IS-1239 heavy class, ERW, G.I pipe line shall be used in the compressed air line. Compressed air pipeline network over ground laying shall be preferred with a minimum slope of 10 mm in 1m (1: 100) along flow and moisture trap with drain provision at regular interval. Compressed air pipeline shall be preferably laid along conveyor gallery or can be supported from building supporting structure. In case of non-availability of same suitable supporting scheme to be developed by the contractor to suit site.

4. In DFDS pumping station, 2 nos. pumps (1w+1s) shall be provided. A pressure relief valve shall be provided to by pass water to storage tank in case the pressure increases above the set value.

5. Spray Nozzles/ Spray bar for DFDS systems at transfer points (at both conveyor discharge & receiving points) shall be selected so as to ensure complete coverage. Solenoid valves shall be mounted on each spray nozzle header at material transfer points. Solenoid valves shall be interlocked with the operation of conveyor running with material. For this necessary load sensor units shall be designed, installed and
hook up with conveyor drives/panel. At reversible shuttle conveyor spray nozzles shall be provided at both sides.

(6) The DFDS system nozzles shall have air driven acoustic oscillator capable of producing super fine atomization of water droplets of size as that of dust particles & blanket of extremely fine fog. The approximate water addition shall not be more than 0.2% of the weight of material being handled.

(7) Compressed air receiver and water tank at different pumping station shall be provided with connecting valve, pipe fitting, and instruments for quality checking.

(8) At each pump station air receiver capacity shall be considered @ 16% of the compressed air consumption in m3/min or 2 m3 capacity, whichever is higher.

(9) MS tank of 6 mm thick with stiffener for 1-hour storage capacity shall be provided at pump stations of DFDS system by the contractor. The inside surface of MS tank shall be epoxy painted.

(10) The contractor shall provide platform, walkway, stair case adequate for the necessary approach to the equipment for operation & maintenance point of view.

(11) Duplex strainer with SS filter element shall be provided at inlet to dust suppression system pumps to remove all suspended particles exceeding 100 micron.

(12) The contractor shall provide the following minimum instruments

- High level and low level switch in water tank. Low level switch interlocked with pump operation.
- Spring loaded operated pressure release valve (adjustable) at pump discharge line for by passing water line to tank to avoid shut-off condition.
- Pressure gauge at all pump discharge line.
- Pressure gauge at air-receivers, safety valve and drain provision
- At consumer application points following instruments shall be provided:
  - Independent pressure gauge & control valve (Ball valves) shall be provided for pressure regulation. This unit shall housed in a steel cabinet of IP-55 construction.
  - For flow activation, solenoid operated valves shall be provided in water and airline.
  - Belt conveyor load monitoring switch shall be provided for sensing conveyor running with material.
  - Pressure switch in compressed air line to prevent spray operation at low pressure.
  - Indication lamp in FAS to show ON/OFF operation of spray.
  - Individual valve shall have selection mode to run in Auto/Manual mode.

1.5 EQUIPMENT SPECIFICATIONS

The equipment for "DFDS" dust control system is grouped into two main categories.

Main Equipment

The main equipment shall include spray bar assemblies fitted with dual-fluid air driven acoustic oscillator atomizing nozzles, pressure regulating units, and flow activation stations for ON-OFF control of the system and instrumentation for auto operation.

Auxiliary Equipment

The auxiliary equipment shall include water storage and pumping unit with duplex water filter and associate electrical works, air and water piping, enclosures,
necessary hoods and skirt boards on belt conveyors / equipment to suit spray nozzle operation.

Starter cum control panel shall be provided at pumping station and local control panel shall be provided at different application points.

Brief Specifications of various components of the system are given below

**Main Equipment**

**Spray bar assemblies**

The spray bar assemblies shall be manufactured from stainless steel tubing drilled and tapped for connection of nozzle adapters. A specially designed and selected dual fluid atomizing nozzle shall be fitted into each of the adapters. These nozzles are fitted with acoustic oscillators for atomizing the water into droplets of micronic size by passing them through a field of high frequency sound waves. The nozzles shall be of stainless steel while the adaptors shall be of brass. Each spray bar shall be provided with mounting brackets and flexible hoses for connection to the air & water pipeline.

**Pressure regulating units (PRU)**

The performance of "Dry Fog" type dust control system is critically related to the size of water droplets. The nature and particle size of dust generated in the material handling system changes with change in size and characteristic of the material. In practice, the sizes of the dust particles have a very wide spectrum (1-800 microns).

A careful control of air and water flow & pressure is therefore necessary to obtain optimum dust suppression results. For this purpose, pressure regulating units shall be provided in the system. The pressure regulating unit shall consist of diaphragm type pressure regulator with pressure gauge and ball valve for isolation of air and water line. The operator can adjust both the air and water pressures independently to change the fog characteristics to obtain optimum dust suppression results vis-a-vis the site requirements. The pressure regulators shall be installed in a metallic enclosure with inspection door with rubber sealing arrangement. Flexible hose shall be provided for connection of PRU to the air & water pipeline.

The number of pressure regulating units shall depend upon the position / elevation of spray bars. Generally independent pressure regulating units shall be provided when the elevation of spray bars exceeds 3 m. Further the number of nozzles operating from one PRU should not exceed 6 ~ 8.

**Flow activation stations (FAS)**

The flow activation station shall consist of solenoid valves in air & water line, pressure switch in the airline, selector switch, and indication lamps. Isolation ball valves shall be provided in the air & water line. All the equipment shall be installed in a metallic enclosure with inspection door with rubber sealing arrangement. Flexible hoses shall be provided with each FAS for connection to air and water pipeline.

The "ON - OFF" control of the fogging system shall be through the flow activation stations with facility for both manual and auto mode. A three-position selector switch shall be provided to select the mode of operation. The switch when energized shall
open the electric solenoid valves, which shall permit compressed air and water to enter into the pressure regulating units and spray bars.

In addition, a pressure switch shall be installed in the airline to ensure that air and water solenoid valves are energized only when sufficient air pressure is available in the line. This will ensure that the system cannot operate without sufficient air pressure to the nozzles and reduces the chance of un-atomized water to pour into the dust source. Flow activation shall have indication for:

- System ON
- System OFF due to lower air pressure

**Auto operation**

The flow activation stations shall have provision for both manual and automatic operation. For manual operation, the system shall become operational with selector switch in manual mode and in auto mode, the fogging operation starts on receiving a signal either from a speed switch cum belt load monitor or limit switches installed at a strategic location in the material conveying line or potential free contract from the drive motor of equipment as per requirements.

Each dust suppression system location shall be provided with requisite number of spray bar assemblies with DFDS atomizing nozzles. Pressure regulating units shall be provided at each location to regulate the pressure of compressed air and water.

The dust suppression system shall be divided into independent circuits taking into account the flow diagram, operational requirements, distances between dust suppression locations etc. Flow activation stations with instruments for auto operation are provided for each circuit for ON/OFF control of the dust suppression system.

**Centrifugal Pump**

Horizontal back pull out pump shall be provided. Pump casing shall be vertically split type. Impeller rpm shall generally not exceed 1450. However, for pumps with low capacity & high head may be provided with 2900 rpm. Pump shall be coupled to motor with flexible coupling. Spacer type coupling shall be provided. Pump shall conform to IS : 1520.

Pump shall give satisfactory performance at any point on the H-Q curve over a range of 40% of rated flow to 120% of the rated flow. The maximum efficiency shall preferably be within ± 10% of the rated design flow. The total head -capacity curve shall be continuous rising towards the shut off without any zone of instability and with a minimum shut-off head of 15% more than the design head.

Pumps shall have shaft seal by gland packing. Pump shall be fitted with double wearing rings, one is fitted in the front of the impeller on the casing and the other is fitted in the back of the impeller on the impeller itself.

Impeller shall be dynamically balanced. The magnitude of peak to peak vibration shall be limited to 75 micron. Pump impeller shall be non overloading type. Impeller shall be made in one piece & keyed to the shaft.
Material of construction

<table>
<thead>
<tr>
<th>Casing</th>
<th>- C.I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impeller</td>
<td>- Bronze</td>
</tr>
<tr>
<td>Bearing Bracket</td>
<td>- C.I</td>
</tr>
<tr>
<td>Shaft protection sleeve</td>
<td>- Bronze</td>
</tr>
<tr>
<td>Wearing ring</td>
<td>- Bronze</td>
</tr>
<tr>
<td>Shaft</td>
<td>- EN-8</td>
</tr>
<tr>
<td>Common base frame for pump &amp; motor</td>
<td>- M.S</td>
</tr>
</tbody>
</table>

Common base plate for pump & motor shall be in one piece & made of welded steel construction. Adequate space shall be provided between pump drain connection and base plate for installation of minimum 15 mm drain piping. Pumps shall be supplied with suitable drain pans or drain rim type base plates with tapped drain connections.

Critical speed of the shaft shall be at least 30 percent above the operating speed.

**Water Piping and Fittings**

Water piping up to 150 mm NB size shall be GI, ERW, heavy class and conforming to IS-1239 Part-1. Pipe ends shall be beveled. Pipe fittings shall be as per IS 1239, Part -2 for pipes of size up to 150 NB.

Plate type pipe flanges (as per IS 6392) shall be provided.

Pipes shall be of welded joints. Welding (manual metal arc welding) shall be as per relevant IS code and only certified welders shall be employed.

All piping systems shall be hydro tested at 1.5 times the design pressure.

Auto air venting valves shall be provided at highest point of the pipe lines & drain valves shall be provided at lowest points of the pipelines in different segments. Pipe supports comprising pipe shoes, saddles, base plate, clamps & structural members like channels, angles etc. shall be provided.

**Valves**

Butterfly Valves shall be provided in water line of size 65 NB and above and ball valve shall be provided for pipe size below 65 NB. However, ball valve shall be provided in the pipe line (irrespective of sizes) when flow control is required.

Specification of butterfly valve, ball valve & check valve shall conform to ES24 of GS-08 of “General Technical Specification”.

**Air Receiver (1no. for each pump station)**

Vertical self supporting in cylindrical design with dished end at both ends having minimum capacity of 2 m³ volume. The air receiver shall be designed for a working pressure of 8 kg/cm² g. Design, manufacture, inspection and testing of air receiver
shall be in accordance with IS:7938 and IS: 2825 – 1969 (RA 1984), Class-2, Dished ends IS: 4049 Part-1, 1979 (RA 1991). Material of construction shall be as follows:

**Shell and dished ends**: IS: 2002 Gr2 or equivalent

**Supports pad, leg, skirt, base**: IS: 2062-1992

**Plate, nozzles**: A 105 (below 300 mm NB)

<table>
<thead>
<tr>
<th>Material</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 106 Gr</td>
<td>(above 300mm NB)</td>
</tr>
</tbody>
</table>

**Flanges & matching flanges**: A 105

The air receiver shall be supplied with following accessories:

- Circular skirt welded to the bottom portion of the shell.
- Circular base plate welded to the skirt with holes for foundation bolts.
- Foundation bolts/studs, nuts, washers.
- Nozzles for inlet and outlet with weld neck flanges.
- Manhole nozzles at an accessible height with weld neck flange and cover having devit arrangement.
- Safety valve of sufficient blowing capacity mounted at a suitable height connected through a flanged joint to nozzle welded on the receiver shell.
- Safety valve shall be provided with test lever and gagging arrangement.
- Vent valve at the point of the dished end for releasing the air during hydro test.
- Water drain nozzle at the lowest point with drain isolation valve, trap station and pass valve.
- Companion flanges with bolts, nuts and gaskets for inlet and outlet nozzles and other valves.
- Studs for pressure indigator for local measurement of pressure.

### Pressure Gauge

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing Standard</td>
<td>IS 3624</td>
</tr>
<tr>
<td>Range</td>
<td>0 – 6 Kg/ cm² or 0-10 Kg/ cm²</td>
</tr>
<tr>
<td>Range (at pump suction)</td>
<td>(-)2 to (+) 2 Kg/ cm²</td>
</tr>
<tr>
<td>Dial Diameter</td>
<td>100 mm</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 1% of FSD</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP 65</td>
</tr>
<tr>
<td>Sensing element</td>
<td>Bourdon tube</td>
</tr>
<tr>
<td>Bourdon tube material</td>
<td>AISI SS316</td>
</tr>
<tr>
<td>Connection</td>
<td>Screwed</td>
</tr>
<tr>
<td>Connection size</td>
<td>½” BSP (M)</td>
</tr>
<tr>
<td>Mounting</td>
<td>Direct with bottom entry</td>
</tr>
<tr>
<td>Case</td>
<td>Die cast Al stove enamelled black finish</td>
</tr>
<tr>
<td>Bezel (screwed)</td>
<td>Die cast Al stove enamelled black finish</td>
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<tr>
<td>Dial window</td>
<td>Shatter proof glass</td>
</tr>
<tr>
<td>Pointer</td>
<td>Al anodised black</td>
</tr>
<tr>
<td>Dial</td>
<td>Al white with black letters</td>
</tr>
<tr>
<td>Movement assembly</td>
<td>AISI 304SS</td>
</tr>
<tr>
<td>Shank</td>
<td>AISI 3166SS</td>
</tr>
<tr>
<td>Adjustable pulsation damper</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Pressure gauges shall be provided with isolation valves (Ball valves)
### Levels of Various Buildings & Junction Houses of Coke Sorting Plant (CSP)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of Building/ Junction House</th>
<th>Ground Level (Mtr.)</th>
<th>No. of Floors</th>
<th>Floor Levels (Mtr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>JH-8</td>
<td>308.500</td>
<td>2</td>
<td>309.000</td>
</tr>
<tr>
<td>2</td>
<td>JH-10</td>
<td>308.500</td>
<td>3</td>
<td>309.000</td>
</tr>
<tr>
<td>3</td>
<td>JH-9</td>
<td>308.500</td>
<td>3</td>
<td>309.000</td>
</tr>
<tr>
<td>4</td>
<td>JH-11</td>
<td>308.500</td>
<td>3</td>
<td>309.000</td>
</tr>
<tr>
<td>5</td>
<td>JH-12</td>
<td>308.500</td>
<td>3</td>
<td>309.000</td>
</tr>
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### Levels of Various Buildings & Junction Houses of Coal Handling Plant (CHP)

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### Levels of Various Buildings & Junction Houses of Fuel Crushing & Screening Facility (FCSF)

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<th>Floor Levels (Mtr.)</th>
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### Levels of Various Buildings & Junction Houses of Flux Crushing & Screening Facility (FCSF)

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<th>Name of Building/Junction House</th>
<th>Ground Level (Mtr.)</th>
<th>No. of Floors</th>
<th>Floor Levels (Mtr.)</th>
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02 WATER SYSTEM

2.1 Scope of work

The scope of work shall include design, engineering, fabrication, manufacturing, assembly & supply, erection/construction/laying, commissioning, testing & performance guarantee tests etc of plant & equipment and piping etc of complete water supply facilities including pump house buildings, civil & structural work & technological structures, electrics, instrumentation, automation, telecommunication, air-conditioning & ventilation, material handling & hoisting equipment etc as specified and required for complete water systems technological structures, pipe-support structures, etc as specified and required for the complete water system for proposed plant as specified in this chapter as well as various chapters of this contract specification in line with General Technical Specification (GTS) and subject to Employer’s approval, complete in all respect on turnkey basis.

The scope of work shall include the following activities.

i) Design, engineering, manufacture /fabrication, assembly, shop testing, painting, packing sequential delivery FOR site, unloading, unpacking, storage at site, preparation & submission of all drawings for civil, mechanical, structural, piping, construction & erection drawings, construction & erection as per approved drawings, site-testing, painting, commissioning and fulfillment of guarantee performance of all plant & equipment of water supply facilities for the proposed plant including drinking water system, industrial service/make-up water system and water based fire-fighting system, in accordance with the water system requirements of the proposed plant.

ii) Supply of pipeline supports, thrust blocks/ anchor blocks, R.C.C. pedestals etc. for over head / on-ground /underground pipelines.

iii) Supply of all technical literature, drawings & documents, general arrangement drawings, assembly & sub-assembly drawings of all the plant & equipment, construction & erection drawings, as-built drawings, operation & maintenance manuals, manufacturing drawings, etc.

iv) Submission of all drawings at (iii) above, design calculations, data sheets for various equipments, pipeline sizing calculation and for approval of Employer/Consultant and finalizing the same as per approval of Employer/Consultant. The approval of the same however does not absolve the contractor from his responsibilities.

v) Supply of commissioning spares & consumables; a list there of shall be submitted by the Contractor.

vi) Contractor shall submit an itemized price-list of two years operation and maintenance spares.

vii) Supply of special tools, tackles for construction, erection operation and repair & maintenance of the plant & equipment.

viii) Supply of special tools and tackles, spares as mentioned in GTS shall be in the scope of Contractor.
ix) All necessary connections for hook-up with Employer’s system at battery limits.

x) Supply of erection, testing & commissioning equipment and material.

xi) Piping network flushing fluids, chemicals & consumables.

xii) First fill of oils, lubricants, filter media, resins, chemicals reagents and other consumables.

xiii) Inspection and performance testing of individual equipment and system as a whole.

xiv) Participation in design conference with the Employer & Consultant as and when called for.

xv) Contractor shall provide two nos drainage pumps for each underground premises, one working, one standby, of suitable capacity and head to drain out the seepage water and rain water from the underground premises. The pumps shall be capable of handling slurry water. The exact numbers, capacity and type of pump shall be finalised during engineering stage.

The Contractor’s scope also covers extension of fire-fighting line, drinking water line and industrial water line from the battery limits to various consumer points of the proposed plant in line with the present Contract technical specification and GTS.

Water supply system/ sub-systems shall be complete in all respects and any equipment or material not specifically mentioned in this specification, but required for safe, efficient & smooth operation and guaranteed performance of the plant shall be deemed to be included under the scope of work of the Contractor. Diversion of existing overhead / underground water pipelines (including those identified during package execution) required for installation of the proposed units covered under this package is included in the scope of work of the Contractor. However, the price & other terms and conditions shall be mutually discussed and agreed during the execution of job by the Contractor.

2.2 Battery Limit

a) Industrial water

Industrial quality make-up water (quality as indicated in GTS, Maroda-I) will be made available to the Contractor at only one point within 100m from the proposed plant at a pressure of approx 1.5 to 2.0 kgf/ cm² (g). The top of the pipeline (carbon steel) shall be approximately 1.2 m below the area ground level. Tapping of industrial make-up water shall be based on two points feeding and shall conform to provisions of GTS. Contractor shall extend the same through isolation gate valves in valve-pit alongwith flow meter (complete with isolation valves and by-pass arrangement) to his proposed systems for service/make-up water requirement for the entire plant area.

Contractor shall indicate the make-up water quantity requirement, pipe size, end connection, MOC of pipeline, etc. at the battery limit.
2.3 Specification and Description of Work

Water System Facilities:

Water system shall in general include the following facilities:

a) Cooling water system,
b) Make-up water system,
c) Water conditioning system,
d) Water supply system for air conditioning & ventilation system,
e) Drinking water system,
f) Service Water System,
g) Dewatering system for underground premises

a) Cooling Water System

1. For cooling of plant and equipment of the air-compressor unit there shall be a separate cooling water re-circulation system for each unit / sub-system with pumps, cooling towers and piping network. Contractor shall provide a separate pump house to house compatible group of pumps. Separate group of pumps and separate piping shall be provided for each sub-system to enable flexibility in operation.

2. The cooling water system shall be supplied in line with the GTS with regard to design norms (including no. of standby pumps, type of pumps, valves and piping design) and subject to Employer’s approval.

3. The cooling water circuits shall be provided with chemical conditioning system to control corrosion and scaling and prevent bio-fouling. To reduce blow-down higher cycle of concentration shall be targeted.

4. Pump houses shall be provided with air-washer based air-conditioning and ventilation system.
5. With a view to conserve and save upon fresh water requirement, the Contractor will plan to utilize/ reuse/ recycle the reject/blow-down from the cooling water systems in the plant with necessary treatment etc. as specified by the Employer.

b) Make- up Water System

1. Make-up water for various usage including cold sump of cooling water circuit for air-compressor, air-conditioning and ventilation systems etc. and for supply of industrial service water will be tapped from the existing industrial water network and will be conveyed to the various consumers through a pipe network, preferably over-ground.

2. Quality of industrial make-up water is furnished in the GTS. This water will be supplied as make-up water to proposed plant unit for process & cooling needs at only one point for the entire needs of the proposed plant unit at battery limit as specified. The Contractor shall provide necessary treatment facility, wherever required, to make the water suitable for cooling and other purposes.

3. The water loss in the various processes in evaporation, process/ system, minor leakages including service water requirement etc. shall be replenished by a separate common make-up water system to be provided by the Contractor.

4. The Contractor shall indicate make-up water requirement duly corroborated by back-up calculation.

5. Make up water system will include extension of pipelines from the battery limit with isolation gate valves in valve pit, along with pumps (if required), valves, valve pits, sumps etc., to the cooling water recirculation system, ACVS, service water requirement as well as process needs.

6. Online booster shall not be accepted. A makeup water sump with pumps and piping (pump house and sump are to be provided by the Contractor), if required, shall be provided.

c) Water Conditioning System

1. To prevent the circulation water system from corrosion and scale formation and to bring the make up water to the condition suitable for the cooling water requirement in the proposed plant there shall be a water conditioning facility as per system requirement and inline with the details given in GTS.

2. It shall consist of dosing tanks, pumps, valves, pipes, fitting, pipe supports and associated civil, structural, electrical, instrumentation, material handling, air-conditioning & ventilation etc. The scope of work for all these remains the same as specified for cooling water system.
3. These pumps may also be housed in the same pump-house for cooling water system or separately.

4. The Contractor shall furnish the details of chemical dosing proposed for the system.

5. The Contractor shall include in the scope of supply three months chemicals requirement for the chemical conditioning system.

d) Water Supply System for air-conditioning & ventilation

1. The entire piping network for water supply for air-conditioning and ventilation and other Systems/ Sub-systems is in the scope of the Contractor.

2. It shall consist of pumps, valves, pipes, fitting, pipe supports and associated civil, structural, electrical, instrumentation, material handling, air-conditioning & ventilation etc.

3. The details and specification of pumps, valves, pipes, fitting, pipe supports and associated civil, structural, electrical, instrumentation, material handling, air-conditioning & ventilation etc. as specified for cooling water system is applicable for this system also.

4. Makeup water for the system shall be provided by the Contractor from the make-up water network provided for the main plant. No separate connection at battery limit will be provided for this purpose.

5. Pumphouses shall be provided with air-washer based air-conditioning and ventilation system.

e) Drinking Water System

1. The drinking water shall be made available at one point near proposed plant within battery limit as specified. The Contractor shall extend the pipeline from battery limit with isolation gate valves in valve-pit upto various drinking water consumers.

2. The Contractor shall indicate drinking water requirement duly corroborated by back-up calculation.

3. If the pressure, as indicated in battery limit parameters, is felt inadequate for the area under the scope of the Contractor. Contractor shall provide separate sump and drinking water pumps along with piping and electrics etc. to meet the requirement. Online booster shall not be accepted.

4. The details and specification of pumps, valves, pipes, fitting, pipe supports and associated civil, structural, electrical, instrumentation, material handling, air-conditioning & ventilation etc. for cooling water system is applicable for this system also.
f) **Service Water System**

For Service Water, pipeline network shall start from common pump house to all the transfer points of each floor and conveyor gallery. In each floor, 1 no. tapping point will be provided and for the conveyor gallery the tapping point shall be provided at every 50 metre interval. For each tapping point 1 no. gate valve, hose and quick fix connection shall be provided.

For service water line each tapping point discharge rate will be 2m³/hr. and maximum 6 Nos. points can be operated at a time.

Service water system shall be supplied in line with the GTS with regard to design norms (including no. of standby pumps, type of pumps, valves and piping design) and subject to Employer’s approval.

g) **Dewatering system for underground premises**

Dewatering system for underground sumps shall be provided for underground portion of the proposed plant. The water from the sumps will be pumped to the nearest surface drainage system through pumping arrangement to be provided as per GTS and subject to Employer’s approval.

**The details of Sump Pumps are given below;**

1. Junction House JH-4 - 2 Nos. (1W+1S)
2. Flux Crushing Building - 2 Nos.(1W+1S)

All Sump Pumps shall have Cap. – 50 CBM /Hr. & Head - 15 Mtr.

**The cooling water systems will generally comprise the following main units:**

a) **Open Indirect Industrial Water Cycle:**
   - Cooling tower,
   - Pumpsets,
   - Strainers,
   - Interconnecting piping,
   - Chemical conditioning System,
   - Electrics, instrumentation & control system.

b) **Miscellaneous and Common Facilities:**
   - Make-up water system,
   - Drinking Water System.
2.4 Design Criteria

Efficiency, reliability and flexibility of operation and maintenance will be the guiding criteria of the design of the water system for the proposed plant. Following design criteria in addition to GTS provisions shall be followed:

1. Water System will be designed as per the provisions of GTS in respect of various design aspects including type of pumps, no. of standby pumps, piping, pipe specification, type of valves, cooling tower, side-stream filtration, handling & hoisting facilities, air-conditioning and ventilation facilities etc.

2. Each circulation system shall be connected with two nos. of delivery headers from the pumphouse and two nos hot return water headers from the consumers to the cooling tower/ pumphouse / treatment unit. The water carrying capacity of each header shall be such that incase one of the headers is under maintenance the other header should be in a position to carry the required quantity of water to the consumers, i.e., 100% of designed flow so that normal production of unit is not affected with only one delivery / return header in operation. There shall be proper isolating facilities in these headers so that supply of water in any circuit or to any area of the Complex is not affected due to leakage in one of header line.

3. All sumps shall be compartmentalised as per GTS and each pump shall have independent suction.

4. Each pump shall have independent suction. Each pump shall be provided with a gate valve on the suction side and a non-return valve and gate valve on delivery side. The delivery line of each pump shall be connected to the main header with isolating header gate valves for isolating pumps’ delivery valves. Motorised gate valves shall be provided in automated pumping system for pumps’ suction & delivery.

5. Suitable number of header valves shall be provided such that delivery valve of a pump can be isolated for maintenance without affecting other stand-by pump’s availability.

6. All the valves of diameter 450 mm and above and the valves requiring remote control operation shall be electrically / pneumatically operated. Electrically operated valves shall be provided with limit switches as a safety measure. Electrically operated valves shall have provision for manual operation also. All manual valves of sizes DN 350 and above shall be gear operated. Frequently operated delivery valves and header valves below diameter 450 mm shall also be electrically operated.

7. Total no. of pumps in a pumping circuit shall be as per GTS. Pump type shall be as per the provisions of the GTS. Pump rpm shall be governed by the kW rating in line with the provisions of the GTS.

8. Drainage pumps (split casing, self priming and horizontal centrifugal pumps) will be one reserve pump for one working pump. The pumps shall not be of mono-block design.
9. All gate valves shall be cast steel with SS internals, NRVs shall have SS internals, rest of the design features shall be as per GTS.

10. Following MOC to be considered for valves:

   a) **Gate valve:**
      - Body & Cover: CS ASTM A216 Gr WCB, Disc: ASTM A216 Gr WCB

   b) **Butterfly valve:**
      - Body: ASTM A216 Gr WCB, Disc: CF8, Seat: EPDM (integral with the body), Shaft: AISI 410 self-lubricated PTFE lined bearings for both drive end and non-drive end, Hand lever / hand wheel: pressed/forged steel, End connection: Flanged to IS6392, T-17.

11. Pipe materials shall be as per CRLA,RSP,SAIL.

12. Sluice gates will have SS internals.

13. Butterfly valves usage shall be accepted for non-critical applications for flow modulation purpose at the express approval of the Employer.

14. Contractor will consider provision of strainers in each header as follows:
   - open industrial water circuit: for 100% flow, simplex strainers, 1W+1S,

15. Material handling facility for the units of the Water System shall be as per GTS.

16. Pump houses shall be provided with air-washer based air-conditioning and ventilation system.

17. Design criteria of the cooling tower shall be as per GTS.

18. Special maintenance tools and spares as mentioned in cl. no. 01.05 in ‘Design Criteria for Cooling Towers’, list of spares & tools & tackles as listed in cl. no. 8.18, list of tools and tackles as listed in cl. no. 8.18.02 of GTS for Water System shall be supplied by the Contractor.

19. Tapping of industrial make up water, drinking water & fire-fighting water shall be based on two points feeding as explained elsewhere in this chapter and shall conform to provisions of GTS.

20. Pipe thicknesses shall be as per GTS provisions.
21. As far as possible pipelines shall be laid above ground or in concrete trenches / tunnels. Wherever, it is not possible then only pipelines shall be laid underground.

2.5 Description of Cooling Water System

Open Industrial Water Cycle

Open industrial water circuits with filtered industrial water as the cooling medium shall be provided for indirect cooling of compressor unit.

Hot industrial cooling water after cooling compressor unit will reach the cooling towers under residual pressure for cooling. Cold water from the cooling tower basin will flow into the cold well of the pump house. From the cold well separate group of pumps shall pump water to the various consumers.

Make-up water shall be added in the cold well to make-up the losses in the system.

2.6 Erection, Testing and Commissioning

i. The erection of all plant and equipment shall be carried out according to the latest engineering practices and according to the drawings, specifications, Instructions etc. duly approved by the Employer/Consultant.

ii. The welding work should be carried out as per the approved WPS and PQR.

iii. The Contractor shall supply all required manpower, tools and related equipment, all hoisting equipment, all necessary scaffoldings, all necessary transporting equipment, consumables. Construction and erection materials, petrol, diesel oil, kerosene, solvents, sealing compound, tapes, brazing and soldering materials, welding and brazing gases, erection bolts, nuts and packing sheets/compounds, temporary supports, wooden blocks, spacers, templates, jute and cotton wastes, sand/emery paper etc. as required for the satisfactory completion of work.

iv. After erection, all equipment having moving part, subject to pressures or voltages shall be given trial operation. The trial operation shall consist of 72 hours of continuous operation. All modifications and rectifications required during the trial operation or required for proper operation shall be done at his own cost by the Contractor as accepted by the Employer/Consultant.

v. Rotating equipment shall be checked for proper direction of rotation and shaft alignment. Equipment subject to pressures shall be carefully examined for leakage. All equipment, such as pressure taps, temperature measurement connections, flow measurement devices etc. shall be provided by the Contractor.

vi. On completion of the work, the Contractor shall remove and dispose off all rubbish and other unsightly materials caused by his working to a distance of five kilometer from the proposed plant area or as directed by the Employer and thereby leaving the premises in good, clean, safe and operable condition.
vii. Before giving call for final inspection, all the documents shall be furnished to the Employer. The record of manufacturing details, inspection and tests carried out by the Contractor shall be made available to the final inspecting authority. However, approval and final inspection at the manufacturing works shall not relieve the Contractor of responsibility of replacing at his cost any defective part/material which may be detected by the employer during erection and commissioning or guarantee period.

viii. All materials required for fabrication, construction, testing and inspection shall be supplied by the Contractor. No material shall be free issue to the Contractor.

ix. No equipment or part item shall be dispatched without final inspection and issuance of inspection certificate.

x. All equipment, assemblies, sub-assemblies shall be shop tested as per relevant standards and the test certificates shall be submitted by the supplier.

xi. Erection, testing & commissioning of various equipments and piping etc shall be done also inline with details given in various chapters of GTS.

2.7 Painting
The Contractor shall follow the painting procedure as mentioned in GTS.

2.8 Drawings & documents

2.9 Drawings/documents to be furnished by the Contractor for approval

1. Process flow diagram indicating the water consumption figures complete with temperature, pressure and quality requirements.
2. Process & instrumentation diagrams for the water systems indicating location of all instruments alarms and interlocks functions using ISA symbols.
3. General arrangement and cross-sectional drawings, characteristics curves and technical details of all the equipments (pumps, diesel engine, cooling tower, sluice gates, fire hydrants, etc.), valves and piping including GA drawings showing plan, elevation and sectional views of the water system.
4. List of instruments comprising bill of materials and instrumentation data sheets.
5. Layout of piping system indicating pipe routing, location of supports, valves and other fittings as required.
6. General arrangement drawings of pump houses and sump / tank (including civil, structural and other facilities) showing dispositions of various equipment and piping.
7. Data sheets, characteristic curves and technical details of all the equipments, valves and piping.
8. List of safety interlocks.
9. Test procedures for preliminary and final acceptance tests.
11. All equipment and piping sizing calculations.
12. GA drawings and details of air conditioning & ventilation facilities.
13. Test certificates for the following:
14. Material test certificate for all major equipment and their components.
15. Hydraulic test of equipment, pipe fittings & valves.
16. Static and dynamic balancing of all rotary parts/ equipments
17. Any other drawing/ documents as required by the Employer.

3.0 Drawings / documents to be furnished by the Contractor for reference and record

1. The Contractor shall submit required sets of all the approved drawings, documents and manuals for Employer’s record and use. After erection of equipment, the Contractor shall submit one set of linen tracings/reproducible in required number of prints along with soft copies in CD (in AutoCAD format) of each “As built drawings”.
2. Operating and maintenance manual.
3. Spare parts recommendation and price list.
4. Instruction for erection, testing and commissioning.
5. Manufacturer’s test certificates.
6. Lubrication schedule and quantity and quality of lubricant for one year’s normal operation.
7. Various equipment assembly drawings and bill of material.
8. Welding procedure.
11. Characteristics curves of the pumps, motors and other equipments.
12. Operation and maintenance manuals for all equipments, valves and complete water system along with soft copies.
13. Test and calibration certificates.
15. Technical literature, catalogues and manufacturer’s drawings for all brought out equipment, valves and other items.
16. All inspection/ test report/ certificates.
17. Any other drawing/ documents as required by the Employer/Consultant.

3.1 Preferred Makes

The Contractor shall follow the list of proffered makes as per the following:

<table>
<thead>
<tr>
<th>SI No.</th>
<th>Item Description</th>
<th>Manufactures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Horizontal centrifugal Pumps</td>
<td>Kirloskar Brothers, KSB, Beacon Weir, Voltas, Mather &amp; Platt, Jyoti, WPIL (Worthington).</td>
</tr>
<tr>
<td>2.</td>
<td>Submersible pumps</td>
<td>KSB, SU Motors, Kirloskar Brothers.</td>
</tr>
<tr>
<td>3.</td>
<td>Dosing Pump</td>
<td>Shapo Tools, Asia LMI (Madras), Toshniwal, Milton Roy India.</td>
</tr>
</tbody>
</table>
## Enquiry Specification for Dust Suppression & Water Supply System

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Item Description</th>
<th>Manufactures</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>Sluice Gates</td>
<td>Jash, IVPL.</td>
</tr>
<tr>
<td>7.</td>
<td>Rubber expansion joints</td>
<td>BDK, CORI Engineers.</td>
</tr>
<tr>
<td>8.</td>
<td>Hoses</td>
<td>Senior Flexonics, Hydrocrimp</td>
</tr>
<tr>
<td>9.</td>
<td>Pipe a) MS/GI</td>
<td>SAIL, TATA, Jindal, MAN, SAW, Welspun, Prakash, PSL, MSL.</td>
</tr>
<tr>
<td></td>
<td>b) DI</td>
<td>Electro Steel Casting</td>
</tr>
<tr>
<td>10.</td>
<td>MS/GI Pipe Fittings</td>
<td>Tube bends, Stewards &amp; Lloyds, BST, Jindal.</td>
</tr>
<tr>
<td>12.</td>
<td>Fire hydrants</td>
<td>New Age Industries, Steelage Industries, ASCO, Strumech, Vijay Fire, Zenith</td>
</tr>
</tbody>
</table>

### Valves

1. **C.S. Gate /Globe Valve**

   A. *Non-IBR- for all Sizes and Ratings* :

   - M/s. BHEL, Tiruchirapalli.
   - M/s. K.S.B. Pumps Ltd, Kolkata.
   - M/s. Larsen & Toubro Ltd., (Audco), Chennai.
   - M/s. Leader Valves Ltd., Jalandhar.
   - M/s. Oswal Industries Ltd., Ahmedabad.

2. **Butterfly Valve**:  

   - M/s. Avcon Control Pvt. Ltd, Mumbai
   (For Actuator operated Valves)
   - M/s. Fisher Xomox Sanmar, Trichinapalli.
   - M/s. Inter Valves (Pvt.) Ltd., Pune.
   - M/s. Larsen & Toubro Ltd., (Audco), Chennai.
   - M/s. Tyco Valves, Baroda.
   - M/s. Virgo Engineers Ltd., Pune.

3. **Ball Valve**:

   - M/s. Fisher Xomox Sanmar., Trichinapalli.
   - M/s. Flowchem Ind., Ahmedabad.
   - M/s. Inter Valves, Pune.
4. **CI/Sluice Gate Valves**

**A. For all Sizes and Ratings:**

- M/s. Calsens Private Ltd., Kolkata.
- M/s. Hawa Engineers Ltd., Ahmedabad.
- M/s. Kirloskar Brothers, Nagpur.
- M/s. Leader Valves Ltd., Jalandhar.

**B. For Sizes upto NB 100 mm & PN 10 Rating:**

- M/s. Steam & Mining Industries, Kolkata.

(Vendors appearing under ‘A’ shall be eligible for ‘B’ also)

5. **Plug Valve:**

- M/s. Fisher Xomox Sanmar Ltd., Chennai.
- M/s. Larsen & Toubro Ltd., (Audco), Chennai.

6. **Cock Valve for Gas applications:**

- M/s. Larsen & Toubro Ltd., (Audco), Chennai.

7. **Check Valve/Non Return Valve:**

- M/s. Inter Valves (Pvt.) Ltd., Pune.
- M/s. K.S.B. Pumps Ltd., Kolkata.
- M/s. Larsen & Toubro Ltd., (Audco), Chennai.
- M/s. Oswal Industries Ltd., Ahmedabad.

8. **Fabricated Gate Valve:**

- M/s. Larsen & Toubro Ltd., (Audco), Chennai.
- M/s. Zimmermann & Janseen, Duren, Germany.

9. **Piston Valve:**

- M/s. Uni -Klinger Ltd., Pune.
10. **Knife Edge Gate Valve:**

- M/s. Energo Engg., Delhi.
- M/s. Orbinox India Pvt. Ltd., Coimbatore.

11. **Non-Ferrous Valve:**

- M/s. Leader Valves Ltd., Jalandhar.
- M/s. Zoloto Ind., Jalandhar.
03.00  **BRIEF SYSTEM DESCRIPTION**

03.01  **DESCRIPTION OF EXISTING COAL HANDLING PLANT**

03.01.01  Coal Preparation Plant No.1

i)  Rotary wagon tippler unloads incoming coal from WT#1 and 2 each having capacity of 800 tph and receives in two conveyor stream Y9-68 & Y9-69. Both the wagon tipplers are provided with electric pusher car on the inhaul side. The empty wagons are released over a gradient.

ii)  Coal from both the streams is fed, through a series of belt conveyors to the CPP-1 coal yard. One stream has toothed roller crusher while other stream has no crusher. Each of the streams has a capacity of 800 tph.

iii)  CPP-1 storage yard No. 1 has a storage capacity of 180,000 t.

iv)  Out of the three Nos. of gantry cranes in coal storage yard No.1 (i.e. CPP-1) only two nos. are existing at present which are planned to be phased out in future.

v)  Reclaimed coal from the storage yard is fed to storage cum blending bunker (15nos) in two rows via. Conveyor series of Y5-Y6. Coal is withdrawn from silos and conveyed to coal tower No. 1, 2 and 4 via junction house J3, J4, J5 and J6. (Presently battery no 5&6 are under rebuilding. After replacement of coal gallery Y6-38, CHP will feed coal to CT-3 also).

vi)  CHP has 4 nos. of hammer crusher of capacity 250 tph and two nos. of 200 tph.

03.01.02  Coal preparation Plant No.2

i)  Incoming coal is unloaded by rotary wagon tippler No. WT# 3 on conveyor no. Y9-87, Y9-88, Y9-90, Y9-91(and finally stacked through stacker-cum-reclaimer I & II through yard conveyors Y9-94 & 95). Wagon tippler is provided with Electric Pusher Car on the inhaul side. The empty wagons are released over a gradient. Under rail hoppers are provided for manual unloading of coal from sick wagon.

ii)  Coal from the conveyor stream like Y9-87, Y9-88, Y9-90, Y9-91 etc. are fed to the series of belt conveyor by passing the preliminary crusher to the coal storage yard No.2 (CPP-2). The single line conveyor capacity is 800 tph upto the storage yard.

iii)  Coal storage yard No.2 (CPP-2 existing) have storage capacity of 120,000 t.

iv)  Provision of direct despatch of coal to the storage cum blending bunkers by passing the storage yard has been kept. The conveyor stream...
capacity from the storage yard to the top of the storage cum blending bunkers is 800 tph.

v) Coal is withdrawn from 14 nos silos in two rows - 7 nos in each row according to predetermined blend ratio in two streams and fed to the final crushing station No.2.

vi) Four reversible hammer crushers of 300T/h have been provided for final crushing in crushing station No.2.

vii) From final crushing station No.2, crushed coal blend is dispatched to junction No. 3F and finally to coal towers No. 5 and 6 and coal tower no 4 in case of constraint in coal supply of CHP.

viii) Also new conveyors Y9-99A and Y9-99B have been commissioned in the year 2002 to have the provision for taking coal from CPP-2 coal yard to conveyor Y9-80 and Y9-81, so that coal can be fed to silos of batteries 1 to 8.

ix) Blending is done through 14 nos of Belt weigh feeders/ Automatic Proportioning Device (APDs).

03.02 DESCRIPTION OF PROPOSED COAL HANDLING PLANT FOR COAL TOWER NO.- 7 OF COB#11 COMPLEX

1. General

In order to meet the enhanced required of coal for coke making, following additions, augmentation & modification to the existing coal handling plant is proposed:

- Addition of 5 nos. of RCC mixing bins (Silos), each of 500t storage in 3rd row of silos parallel to existing two rows of silos.

- Installation of 2 nos. additional reversible hammer mills (designated as hammer mill 7&8), each of capacity 300t/h in existing row of hammer mills after extending the existing final crushing station suitably.

- Replacement of existing hammer mills no. 5 & 6 by new hammer mills of 300 t/h capacity each, along with 630 KW slip ring reversible electric motors. Room for resistance banks & control panels for hammer mill no. 5, 6, 7 & 8 shall be provided in the new portion of the final crushing station.

- Upgrading & modification of existing collecting conveyors Y7-12 & Y7-13 to 1000 t/hr. rated capacity in the existing location with minimum shutdown.

- Connecting conveyor stream, connecting new coal tower no.-7 with existing coal handling plant.
- Connecting conveyor for new silos & new crushers to the existing Coal Handling Plant.

- 4 nos. split gates for coal handling plant on conveyors Y7-36, Y11-130, Y7-13 and Y11-134.

Flow diagram drawing no. MEC/S/9101/11/17/55/01/064.12/R0 (Sheet 1 of 2 & Sheet 2 of 2) and layout drawing no. MEC/S/9101/11/17/55/01/064.13/R0 showing the tentative location of proposed unit are enclosed for reference.

New conveyor Y11-125 will take feed from existing conveyor Y7-49 in the existing junction house 2C and feed conveyor Y11-126 with a traveling tripper to feed the individual silos (5 nos. new). Each silo will be of 500 tonne effective storage capacity. The vertical portion at a height of 1m and conical portion (slope 60°) shall be lined with 409M 8mm thick SS liner plate.

Each silo will be provided with identical Belt Weigh Feeder with PLC being provided in existing SILOS.

Silos shall be provided with pneumatic blow down facility. Bunker discharge mouth level shall be +10.2m and shall have floor at +6.2m level for laying conveyor Y11-127.

Belt weigh feeders will feed the coal to proposed conveyor Y11-127 and through conveyor Y11-128, the coal will be fed to existing conveyor Y7-35, which also carries coal from existing 2nd row of similar bunkers. The rated capacity of conveyor Y7-35 shall be 600t/hr. Conveyor Y7-35 will feed to modified conveyor Y7-36. The modification & strengthening of these conveyors are in the scope of contractor. Apart from replacing existing one way chute with split gate, conveyor Y7-36 shall be modified for accommodating split gate and upgraded to 600 tph.

Modified conveyor Y7-36 will feed the coal to existing conveyor Y7-51 & new conveyor Y11-129 through a bifurcated chute & split gate. Coal from conveyor Y11-129 will be fed to the new hammer mill nos. 7 & 8 through conveyors Y11-130 & bifurcated chute with split gate.

The existing final crushing building shall be extended suitably to accommodate new hammer mills (No. 7 & 8) and related items & electrics. The building shall be of RCC upto top floor with structural roofing. Each hammer mill shall have independent foundation.

In order to collect crushed product from the new hammer mills, the existing conveyor Y7-12 will be extended at the tail end adequately & its capacity shall be upgraded to 1000 t/h rated capacity. The existing conveyor Y7-13 will also be upgraded to 1000 t/h rated capacity and will be provided with a bifurcated chute with split gate to enable feeding of
existing conveyors Y14 & Y18. These two conveyors shall have stand-by drives. The upgraded conveyor shall be provided with new drive (1W+1S), belt, 35 degree carrying and 10 degree return idlers. The drives of upgraded conveyor Y7-12 and Y7-13 shall be of 1 step higher rating. The belting shall be 1400mm wide and N/N grade of 1250 kN/m rating minimum.

The proposed stream connecting the new Coal Tower No - 7, comprises of new belt conveyor nos. Y11-131, Y11-132, Y11-133, Y11-134 & reversible shuttle conveyors Y11-135 & Y11-136. The existing chute feeding to the existing Conveyor No. Y-15 will be replaced by a bifurcated chute fitted with a 2 position motorised diverter gate to feed the new conveyor no. Y11-131. The coal will be conveyed to the new coal tower no.-7 via new conveyors Y11-131, Y11-132 & Y11-133 through new junction house no. 11A & 11B. The stream rated capacity shall be 600t/h.

Reversible shuttle conveyors Y11-135 & 136 shall be provided at the top of the coal tower no.-7. These shuttle conveyors shall be fed by conveyor Y11-134 through a split diverter gate. Each of the shuttle conveyors will be of 400 t/h capacity and shall be mounted on parallel tracks and can be placed on different compartments of the coal tower to uniformly distribute the coal charge in the coal tower. For this purpose suitable nos. of limit switches shall be provided.

Additionally, the coal tower shall be provided with 18 nos. of level monitors for giving continuous measurement of level of coal in the coal tower.

A belt weigh scale shall be provided on the new conveyor no. Y11-132 to indicate the flow rate & total quantity of coal fed to the coal tower.

The new equipment & conveyors shall be interlocked & controlled with the existing coal handling plant from the existing control room.

The existing system of LSTB shall be extended to all the new units up to the top of new Coal Tower no.-7 for communication.

Facilities for dust suppression, fire fighting facilities and proper illumination of galleries and junction house is included in the scope of work.

The conveyor drives of 30 KW and above shall be provided with fluid coupling. All coupling bolts shall be replaceable without shifting of drive components. Chutes shall be lined with 8mm thick 409M SS liners. Each discharge legs of the chutes shall be provided with chute jam indicators.

Flap/ Diverter gates shall be lined with 8mm thick SS 409M liner plates.
Each junction house shall be provided with Electric hoist. The Capacities of EOT Cranes / Electric Hoists for maintenance shall be at least 1.2 times the heaviest load – or – the Capacity & approximate height of some Junction houses are indicated as below:

<table>
<thead>
<tr>
<th>Location</th>
<th>Capacity (t)</th>
<th>Lift (m)</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silo top</td>
<td>3</td>
<td>37</td>
<td>1</td>
</tr>
<tr>
<td>Junction House 11E</td>
<td>2</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Final crushing station</td>
<td>10</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>New Junction House 11A</td>
<td>2</td>
<td>30</td>
<td>1</td>
</tr>
<tr>
<td>New Junction House 11B</td>
<td>3</td>
<td>45</td>
<td>1</td>
</tr>
<tr>
<td>Top of coal tower no.7</td>
<td>3</td>
<td>50</td>
<td>1</td>
</tr>
</tbody>
</table>

03.03 DESCRIPTION OF PROPOSED COKE SORTING PLANT FOR COB#11

03.03.01 Design Limits

Following design limits are to be considered for the proposed Coke Sorting Plant (CSP-4)

a) From & including surge hopper in the junction house no.1. Junction house no.1 is included in the scope of the contractor.
b) Upto & including junction house no. Z17 and upto & including discharge chutes of conveyors K11-21 & K11-22.
c) Including upgradation of existing conveyor no. KD-1, modification of gallery of KD-1 is included in the scope of the Contractor.
d) For coke breeze from the proposed conveyor KA-3 to the coke breeze bunkers & C3A-C2 with two way Diverter gate at Junction house JH-C3A. Nut coke from CSP coke breeze bunkers shall be disposed off by wagons and conveyor C3A-C2, for any exigency 100% disposal facilities by wagon will be provided.
e) The discharge chute with pneumatically operated sector gate for coke car track from surge hopper in JH – 1 is in the scope of contractor.
f) 3 nos. bin vibrators shall be considered for each bunker; hence, total no. of vibrators for coke sorting plant shall be 6.

03.03.02 Brief Description

A coke sorting plant of 300t/h capacity has been envisaged for the plant. The coke sorting plant will sort out the coke into three fractions i.e. 30-60 mm, 60-80mm & (-) 30mm. The coke will pass through a series of screens and coke cutters for this purpose. Flow diagram, layout, sections etc. are shown in drgs. MEC/S/9101/11/17/55/01/064.01 to 064.08.

The (-) 30mm fraction will be sent and stored in the 150t capacity RCC bunkers, after screening at 15mm. The other coke fractions will be sent through conveyors to Blast furnace stock house. In addition to the above, an open mechanized emergency coke storage yard of about 2500t capacity will be provided. Required conveyor streams, traveling
trippers will be provided for storage of coke. Coke will be reclaimed by an underground reclaiming conveyor as shown in the drawings.

Additionally a 1400mm wide 200 t/h conveyor streams shall be provided to carry BF coke from existing CSP-1 and feed to two numbers of 100t capacity RCC surge hoppers provided over conveyors K11-13 & K11-14. Each surge hopper shall be provided with level meters & belt weigh feeders to properly proportion the coke coming from CSP-1 & the new CDCP plant.

To take tapping from existing conveyor KD-1 a fixed tripper with a bifurcated gate shall be provided. One leg of the chute will feed coke to the new conveyor KA-1 of 1400mm wide & the other leg will feed the conveyor KD-1. A split gate shall be provided to enable feeding of coke to both the conveyors simultaneously. The walkway of conveyor KD-1 shall be suitably modified in the vicinity of the fixed tripper to facilitate movement of plant personnel.

All the buildings, junction houses, conveyor galleries will have adequate facilities like ventilation, illumination, hoisting and handling equipment, dust suppression facilities, etc. wherever necessary. All buildings shall be provided with LSTB system for communication.

Further, a dust extraction system shall be provided in the proposed Coke Dedusting Unit (CDU). A brief description of the same is given below:

03.03.03 **Dust Extraction System with Air Blasting Unit**

03.03.03.01 Brief Description

A dust extraction system with an air-blasting unit is to be provided in the coke-dedusting unit (CDU).

The system shall comprise dust extraction unit and air blasting unit. The dust extraction unit shall comprise suction hoods on the coke dedusting chute, ducting network, electrically operated dampers, bag filter unit, centrifugal fans, stack, electrics & control.

Bag filter unit shall consist of distribution chamber, filtering chamber with filter bags & fitting for the bags, outlet chamber, dust collection hopper with rotary air lock valves & screw conveyor, dust storage cum disposal hopper with rack & pinion gate and disposal chute, structural stair case and platform, timers etc. and one multiclone and one spark arrestor in the ducting network at the inlet side of distribution chamber of bag filter unit. (these two equipment are required to collect the hot/ glowing coke particles thereby preventing them to enter into bag filter). Two suction ducts of the ducting network shall be provided with electrically operated dampers & flanges for connecting them with the coke dedusting unit (CDU) chambers (2 nos.) separately.
The air blasting unit shall consist of air intake louver, transition piece, centrifugal blasting fan, main duct and two numbers of branch ducts with electrically operated dampers & flanges.

03.03.02 **Arrangements and the Components:**

The air intake louver of air blasting unit shall be installed in the opening of wall exposed to ambient. This shall be connected to suction side of blasting fan through transition piece. The delivery side of this fan shall be connected to ducting network. The branch ducts (2 nos.) shall be connected to both the coke deducting unit (CDU) chambers through the flanges separately. There shall be two air stream/ paths, one working & one standby, from air blasting unit to dust extraction unit, through CDU chamber. The material flow in the CDU chambers conceptually shall be perpendicular to the airflow of air stream from blasting unit to dust extraction unit. Electrically operated dampers provided in the air stream at the both sides of CDU chamber shall be interlocked with the operation of CDU chambers; this is required to isolate the stand by CDU from air stream and to take the working CDU into air stream of our above system.

03.03.03 **Functional Description**

While running the CDU, air blasting unit fan shall suck ambient air though air intake louver & transition piece and blast/ supply the air into the CDU through the ducting network.

The working of the dust extraction unit shall suck the air dust laden air including blasting air shall be sucked from CDU and hot/unburnt glowing coke particles shall be collected in multiclone and spark arrestor placed in the ducting network at the suction side of bag filter. The dust disposal from bag filter, multiclone & spark arrester shall be through discharge into a central pneumatic system (through dust storage hopper). However, central pneumatic system shall not be in the scope of Contractor.

03.03.04 **Major Facilities**

03.03.04.01 **The major scope of work of Coke Sorting Plant** comprising of Coke crushing station, coke screening station, coke breeze bunkers, emergency coke storage yard, coke deducting units, junction houses, traveling tripper bridge, galleries and associated mechanical, civil, structural, electrical works of COBP # 11 is given below: -

- 2 nos. grizzly screens (80mm), capacity 300 t/h.
- Grizzly shall be of Manganese steel casting DISC and the underpass chute liners should be cast Basalt 110mm thick
- 2 nos. coke cutters (+80mm) capacity 180 tph.
- 2 nos. vibrating screens, (30 mm) capacity 300 t/h. Screen wires should be 5 mm dia SS.
- 2 nos. grizzly screens (60 mm), capacity 200 t/h. Grizzley specifications and chute liners shall be same as mentioned above.
- Conveyor stream capacity 300/150 t/h.
- 2 nos. variable speed belt weigh feeders 20t/h to 100 t/h.
- Chain samplers – 2 nos., one each for different BF coke fractions.
- Belt conveyors as per conveyor data sheets.
- Belt weighers shall be provided on Coke Conveyors K11-11, K11-12, K11-15, K11-16 & conveyor K11-18.
- Capacity upgradation of existing conveyor KD-1 to 400tph from 300tph.
- Capacity of conveyor staying from conveyor KD-1 to the CSP-4 shall be 300t/h.
- All chutes should be box design to avoid direct fall of Coke on Chute liners.
- Only Cast Basalt/ Ceramic liners of 110 mm thk are to be used in Coke Transfer Chutes.
- DE system shall be provided for dust extraction at all transfer points.
- Control room & maintenance room shall be provided in coke screening station.
- Automation & control facilities shall be interfaced with coke oven battery operation.
- The extension of existing conveyor stream comprising conveyors KA-2/KA-3 to the new breeze bunkers of CSP-4 for onward conveyance to SP-3.
- Wagon loading shall be provided for BF coke in the coke screening station of CSP-4.
- Shift in-charge & supervisor room shall be air condition.
- Maintenance post with Air Conditioned Supervisors room along with shift in changes room and toilet block is to be provided in the Coke Screening Station.
- Handling & Hoisting facilities: All Junction houses shall be equipped with suitable handling & hoisting facilities. Junction houses below 6m height shall have suitable capacity (2t min.) manual hoist and more than 6m
height shall have electric hoists. Under slung & EOT cranes as required in CS and other handling facilities as specified in system description shall be provided.

- 1 no. mobile belt coiler / decoiler type belt changing device and 2 nos. hot vulcanizing unit suitable for 1600 mm belt width. Contractor shall also to provide guide rollers at required locations for coiling / de-coiling of belt near each junction house / take up unit.

**03.03.05 Other Features**

In addition to the above, following is to be provided in this package by the Contractor.

1. The capacity of the belt weighers shall be 1.2 times the rated capacity of the respective conveyors.

2. The two way diverter gates shall be of robust design and of wear resistant material for longer life.

3. Flap/ Diverter gate drives shall be of adequate rating to take care of dirty conditions of the chute's interior.

4. Flap/ Diverter/ split gate, surge hoppers etc shall be lined with 10 mm thick ‘Hardox 500’ material with CSK bolting.

5. RCC bunkers/ under-ground hoppers shall be lined with 8mm thick SS-409M Stainless Steel.

6. Scraper/ breeze chutes should have a minimum inclination of 70 degree and should be made up 409M SS.

7. In case of bifurcated chutes, where steep angle scraper chute is not possible, the scraper shall be provided in the main chute with proper design to ensure easy accessibility for removal of scraper for maintenance purpose.

8. Suitable windows shall be provided in chutes & scraper chutes to enable proper cleaning of the chute’s interior.

9. The yard surface slope shall be such that drainage is outward.

10. Side sheeting & roofing shall be of suitable material and shall be properly fixed to ensure longer life in corrosive atmosphere.

11. Fiber glass roofing & sheeting shall be provided at suitable intervals for proper illumination in the galleries.

12. Each underground hopper in the stockyard shall be provided with manually operated sector gates.
13. Yard reclaim conveyor K11-10D shall be 1600mm wide with 35° troughing angle and without skirt board.

14. Discharge chutes shall be lined with 110mm thk. liners/ cast basalt liners.

15. Anti-corrosion painting shall be provided on all structures.

16. Silos shall be lined with 8mm thick SS-409M with SS steel coping at 1m high in vertical & complete in slope portion.

17. DE system shall be provided for dust extraction at all transfer points.

18. Grizzly screens discs shall be of high manganese cast steel.

19. All types of gear boxes shall be supplied with input shaft with matching gear wheel assly.

20. Control room & maintenance room shall be provided in coke screening station.

21. Automation & control facilities shall be interfaced with coke oven battery operation.

22. The control room shall be provided with package type AC.

23. Existing conveyor KD-1 shall be renovated with following features.

i) Capacity : 400t/h

ii) Belt width : 1400m

iii) Troughing Angle : 35°

iv) To be provided with fixed tripper

v) Drive to be changed accordingly.

i) For disposal of coke breeze from CSP-1, the existing conveyor stream comprising conveyors KA-2/KA-3 shall be extended to the new breeze bunkers of CSP-4 for onward conveyance to SP-3. Nut coke from CSP coke breeze bunkers shall be disposed off by wagons and conveyor C3A-C2. For any exigency 100% disposal facility by wagon will be provided.

ii) Nut coke from CSP-1 shall disposed off by wagons as per present practice.

iii) Nut coke from CSP-4 bunkers shall also be disposed off by wagons/ road. Facility for the same shall be provided.
24. Wagon loading shall be provided for BF coke in the coke screening station of CSP-4.

25. Maintenance post with Air Conditioned Supervisors room along with shift in changes room and toilet block is to be provided in the Coke Screening Station.

Conveyor belt width, troughing angle and belt width will be properly selected to prevent coke spillage. Conveyor galleries, buildings will follow IPSS norms and will be provided with adequate maintenance facilities and space.

Coke crushing station, coke screening station, coke bunkers and junction house no. 1 & coke dedusting unit shall be of civil construction upto the top floor, above which it shall be of steel structure.

Other Junction Houses & travelling Tripper Bridge shall be of steel structure with RCC flooring.

Electric hoists/ manual hoist of suitable capacity & lift shall be provided in each junction house & buildings to cater to the maintenance needs. Electric hoists shall be provided wherever height of lift is more than 6 meters.
03.04 **Brief System Description of Augmentation in Flux - Fuel Preparation and Plant return fines handling for SP III**

The turnkey package of this CS also comprises of the following sub-systems:

- **Up gradation / Addition of coke crushing and screening and grinding facilities**
- **Up gradation/ addition of Flux crushing & screening facilities in an integrated manner.**
- **Transportation of Fines from Blast Furnace nos.1 to 7 & BF # 8 to Existing Junction house JH-127**
- **Transportation of Coke Breeze from CSP#4 to Conveyor C102 in an integrated manner.**

Brief descriptions of the various sub-systems are given below and are also reflected in the drawings enclosed. However the Contractor shall consider the contract drawings only as indicative and any changes for completeness and improvement shall be finalized during submission of basic engineering document for approval by the Contractor.

03.04.01 **RECEIPT OF RAW MATERIAL**

Presently iron ore fines and fluxes are being conveyed to SP-III from existing Ore Handling Plant (OHP) through two series of belt conveyors and coke from existing Coke Sorting Plant (CSP) by dump-cars unloaded in an underground hopper & through a series of belt conveyors. All the three conveyors pass through JH-111A. This system is adequate to feed both strands (existing & proposed) of Sinter Plant-III.

Sieve analysis of raw material input to fuel & flux crushing & Screening circuit
1. Lime Stone (received from Koteswar)

<table>
<thead>
<tr>
<th>Max</th>
<th>Min</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 75 mm</td>
<td>-</td>
<td>2.0%</td>
</tr>
<tr>
<td>- 75 mm</td>
<td>to + 60 mm</td>
<td>15.0%</td>
</tr>
<tr>
<td>- 60 mm</td>
<td>to + 50 mm</td>
<td>16.6%</td>
</tr>
<tr>
<td>- 50 mm</td>
<td>to + 30 mm</td>
<td>40.2%</td>
</tr>
<tr>
<td>- 30 mm</td>
<td>to + 25 mm</td>
<td>9.2%</td>
</tr>
<tr>
<td>- 25 mm</td>
<td>-</td>
<td>17.0%</td>
</tr>
</tbody>
</table>

Moisture - 15%

2. Raw Dolomite

<table>
<thead>
<tr>
<th>Max</th>
<th>Min</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 60 mm</td>
<td>-</td>
<td>1.3%</td>
</tr>
<tr>
<td>- 60 mm</td>
<td>to + 50 mm</td>
<td>7.3%</td>
</tr>
<tr>
<td>- 50 mm</td>
<td>to + 20 mm</td>
<td>44.9%</td>
</tr>
<tr>
<td>- 20 mm</td>
<td>to + 10 mm</td>
<td>16.7%</td>
</tr>
<tr>
<td>- 10 mm</td>
<td>to + 6 mm</td>
<td>14.3%</td>
</tr>
<tr>
<td>- 6 mm</td>
<td>-</td>
<td>15.5%</td>
</tr>
</tbody>
</table>

Moisture - 15%

3. Coke Breeze

<table>
<thead>
<tr>
<th>Max</th>
<th>Min</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 25 mm</td>
<td>-</td>
<td>4.3%</td>
</tr>
<tr>
<td>- 25 mm</td>
<td>to + 15 mm</td>
<td>12%</td>
</tr>
<tr>
<td>- 15 mm</td>
<td>to + 10 mm</td>
<td>11.5%</td>
</tr>
<tr>
<td>- 10 mm</td>
<td>to + 5 mm</td>
<td>15.3%</td>
</tr>
<tr>
<td>- 5 mm</td>
<td>to + 3 mm</td>
<td>16.5%</td>
</tr>
<tr>
<td>- 3 mm</td>
<td>-</td>
<td>40.4%</td>
</tr>
</tbody>
</table>

Moisture - 10% (normally), 15% (in rainy season)

Tentative size distributions of raw material (sizes as required in this CS) are shown in Table: 05.01 below. Further, the product/output of crushed fuel & flux shall be in accordance with the sizes is also given below:

<table>
<thead>
<tr>
<th>Sl no</th>
<th>Material</th>
<th>Size Distribution (mm)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Iron ore fines</td>
<td>-8 mm</td>
<td>+8mm (5% max.)</td>
</tr>
<tr>
<td>2</td>
<td>Lime stone/Dolomite (Crushed)</td>
<td>-5mm</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-3mm</td>
<td>95% (Minimum)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1mm</td>
<td>70% (Minimum)</td>
</tr>
<tr>
<td>3</td>
<td>Coke breeze (Crushed)</td>
<td>-5mm</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-3mm</td>
<td>90% or above</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1.0mm</td>
<td>Not to exceed 50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.5mm</td>
<td>Not to exceed 30%</td>
</tr>
<tr>
<td>4</td>
<td>Mill scale</td>
<td>-8 mm</td>
<td>+8mm (5% max.)</td>
</tr>
<tr>
<td></td>
<td>BF sinter return fines</td>
<td>- 8 mm</td>
<td>+8mm (5% max.)</td>
</tr>
<tr>
<td>---</td>
<td>------------------------</td>
<td>--------</td>
<td>----------------</td>
</tr>
<tr>
<td>6</td>
<td>Flue dust</td>
<td>- 1 mm</td>
<td>+1mm (5% max.)</td>
</tr>
</tbody>
</table>

03.04.02 ADDITIONS/ MODIFICATIONS AND UPGRADATION IN EXISTING RAW MATERIAL PREPARATION SYSTEM

03.04.02.01 EXISTING FUEL crushing and screening facility

There is a provision of covered storage for coke breeze received from blast furnace adjacent to coke crushing and screening building. The coke breeze is reclaimed by front end loaders and conveyed to coke crushing and screening building through series of conveyors C101, C102, C103, C104, C105 and finally C106. The coke breeze gets crushed by 2 roll crusher to -10 mm from -25mm size and subsequently screened by Mogensen sizer. +3mm output from the sizer is conveyed to coke grinding building by conveyor C111 and discharged onto reversible conveyor C112. Conveyor C112 discharges into 2 nos. surge bins from where belt feeders extracts material and feeds to rod mill (2 nos.) where it gets crushed to -3mm. (-)3 mm size from crushing and screening building is directly conveyed and discharged onto conveyor C114 through conveyors C110 and C113 , which in turn discharges to conveyor C115.

03.04.02.02 Existing FLUX crushing and screening facility

Limestone and dolomite required for the existing machine of Sinter Plant III is drawn from bunkers of flux proportioning building and conveyed by conveyor 105 to surge bin of existing flux crushing building. The material is discharged onto reversible shuttle conveyor L106 from where it is discharged onto bins. The material is withdrawn by vibratory feeder and fed to primary hammer mill (3 nos.) of 250tph capacity. From the hammer mills the crushed flux is conveyed by conveyors L109, L110 and L111 onto secondary hammer mills (3 nos.) These three conveyors carry crushed flux to flux screening building and discharge into surge bins (3 nos.). Material is withdrawn from each of the two openings by traveling
vibro feeder (6nos.) and fed to flux screens (6 nos.) for screening -3mm size fraction. The under size (-3 mm) from each of the six screens is fed to a common conveyor L120 which conveys the material onward to storage and proportioning bin building. The oversize (+3mm) is fed to a common conveyor L115 and recycled back to flux crushing building for further crushing.

03.04.02.03 PROPOSED Fuel and Flux Crushing and Screening Facility

In order to cater to increased requirement of fuel and flux for the new sinter machine, following three facilities have been envisaged under this package which shall form part of scope of this Contract:

- Up gradation / Addition of coke crushing and screening facilities.
- Up gradation / Addition of Coke Grinding facilities
- Up gradation/Addition of Flux crushing & screening facilities.

The existing facilities also need to be modified/ extended so as to integrate the existing with proposed facilities.

03.04.02.03.A UP gradation / Addition of coke crushing and screening and grinding facilities

A similar facility for coke breeze crushing, screening & grinding with related facilities shall be added adjacent to the existing one.

As described earlier that the coke breeze is being received from the existing track hopper via belt conveyors C101, C102, C103, C104 to the coke storage yard. It is now proposed that Coke breeze & BF return fines shall also be received by conveyor C-102 for further transportation to coke storage yard. Belt conveyor C-104 shall be suitably modified & extended and discharge onto new reversible conveyor RC 106. RC 106 shall be able to discharge either onto existing conveyor C106 or onto new conveyor C106A in a new Junction house CK-1. Converyor C-106A shall carry the material to feed over a hopper of capacity 200m3 (effective volume) with suitable gate at proposed New Coke crushing house CK-2. A reversible belt conveyor RC-CK2 will receive the material
from bunker and feed either to the two roll crusher or bypass the crusher and feed to conveyor C107A as shown in the flow diagram. The two roll crusher shall be of capacity 50 tph and shall receive -25mm (10-15% moisture) coke breeze, crush and discharge over conveyor C-107A. Conveyor C-107A shall further transfer Crushed/ bypassed uncrushed material to Junction house CK-3 and discharge over a Mogensen Sizer of capacity 50 tph for product size of (-3) mm. The oversize (+ 3 mm) from sizer shall be discharged onto conveyor C-111A which shall convey and discharge the material onto new conveyor C-112A in new coke grinding building. Conveyor C-112A shall discharge into either of two nos. surge bins of effective capacity ~100 m³ each from where material shall be withdrawn by Belt feeder and fed to rod mill. Sized material (-3mm) from rod mill shall be discharged onto existing conveyor C-114, which shall further convey the material to existing storage and proportioning bin building through existing conveyors C115, C115A and C115B.

It may be noted that input material of size -25mm and product material of size -3mm is the basic system requirement of the integrated fuel crushing and screening system. The facilities envisaged between input stage to output stage have been given in the CS. Crushing of coke at two roll crusher, screening at coke sizer and grinding at rod mill shall be decided by the contractor in an integrated manner to given the plant output of ~3mm.

03.04.02.03.B Up gradation/Addition of Flux crushing & screening facilities

An additional stream similar to the existing one consists of Primary & Secondary Hammer Mill with surge bin & vibro-feeders and related facilities shall be provided by extending flux crushing building. Further screens with surge bin & vibro feeders in screen building with feeding conveyor from crushing building to screen building shall be provided.

Limestone and dolomite required for the existing machine of Sinter Plant III is drawn from bunkers of flux proportioning building and conveyed by
the conveyor L105 to surge bin of existing flux crushing building. It is proposed to extend the existing conveyor L 105 by nearly 7.3 m to new proposed extension of flux crushing building.

The existing reversible shuttle conveyor L-106 shall be replaced by new one of larger length so that it can feed existing three crushing series surge bins as well as a new crushing series surge bin (200 m$^3$ effective volume each). New series having a Primary hammer Mill shall receive the material from respective surge bin through vibro-feeder and after crushing it will discharge onto a new conveyor L111A. Conveyor L111A shall further feed the crushed material to secondary Hammer Mill. After crushing in secondary crusher, the material shall be conveyed to new surge bin in the screen building (100m$^3$ Effective volume) with the help of a new belt conveyor L114A. The surge bin of this screen building shall have two discharge points so as to feed the new two nos. screens.

The undersized material (-3mm) shall be received by the existing conveyor L120. The tail end, horizontal gravity take up arrangement, electrics, control, etc. of belt conveyors L120 shall be suitably extended backward to receive the above material from Screens.

The over sized material (+3 mm) shall be recycled through existing conveyors L115, L116 & L117 to the Crushing building. The tail end, horizontal gravity take-up arrangement, electrics, control, etc. of belt conveyors L115 shall be suitably extended backward to receive the above material from Screens. Belt conveyor L117 shall further discharge the material onto the new reversible shuttle conveyor L118. The existing reversible shuttle conveyor L118 shall be replaced by new one of larger length so that it can feed existing three surge bins as well as a new surge bin (75m$^3$ EV). The surge bins will then discharge the material over the same (as referred above) new secondary Hammer Mill with the help of Vibro-Feeder. The material shall be further crushed and fed to the screens as described above.

**03.04.02.04 RE-ROUTING OF EXISTING SINTER FINES CONVEYORS (C-LINES).**

The existing series C-line conveyor is feeding BF return fines from existing Blast furnaces to the sinter return fines (IPRF) conveyor F101 of SP-III at JH-127. It is now proposed to dispatch these return fines straight to the same conveyor with strengthening & modification of gallery. The same shall be executed by dismantling & re-routing of the existing C-line conveyors so as to install new CDCP unit in place of C-line Belt conveyor no. C3, and hence the existing C3, C4, C5 & C6 belt conveyors require relocation.

Dismantling of the existing belt conveyors C3, C4, C5 & C6, related galleries & junction houses no.-3, 4, 5 & 6 is included in the scope of the contractor. Junction house - C2 shall be suitably modified to re-install the tail end of new conveyor-C3 from perpendicular direction as shown in General layout drg. No. MEC/S/9101/11/14/0/00/00/064.03/R0.

Belt Conveyor No. C3 shall be re-routed and re-installed (two conveyors C3A-C1 & C3-C1) along the existing gallery of JH124 & 123A/B adjacent to railway tracks so as to feed the fines at relocated junction house -C3. Belt Conveyor C3A-C1 shall receive BF return fines at JH-C2 and discharge onto conveyor C3-C1 as well as conveyor C3A-C2 shall receive coke breeze from CSP#4 and discharge onto conveyor C3-C2 at Junction house JH-C3A. These two belt conveyors i.e. C3-C1 & C3-C2 together carry the material through common gallery and discharge onto belt conveyor C4-C1 & C4-C2 respectively. Belt conveyor C5-C1 (Sinter/ore fines) and C5-C2 (Coke fines) shall receive the material from BF#8 Stock house and discharge over C6-C1 and C7-C1 respectively at JH-C5. Also Conveyor C4-C1 and C4-C2 shall discharge the material over
conveyor C5-C1 & C5-C2 respectively at JH-C4. Conveyor gallery C5-C1 & C5-C2 shall cross over the existing gallery of conveyors between JH-120 & Emergency Sinter Storage Building.

Belt conveyor C6-C1 shall carry the Iron bearing fines (BF return) and discharge over conveyor J127-C1 at JH-C6 and in turn to F101 existing Belt conveyor at JH-127. Junction house JH-127 shall be suitably modified so as to accommodate drive and discharge end of belt conveyor J127-C1. Existing drive and discharge of belt conveyor C6 shall be dismantled before installation of new conveyor J127-C1. Belt conveyor C7-C1 shall discharge the material over belt conveyor C102A at Junction house JH-C7 and in turn feed to existing belt conveyor C102 at pent house. As a storage capacity of 12 hrs has been envisaged in BF#8 return coke bunker in BF#8 itself, no separate storage/surge bin has been considered in C102A to C102 conveyor transfer points. Suitable gallery structure to place drive/discharge end of conveyor belt C102A, de-dusting system, skirt board & impact idlers on existing conveyor C-102 shall be provided to receive coke breeze. The pent house roof shall be locally dismantled to enable erection of transfer house and discharge onto conveyor C-102. However, after installation of new Junction house over pent house, the roof & structure of pent house may again be utilized to cover remaining part of pent house.

Two dedicated routes shall be provided to transport Iron bearing material (BF return fines) till existing belt conveyor F101 of SP-III and coke fines from coke sorting plant & BF#8 stock house till existing belt conveyor C102 of SP-III. A common gallery may be considered for all parallel conveyors.

Floors of Conveyor galleries of all return line conveyors from junction house C2 to new junction house J127 & pent house of C102 shall be of chequered plate construction (Minimum 8mm O/P) with semi circular hood over conveyor.
Rerouting of these conveyor series shall be so meticulously planned that minimum shut down is required in the existing plant. Design, supply, erection, commissioning and performance guarantee test of the Re-routed conveyors are under the scope of the Contractor. Existing equipments/ components of dismantled (by the Contractor) conveyor/gallery/ junction houses shall not be re-used.

All Proposed junction houses shall have Electric hoist. The capacity & lift may be followed as per CS. Junction houses (where these facilities are not considered) of below 6m height shall have suitable capacity ( 2t min.) manual hoist and more than 6m height shall have at least 5t cap electric hoists. Under slung & EOT cranes as specified in CS and other handling facilities as specified in system description shall be provided.
4.2.0 COMPRESSED AIR FACILITY

4.2.1 INSTRUCTION TO CONTRACTOR

Dedusting system of Coal Handling & Coke Sorting plant for COB #11 plant will require substantial quantity of compressed air. To meet the air requirement, a compressed air station along with interconnecting inter-shop and in-shop piping system upto the individual consumers will be provided in the Coal Handling & Coke Sorting plant area on turnkey basis.

4.2.2 The Contractor will furnish all the drawings, documents, data like fault diagnosis, operation and maintenance manuals, general details and layout drawings, design calculations and equipment specification of plant and equipment, together with `as built' drawings for all mechanical, electrical, civil, structural and instrument & control.

4.2.3 Meteorological data

The following meteorological data will be taken into account for design of plant and equipment. Site conditions will be assumed to be as follows.

**Temperature**

- Max: 48°C
- Min: 9°C

**Humidity**

- Maximum: 100%
- Minimum: 25%

Altitude above MSL: 307m

*Design ambient condition for the compressors will be taken as 45°C temperature and 60% RH. Design ambient temperature for Electrics will be considered as 50°C.*

4.2.4 Delivery Schedule

Delivery schedule will be matched with schedule of the overall package.

4.2.5 SCOPE OF WORK

The Scope of work will include design, engineering, manufacture, assembly, shop testing at manufacturer's works, painting, supply, transportation and delivery F.O.R. site of all the plant & equipment and connected utilities of compressed air facility, handling and storage at site, erection, testing, commissioning, demonstration of performance guarantee tests and final handing over of all plant and equipment with connected accessories along with the following facilities.

The compressors will be housed inside a building (compressed air station). The Air receivers will be installed outside but adjacent to the building. The building and equipment foundations including grouting and chipping works, structural works, etc. are also covered under the scope of this specification. The routing of inter-shop and in-shop compressed air piping system will be overhead.
The compressed air facility will comprise of following main equipment:

i) Three (3) sets (2 W + 1SB) of 36 Nm3/min (@ 8 kgf/cm2(g) discharge pressure after aftercooler) oil free, water cooled rotary screw packaged type air compressors with electric motor and all its accessories & auxiliaries including the following:
   a) Intercooler, aftercooler, moisture separator with trap station,
   b) Suction air filter cum silencer,
   c) Lube oil system.
   d) Cooling water system including duplex type filters in supply line.
   e) Acoustic enclosure along with exhaust fan and necessary illumination.
   f) Each Compressor will have dual type control system, which will permit operation of each compressor in either of the following way:
      (a) Continuous Variable Load /unload regulation
      (b) Automatic Start-Stop Regulation.

ii) 2 no. Refrigerant type of Air Dryer’s of Capacity 4 Nm3/min each will be provided.

iii) 1 no. of Air Receiver of 4 m3 capacity for instrument air and 1 no. Air Receiver of capacity 12 m3 for plant air at 8 kgf/cm2(g) operating pressure, complete with all fittings such as safety valves, drain connection with auto condensate trap and bypass valve, vent connections and all inlet and outlet connections with companion flanges, supporting arrangement, access platforms, instruments etc. The material of construction will be as per IS – 2002 – Gr. – 2A . The air receiver will be designed, manufactured and tested according to IS – 7938, 1976 (RA 1991).

iv) All necessary interconnecting pipes (from compressors outlet upto the consumer points), valves, fittings including supports and supporting structures.

v) Drain pipelines from compressed air station to nearest drain/drain pit.

vi) Miscellaneous structures, access platforms for operation and maintenance of equipment parts, valves, instruments, etc. forming part of the equipment.

vii) A complete new and unused set of all special tools & tackles required for operation and maintenance.

viii) Electrics and C&I .

ix) Contractor will furnish list of itemwise spares for 2 years O&M along with unit rate. The item rates will be valid upto 12 months from last consignment at site

x) All anchor bolts & nuts, washers, foundation bolts, shear lugs, counter flanges for inlet and outlet of each compressor, receivers and connected piping & base frame for equipment. Miscellaneous materials and services, if
not otherwise specifically mentioned will be included, but not limited to nuts, bolts, washers, gaskets, necessary connections for hook up with employer's pipe network and equipments.

xi) Special tools & tackles (along with list), Nil - as per Annexure-B.

xii) Supply of first fill of lube oil & consumables and also for testing, commissioning and performance guarantee.Specification of all consumables will be indicated.

xiii) Commissioning spares (All spares used until the plant is handed over to the employer), Nil, as per Annexure-B.

xiv) Training of O&M staff of Employer for 10 mandays.

**Electrics**

The Contractor will supply complete electrical equipment for compressors. All the technical specifications of the electrical equipment/system including LT switchgear, MCC, Metering and protection, cables, etc., will be as per GTS/TS.

The scope of supply for electrics will include the following:

i. Drive motors for compressors & lubrication system as well as for motor operated valves.

ii. Control Cabinet/ Console: one for each compressor.

iii. Double compression brass cable glands and cable lugs for all electrical equipment supplied by the Contractor.

iv. For compressor motor bearing and winding temperature detection, monitoring, interlocking, signaling & annunciation, micro processor based temperature controller will be provided for each motor by the Contractor. The scanner will be housed in an independent control panel.

v. Contactor will note that the HT Power for the Compressed Air Station will be fed from the near by HT sub-station SS-45 through 3 nos. 6.6kV feeders. Supply, laying & termination of the incoming cables from the HT substation to the compressed Air station along with terminations at both ends will be done by the Contactor. The cables will be routed through under ground trench. Further distribution of HT and LT power will be done by the contactor.

vi. All erection/installation accessories, cable trenches, cable support structures/cable gallery, cable termination at both ends, cable fixing, support materials etc. for all equipment within the scope of supply of Contractor within the plant area including cables from HT switch board at HTSS-45.

vii. Power and control cables from the control cabinets, for interlocking & inter connection to all motors, instruments, consumers etc.

viii. Junction boxes with required number of terminals including 20% spare terminals.
ix. All other equipment, accessories, field devices, safety switch etc required for safety interlocks, process control & interlocking etc.

x. The contractor will include all power and control cables in adequate quantities in turnkey/lot basis as per actual requirement at site.

xi. Contractor will include commissioning spares in their scope. They are also furnish the list of commissioning spares.

xii. Make of all the equipment will be restricted to the list of preferred makes given in the TS.

xiii. HT compressor motor will be provided with Flux compensated magnetic amplifier (FCMA) type soft starter enclosed herewith. The HT soft starter to be designed considering the incoming feeder line distance from the supply feeder end. Motor soft starter to be connected in line side of motor.

xiv. LT Power to the compressed air station will be fed from a dedicated MCC cum PDB which will have 2 incomers with bus-coupler arrangement.

xv. Local push button stations

xvi. UPS as per requirement will be provided.

xvii. LDBs / Junction Boxes, etc. (as per the requirement).

xviii. Earthing for all equipment within the scope of supply.

xix. Cable trestle, supporting structures, conduits, prefabricated GI cable trays, cable racks, other associated accessories like cable glands, lugs, termination/jointing kits, ferrules, clamps including trefoil clamps for single core cables, cable markers, cable identification tags, and all other hardware material as per requirement.

xx. Fire sealing materials for laying termination and sealing of cables.

xxi. Complete electrics of material handling equipment like cranes, lifts, hoists, etc (if any).

xxii. Complete electrics of ventilation systems for area under battery limit.

xxiii. Water drainage pumps in required numbers with complete electrics including source feeders, pumps/motors, cable laying, etc.

xxiv. Fire protection system including Fire Detection and Alarm System for the complete plant, etc.

xxv. Welding sockets, 240 V power sockets and 24 volts AC sockets with transformers.

xxvi. Illumination for the entire plant and boundaries.

xxvii. Installation, erection accessories.

xxviii. Safety items.
SPECIFICATIONS OF MOTOR SOFT STARTER

To avoid impact on electrical system due to heavy motor starting current, a soft start system limiting motor current to 2 to 2.5 times will be provided to ensure voltage drop at motor terminals limited to 15% with a provision of DOL starting. Contractor to submit the voltage drop calculation, considering adequate fault level at 6.6 kV board.

The soft start system will be based on principle of flux compensated non-saturated magnetic amplifiers for control of motor starting current. Also, the starter should not introduce any harmonics into the system.

The flux compensated magnetic amplifiers will work on principle of flux opposition and operate in the linear non saturable zone of magnetic circuit. The system will work on constant mode in the starting zone so as to result in smooth start.

The enclosure class will be IP52.

The Sheet steel thickness will be 1.6 mm.

The control circuit will utilize auxiliary contacts and timers for starting function.

Lamp indication will be provided using LED type lamps.

Ammeter will be provided on front door.

The cubicle will have cable entry and exit from bottom through gland plate.

Bypass device used will be 6.6kV contactor.

4.2.6  CONTROL & INSTRUMENTATION

General

Electronic type instruments generally working on 4-20 mA DC signal system will be used. The instrument panel will be suitably installed in the compressor room. All instrumentation items will be selected to function satisfactorily in shop floor environment.

List of measurements & controls

For each compressor, the list of measurements & controls will include, but not limited to, the following:

i) Equipment/ local panel mounted measurements

1. Indication of differential pressure across suction air filter for each compressor.

2. Indication of pressure of compressed air after after-cooler and after compressor.

3. Indication of temperature of compressed air after after-cooler and air compressor.
4. Indication of pressure of compressed air in air receiver.

5. Indication of pressure of lube oil before & after oil cooler.

6. Indication of temperature of lube oil before & after oil cooler.


8. Indication of temperature at the inlet & outlet of common header of compressor cooling water circuit.

9. Indication of pressure at the outlet of common header of compressor cooling water circuit.

10. Indication of flow of compressed air.

ii) **Alarms and interlocks**

Following audiovisual alarms and interlocks will be provided for each compressor:

1. Differential pressure of air across suction air filter high - alarm only.

2. Temperature of air after air compressor high - alarm only.

3. Temperature of air after air compressor too high - alarm and trip.

4. Pressure of air after after-cooler high - alarm only.

5. Pressure of air after after-cooler too high - alarm & trip.

6. Differential pressure across lube oil filter high - alarm only.

7. Pressure of lube oil to compressor low - alarm only.

8. Pressure of lube oil to compressor too low - alarm & trip.

9. Temperature of lube oil to compressor high - alarm only.

10. Cooling water supply pressure low - alarm only.


12. Motor over load - alarm & trip.

13. Manual tripping - alarm only
4.2.7 PIPES, FITTINGS & VALVES

1. Pipe sizing will be done considering a velocity of 10 -12 m/s. The pipes will be hydro tested at shop as well as at site.

2. All pipes and valves will be as per the following tables.

**Specification of Pipes & Fittings**

<table>
<thead>
<tr>
<th>Sl.</th>
<th>Service</th>
<th>Size</th>
<th>Pipes</th>
<th>Fittings</th>
<th>Flanges</th>
<th>Gaskets</th>
<th>End Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Compressed Air System</td>
<td>≤50NB</td>
<td>A53 Gr.B or IS 1239, Heavy Grade</td>
<td>ASTM A105</td>
<td>ASTM A105</td>
<td>Teflon</td>
<td>Plain End</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥65NB</td>
<td>A53 Gr.B or IS 1239, Heavy Grade</td>
<td>ASTM A234, Gr.WPB</td>
<td>ASTM A105</td>
<td>Teflon</td>
<td>Welded/Flanged</td>
</tr>
</tbody>
</table>

**Specification of valves**

<table>
<thead>
<tr>
<th>Sl.</th>
<th>Service</th>
<th>Size</th>
<th>Body/Bonnet</th>
<th>Disc</th>
<th>Stem</th>
<th>Hand Wheel</th>
<th>Valve ends</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Compressed Air System</td>
<td>&gt;25 &amp; ≤ 50 NB</td>
<td>ASTM A 216 Gr. WCB</td>
<td>ASTM A 479, Type 410-2</td>
<td>A</td>
<td>ASTM A47 Gr. 32510</td>
<td>Flanged Raised Face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤25 NB</td>
<td>ASTM A 105</td>
<td>ASTM A 479, Type 410-2</td>
<td>A</td>
<td>ASTM A47 Gr. 32510</td>
<td>Flanged Flat Face</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥65NB</td>
<td>ASTM A 216 Gr. WCB</td>
<td>ASTM A 479, Type 410-2</td>
<td>A</td>
<td>ASTM A47 Gr. 32510</td>
<td>Socket Welded</td>
</tr>
</tbody>
</table>

(*) Testing of valve body, seat and back seat will be as per ANSI B16.34.
4.2.8 TESTING

Unless otherwise stated, main equipment, valves and other ancillary units will be tested to various stipulations stated in Indian Standards of BIS or any other reputed international standard listed.

Recommended tests on Air Compressors are listed hereunder. Compressors may be tested using a suitable shop motor.

i) Volumetric and overall efficiency (type test)
ii) Capacity (Routine test)
iii) Specific power consumption from no load to full load (Routine test)
iv) Speed (Routine Test)
v) Testing of unloader (Routine test)
vi) Safety valve test (Routine test)

All other tests will be performed in accordance with IS:5456.

4.2.9 STANDARDS AND CODES

The complete system as a whole and individual equipment will be in accordance with the Indian Standards, British Standards, DIN or American Standards like ASME, ANSI or any other internationally accepted codes.

4.2.10 GUARANTEE AND PENALTIES

The Contractor will guarantee individual as well as integrated performance of all the equipment supplied by them for period as stipulated in the GCC prior to the date of issue of taking over certificate by the Employer. The final acceptance certificate will be issued by the Employer after successful commissioning of the Plant by the Contractor showing all the performance test at specified parameters.

The following parameters will be guaranteed as regards to Air compressor at the design ambient conditions: Temp. 45° C, 60% RH, cooling water temp. 34° C.

**Air Compressor:**

* Rated Capacity at lowest frequency : 36 Nm³/ min (each)

* Rated discharge pressure at the outlet of after cooler : 8 kgf/cm² (g)

* Discharge temperature after after cooler at rated capacity and pressure : 45° C

* Oil content in the air at the outlet of air compressor, : Oil free

* Specific Power consumption of the compressor at the rated condition mentioned above (kwh/Nm3) : To be indicated by the Contractor
* Noise Level : 80 dB(A)

* Volumetric efficiency of each compressor : To be indicated by the Contractor

* Inter cooler/ After cooler pressure drop : 0.2 kgf/cm² (max)

Tolerance on guarantee values of energy consumption, volumetric efficiency, intercooler & after cooler pressure drop is ± 0.00%

4.2.11 LIST OF PREFERRED MAKES

- Compressor

  M/s Atlas Copco, M/s ELGI, M/s Ingersoll Rand, M/s Kirloskar Pneumatics.

4.2.12 Water System Facilities for Air Compressor Unit

a) Cooling Water System

1. For cooling of plant and equipment of the air-compressor unit there shall be a separate cooling water re-circulation system for each unit / sub-system with pumps, cooling towers and piping network. Contractor shall provide a separate pump house to house compatible group of pumps. Separate group of pumps and separate piping shall be provided for each sub-system to enable flexibility in operation.

2. The cooling water system shall be supplied in line with the GTS with regard to design norms (including no. of standby pumps, type of pumps, valves and piping design) and subject to Employer's approval.

3. The cooling water circuits shall be provided with chemical conditioning system to control corrosion and scaling and prevent bio-fouling. To reduce blow-down higher cycle of concentration shall be targeted.

4. Pump houses shall be provided with air-washer based air-conditioning and ventilation system.

5. With a view to conserve and save upon fresh water requirement, the Contractor will plan to utilize/reuse/recycle the reject/blow-down from the cooling water systems in the plant with necessary treatment etc. as specified by the Employer.

6. The cooling water systems will generally comprise the following main units:

a) Open Indirect Industrial Water Cycle:
   - Cooling tower,
   - Pumpsets,
   - Strainers,
- Interconnecting piping,
- Chemical conditioning System,
- Electrics, instrumentation & control system.

b) **Make-up Water System**

1. Make-up water for various usage including cold sump of cooling water circuit for air-compressor, air-conditioning and ventilation systems etc. and for supply of industrial service water will be tapped from the existing industrial water network and will be conveyed to the various consumers through a pipe network, preferably over-ground.

2. Quality of industrial make-up water is furnished in the GTS. This water will be supplied as make-up water to proposed plant unit for process & cooling needs at only one point for the entire needs of the proposed plant unit at battery limit as specified. The Contractor shall provide necessary treatment facility, wherever required, to make the water suitable for cooling and other purposes.

3. The water loss in the various processes in evaporation, process/system, minor leakages including service water requirement etc. shall be replenished by a separate common make-up water system to be provided by the Contractor.

4. The Contractor shall indicate make-up water requirement duly corroborated by back-up calculation.

5. Make up water system will include extension of pipelines from the battery limit with isolation gate valves in valve pit, along with pumps (if required), valves, valve pits, sumps etc., to the cooling water recirculation system, ACVS, service water requirement as well as process needs.

6. Online booster shall not be accepted. A makeup water sump with pumps and piping (pump house and sump are to be provided by the Contractor), if required, shall be provided.

c) **Water Conditioning System**

1. To prevent the circulation water system from corrosion and scale formation and to bring the make up water to the condition suitable for the cooling water requirement in the proposed plant there shall be a water conditioning facility as per system requirement and inline with the details given in GTS.

2. It shall consist of dosing tanks, pumps, valves, pipes, fitting, pipe supports and associated civil, structural, electrical, instrumentation, material handling, air-conditioning & ventilation etc. The scope of work for all these remains the same as specified for cooling water system.

3. These pumps may also be housed in the same pump-house for cooling water system or separately.
4. The Contractor shall furnish the details of chemical dosing proposed for the system.

5. The Contractor shall include in the scope of supply three months chemicals requirement for the chemical conditioning system.

### 4.2.13 COOLING TOWER

**Type:** Induced draft counter flow  
**Casing/Basin:** FRP  
**Frame Work:** MS hot dip galvanized  
**Fills:** PVC  
**Nozzles:** Brass  
**Bolts, nuts, miscellaneous hardware:** MS electro galvanized  
**Fan hub & blades:** Cast Aluminium  
**Fan type:** Axial flow, direct drive  
**Fan speed:** 720 rpm  
**Degree of protection of motor:** IP 55 (temperature rise limited to class B)  
**Ladder:** Galvanised steel ladder with safety cage & hand railing up to the top of tower. Inclined to 30° to the vertical  
**Eliminators:** No. of deflector to be arranged to reduce drift loss < 0.2% of water circulation.

Cooling Tower Accessories:

(i) Level switch at cooling tower basin (to be interlocked with pump)  
(ii) Make up connection with float valve (float made of copper) & backup ball valve  
(iii) Quick fill connection with ball valve  
(iv) Overflow connection  
(v) Drain connection with ball valve  
(vi) GI wire mesh 18 gauge strainer  
(vii) Equalizing line of cooling towers with isolation valves

### 4.2.14 WATER PUMPS

*Mono block pump* will be provided for capacity 15 m³/hr & less. Pump will conform to IS: 9079-1989. Pump casing will be of C.I & impeller will be of bronze & will have stuffing box arrangement for gland packing. IP-55 protection motor will be provided.
Horizontal back pull out pump will be provided for capacity more than 15 m³/hr.

**Centrifugal Pump:**

Horizontal back pull out pump will be provided. Pump casing will be vertically split type. Impeller rpm will generally not exceed 1450. However, for pumps with low capacity & high head may be provided with 2900 rpm. Pump will be coupled to motor with flexible coupling. Spacer type coupling will be provided. Pump will conform to IS : 1520.

Pump will give satisfactory performance at any point on the H-Q curve over a range of 40% of rated flow to 120% of the rated flow. The maximum efficiency will preferably be within ± 10% of the rated design flow. The total head -capacity curve will be continuous rising towards the shut off without any zone of instability and with a minimum shut-off head of 15% more than the design head.

Pumps will have shaft seal by gland packing. Pump will be fitted with double wearing rings, one is fitted in the front of the impeller on the casing and the other is fitted in the back of the impeller on the impeller itself. Impeller will be dynamically balanced. The magnitude of peak to peak vibration will be limited to 75 micron. Pump impeller will be non overloading type. Impeller will be made in one piece & keyed to the shaft.

**Material of construction**

- Casing - C.I
- Impeller - Bronze
- Bearing Bracket - C.I
  - Shaft protection sleeve - Bronze
- Wearing ring - Bronze
- Shaft - EN-8

Common base frame for pump & motor - M.S

Common base plate for pump & motor will be in one piece & made of welded steel construction. Adequate space will be provided between pump drain connection and base plate for installation of minimum 15 mm drain piping. Pumps will be supplied with suitable drain pans or drain rim
type base plates with tapped drain connections.

Critical speed of the shaft will be at least 30 percent above the operating speed.

4.2.15 Water Piping and Fittings

Water piping up to 150 mm NB size will be GI, ERW, heavy class and conforming to IS-1239 Part- 1. The pipes above 150 NB will be MS, spirally welded, 6 mm thick and conforming to IS:3589. Pipe ends will be beveled. Pipe fittings will be as per IS 1239, Part -2 for pipes of size up to 150 NB. Fabricated fittings manufactured from the pipes may be provided for pipes of sizes 200 NB & above.

Plate type pipe flanges (as per IS 6392) will be provided.

Pipes will be of welded joints. Welding (manual metal arc welding) will be as per relevant IS code and only certified welders will be employed.

All piping systems will be hydro tested at 1.5 times the design pressure. Auto air venting valves will be provided at highest point of the pipe lines & drain valves will be provided at lowest points of the pipelines in different segments.

Pipe supports comprising pipe shoes, saddles, base plate, clamps & structural members like channels, angles etc. will be provided

Valves

Butterfly Valves will be provided in water line of size 65 NB and above and ball valve will be provided for pipe size below 65 NB. However, ball valve will be provided in the pipe line (irrespective of sizes) when flow control is required.

Butterfly valve
Type : Wafer design, flange less
Body : SG iron with nitrile rubber/ EPDM lining
Disc : SG Iron with teflon (PTFE) coating
Stem : High tensile stainless steel
The valves will be provided with integrally moulded & bonded body liner to provide perfect seating and complete isolation of body material from fluid. The body liner will provide the seating to valve disc, primary seal to the stem & gasket joint with mating pipe flanges. Valves will be provided with self locking lever operation from open to fully closed position with intermediate positions marked on the indicator plate mounted on the top flange. The valves will conform to BS : 5155 / IS : 13095. Extended valve shaft will be provided so that the lever can be operated without any obstruction on the insulated pipes. Gear operated valves will be provided for sizes more than 250 NB.

**Ball Valve**

Body : Cast steel  
Body liner : Nitrile rubber/ EPDM  
Ball : ASTM A351 Gr CF8  
3 piece design  
Socket welded type  

Ball valves will be with 200 mm length welded joint pipes from manufacturer works.  

**Check valve**

Type : Dual plate check valve with two springs hinged on a central hinge rod  
Body : SG iron  
Body liner : Nitrile rubber/ EPDM  
Disc : ASTM A351 Gr CF8  
Wafer design  

**Pressure Gauge**

Manufacturing Standard : IS 3624  
Range : 0 – 6 Kg/ cm² or 0-10 Kg/ cm²  
Range (at pump suction) : (-)2 to (+) 2 Kg/ cm²  
Dial Diameter : 100 mm  
Accuracy : ± 1% of FSD  
Degree of protection : IP 65  
Sensing element : Bourdon tube  
Bourdon tube material : AISI SS316
Connection: Screwed
Connection size: \( \frac{1}{2} \) BSP (M)
Mounting: Direct with bottom entry
Case: Die cast Al stove enamelled black finish
Bezel (screwed): Die cast Al stove enamelled black finish
Dial window: Shatter proof glass
Pointer: Al anodised black
Dial: Al white with black letters
Movement assembly: AISI 304SS
Shank: AISI 3166SS
Adjustable pulsation damper: Yes

Pressure gauges will be provided with isolation valves (Ball valves)
4.3.0 Water Supply System

4.3.1 Scope of work of Water Supply System

The scope of work of water supply system include

(i) Drinking water system,

(ii) Service water system,

(iii) Dewatering system for underground premises (Emergency Coke Yard, Junction House CK-1 etc.),

(iv) Interplant pipeline for Make-up water system

4.3.2 Battery Limit

a) Industrial water / Service Water

Industrial quality make-up water (quality as indicated in GTS, Maroda-I) will be made available to the Contractor at only one point within 100m from the proposed plant at a pressure of approx. 1.5 to 2.0 kgf/cm² (g). The top of the pipeline (carbon steel) shall be approximately 1.2 m below the area ground level. Tapping of industrial make-up water shall be based on two points feeding and shall conform to provisions of GTS. Contractor shall extend the same through isolation gate valves in valve-pit along with flow meter (complete with isolation valves and by-pass arrangement) to his proposed systems for service/make-up water requirement for the entire plant area.

Contractor shall indicate the make-up water quantity requirement, pipe size, end connection, MOC of pipeline, etc. at the battery limit.

b) Drinking water

Drinking water will be made available to the Contractor at only one point within 100m from the proposed plant at a pressure of approx. 1.0 kgf/cm² (g). The top of the pipeline (carbon steel) shall be approximately 1.2 m below the area ground level. Tapping of drinking water shall be based on two points feeding and shall conform to provisions of GTS. Contractor shall extend the same from the battery limit through isolation gate valves in valve-pit to his proposed systems/ shops, offices, toilets, drinking water platforms, water coolers, etc. for the entire plant area.

The Contractor shall indicate the drinking water quantity requirement, pipe size, end connection, MOC of pipeline, etc. at the battery limit.

c) Construction Water

Construction water arrangement shall be in the scope of contractor. The location of borewells, if planned by the Contractor for construction water requirement would require clearance / approval from BSP/MECON.
4.3.3 Specification and Description of Work

a) Drinking Water System

1. The drinking water shall be made available at one point near proposed plant within battery limit as specified. The Contractor shall extend the pipeline from battery limit with isolation gate valves in valve-pit upto various drinking water consumers.

2. The Contractor shall indicate drinking water requirement duly corroborated by back-up calculation.

3. If the pressure, as indicated in battery limit parameters, is felt inadequate for the area under the scope of the Contractor. Contractor shall provide separate sump and drinking water pumps along with piping and electrics etc. to meet the requirement. Online booster shall not be accepted.

4. The details and specification of pumps, valves, pipes, fitting, pipe supports and associated civil, structural, electrical, instrumentation, material handling, air-conditioning & ventilation etc. for cooling water system is applicable for this system also.

b) Service Water System

For Service Water, pipeline network shall start from common pump house to all the transfer points of each floor and conveyor gallery. In each floor, 1 no. tapping point will be provided and for the conveyor gallery the tapping point shall be provided at every 50metre interval. For each tapping point 1 no. gate valve, hose and quick fix connection shall be provided.

For service water line each tapping point discharge rate will be 2m³/hr. and maximum 6 Nos. points can be operated at a time.

Service water system shall be supplied in line with the GTS with regard to design norms (including no. of standby pumps, type of pumps, valves and piping design) and subject to Employer’s approval.

c) Dewatering system for underground premises

Dewatering system for underground sumps shall be provided for underground portion of the proposed plant. The water from the sumps will be pumped to the nearest surface drainage system through pumping arrangement to be provided as per GTS and subject to Employer’s approval.

d) Interplant Pipelines

Interplant pipeline for Make-up water shall be tapped from Purchaser’s network through flow meter with requisite isolation valves on either side and by-pass arrangement and shall be brought to common Make-up
water tank near Pump House. Supply of make-up water required for Air Washer Units shall be in the scope of other bidders.

All the water lines including make-up water, fire water and drinking water lines, process and cooling water lines will generally be laid over-ground preferably on structural trestles.

e) Water Pollution Control and Conservation

Extensive recycling shall be adopted in the design of plant water systems. Quality of circulating water will be maintained through dosing of conditioning chemicals for controlling corrosion, scale deposit and microbial growth.

Through cascaded reuse of blow down, the water scheme will ensure minimization of waste water discharge from the industrial water circuits.

Any discharge being made into the Employer’s existing network shall conform to the local pollution control norms fulfilling the statutory requirements.

4.3.4 Design Criteria

Efficiency, reliability and flexibility of operation and maintenance will be the guiding criteria of the design of the water system for the proposed plant. Following design criteria in addition to GTS provisions shall be followed:

1. Water System will be designed as per the provisions of GTS in respect of various design aspects including type of pumps, no. of standby pumps, piping, pipe specification, type of valves, cooling tower, side-stream filtration, handling & hoisting facilities, air-conditioning and ventilation facilities etc.

2. Each circulation system shall be connected with two nos. of delivery headers from the pumphouse and two nos hot return water headers from the consumers to the cooling tower/ pumphouse / treatment unit. The water carrying capacity of each header shall be such that incase one of the headers is under maintenance the other header should be in a position to carry the required quantity of water to the consumers, i.e., 100% of designed flow so that normal production of unit is not affected with only one delivery / return header in operation. There shall be proper isolating facilities in these headers so that supply of water in any circuit or to any area of the Complex is not affected due to leakage in one of header line.

3. All sumps shall be compartmentalised as per GTS and each pump shall have independent suction.

4. Each pump shall have independent suction. Each pump shall be provided with a gate valve on the suction side and a non-return valve and gate valve on delivery side. The delivery line of each pump shall be connected to the main header with isolating header gate valves for isolating pumps’ delivery valves. Motorised gate valves shall be provided in automated pumping system for pumps’ suction & delivery.
5. Suitable number of header valves shall be provided such that delivery valve of a pump can be isolated for maintenance without affecting other stand-by pump's availability.

6. All the valves of diameter 450 mm and above and the valves requiring remote control operation shall be electrically / pneumatically operated. Electrically operated valves shall be provided with limit switches as a safety measure. Electrically operated valves shall have provision for manual operation also. All manual valves of sizes DN 350 and above shall be gear operated. Frequently operated delivery valves and header valves below diameter 450 mm shall also be electrically operated.

7. Total no. of pumps in a pumping circuit shall be as per GTS. Pump type shall be as per the provisions of the GTS. Pump rpm shall be governed by the kW rating in line with the provisions of the GTS.

8. Drainage pumps (split casing, self priming and horizontal centrifugal pumps) will be one reserve pump for one working pump. The pumps shall not be of mono-block design.

9. All gate valves shall be cast steel with SS internals, NRVs shall have SS internals, rest of the design features shall be as per GTS.

10. Following MOC to be considered for valves:

   a) **Gate valve:**
   
   Body & Cover: CS ASTM A216 Gr WCB, Disc: ASTM A216 Gr WCB

   b) **Butterfly valve:**
   
   Body: ASTM A216 Gr WCB, Disc: CF8, Seat: EPDM (integral with the body), shaft: AISI 410 self-lubricated PTFE lined bearings for both drive end and non-drive end, hand lever /hand wheel: pressed/forged steel, end connection: Flanged to IS6392, T-17.

11. Pipe materials shall be as per CRLA,RSP,SAIL.

12. Sluice gates will have SS internals.

13. Butterfly valves usage shall be accepted for non-critical applications for flow modulation purpose at the express approval of the Employer.

14. Contractor will consider provision of strainers in each header as follows:

   - open industrial water circuit : for 100% flow, simplex strainers, 1W+1S,

15. Material handling facility for the units of the Water System shall be as per GTS.
16. Pump houses shall be provided with air-washer based air-conditioning and ventilation system.

17. Design criteria of the cooling tower shall be as per GTS.

18. Special maintenance tools and spares as mentioned in cl. no. 01.05 in 'Design Criteria for Cooling Towers', list of spares & tools & tackles as listed in cl. no. 8.18, list of tools and tackles as listed in cl. no. 8.18.02 of GTS for Water System shall be supplied by the Contractor.

19. Tapping of industrial make up water, drinking water & fire-fighting water shall be based on two points feeding as explained elsewhere in this chapter and shall conform to provisions of GTS.

20. Pipe thicknesses shall be as per GTS provisions.

21. As far as possible pipelines shall be laid above ground or in concrete trenches / tunnels. Wherever, it is not possible then only pipelines shall be laid underground.

4.3.5 Description of Cooling Water System

Open Industrial Water Cycle

Open industrial water circuits with filtered industrial water as the cooling medium shall be provided for indirect cooling of compressor unit.

Hot industrial cooling water after cooling compressor unit will reach the cooling towers under residual pressure for cooling. Cold water from the cooling tower basin will flow into the cold well of the pump house. From the cold well separate group of pumps shall pump water to the various consumers.

Make-up water shall be added in the cold well to make-up the losses in the system.

4.3.6 Erection, Testing and Commissioning

i. The erection of all plant and equipment shall be carried out according to the latest engineering practices and according to the drawings, specifications, Instructions etc. duly approved by the Employer/Consultant.

ii. The welding work should be carried out as per the approved WPS and PQR.

iii. The Contractor shall supply all required manpower, tools and related equipment, all hoisting equipment, all necessary scaffoldings, all necessary transporting equipment, consumables. Construction and erection materials, petrol, diesel oil, kerosene, solvents, sealing compound, tapes, brazing and soldering materials, welding and brazing gases, erection bolts, nuts and packing sheets/compounds, temporary supports, wooden blocks, spacers, templates, jute and cotton wastes, sand/emery paper etc. as required for the satisfactory completion of work.

iv. After erection, all equipment having moving part, subject to pressures or voltages shall be given trial operation. The trial operation shall consist of 72 hours of continuous operation. All modifications and rectifications required
during the trial operation or required for proper operation shall be done at his own cost by the Contractor as accepted by the Employer/ Consultant.

v. Rotating equipment shall be checked for proper direction of rotation and shaft alignment. Equipment subject to pressures shall be carefully examined for leakage. All equipment, such as pressure taps, temperature measurement connections, flow measurement devices etc. shall be provided by the Contractor.

vi. On completion of the work, the Contractor shall remove and dispose off all rubbish and other unsightly materials caused by his working to a distance of five kilometer from the proposed plant area or as directed by the Employer and thereby leaving the premises in good, clean, safe and operable condition.

vii. Before giving call for final inspection, all the documents shall be furnished to the Employer. The record of manufacturing details, inspection and tests carried out by the Contractor shall be made available to the final inspecting authority. However, approval and final inspection at the manufacturing works shall not relieve the Contractor of responsibility of replacing at his cost any defective part/material which may be detected by the employer during erection and commissioning or guarantee period.

viii. All materials required for fabrication, construction, testing and inspection shall be supplied by the Contractor. No material shall be free issue to the Contractor.

ix. No equipment or part item shall be dispatched without final inspection and issuance of inspection certificate.

x. All equipment, assemblies, sub-assemblies shall be shop tested as per relevant standards and the test certificates shall be submitted by the supplier.

xi. Erection, testing & commissioning of various equipments and piping etc shall be done also inline with details given in various chapters of GTS.

4.3.7 Painting
The Contractor shall follow the painting procedure as mentioned in GTS.

4.3.8 Drawings & documents

Drawings/documents to be furnished by the Contractor for approval

1. Process flow diagram indicating the water consumption figures complete with temperature, pressure and quality requirements.
2. Process & instrumentation diagrams for the water systems indicating location of all instruments, alarms and interlocks functions using ISA symbols.

3. General arrangement and cross-sectional drawings, characteristics curves and technical details of all the equipments (pumps, diesel engine, cooling tower, sluice gates, fire hydrants, etc.), valves and piping including GA drawings showing plan, elevation and sectional views of the water system.

4. List of instruments comprising bill of materials and instrumentation data sheets.

5. Layout of piping system indicating pipe routing, location of supports, valves and other fittings as required.

6. General arrangement drawings of pump houses and sump / tank (including civil, structural and other facilities) showing dispositions of various equipment and piping.

7. Data sheets, characteristic curves and technical details of all the equipments, valves and piping.

8. List of safety interlocks.

9. Test procedures for preliminary and final acceptance tests.


11. All equipment and piping sizing calculations.

12. GA drawings and details of air conditioning & ventilation facilities.

13. Test certificates for the following:

14. Material test certificate for all major equipment and their components.

15. Hydraulic test of equipment, pipe fittings & valves.

16. Static and dynamic balancing of all rotary parts/equipments

17. Any other drawing/documents as required by the Employer.

**Drawings / documents to be furnished by the Contractor for reference and record**

1. The Contractor shall submit required sets of all the approved drawings, documents and manuals for Employer’s record and use. After erection of equipment, the Contractor shall submit one set of linen tracings/ reproducible in required number of prints along with soft copies in CD (in AutoCAD format) of each “As built drawings”.

2. Operating and maintenance manual.

3. Spare parts recommendation and price list.

4. Instruction for erection, testing and commissioning.

5. Manufacturer’s test certificates.

6. Lubrication schedule and quantity and quality of lubricant for one year’s normal operation.

7. Various equipment assembly drawings and bill of material.

8. Welding procedure.


11. Characteristics curves of the pumps, motors and other equipments.

12. Operation and maintenance manuals for all equipments, valves and complete water system along with soft copies.

13. Test and calibration certificates.


15. Technical literature, catalogues and manufacturer’s drawings for all brought out equipment, valves and other items.

16. All inspection/test report/certificates.

17. Any other drawing/documents as required by the Employer/Consultant.
4.3.9  Preferred Makes

The Contractor shall follow the list of proffered makes as per the following:

<table>
<thead>
<tr>
<th>SL No.</th>
<th>Item Description</th>
<th>Manufactures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Horizontal centrifugal Pumps</td>
<td>Kirloskar Brothers, KSB, Beacon Weir, Voltas, Mather &amp; Platt, Jyoti, WPIL (Worthington).</td>
</tr>
<tr>
<td>2.</td>
<td>Submersible pumps</td>
<td>KSB, SU Motors, Kirloskar Brothers.</td>
</tr>
<tr>
<td>3.</td>
<td>Dosing Pump</td>
<td>Shapo Tools, Asia LMI (Madras), Toshniwal, Milton Roy India.</td>
</tr>
<tr>
<td>5.</td>
<td>Sluice Gates</td>
<td>Jash, IVPL.</td>
</tr>
<tr>
<td>7.</td>
<td>Rubber expansion joints</td>
<td>BDK, CORI Engineers.</td>
</tr>
<tr>
<td>8.</td>
<td>Hoses</td>
<td>Senior Flexonics, Hydrocrimp</td>
</tr>
<tr>
<td>9.</td>
<td>Pipe a) MS/GI</td>
<td>SAIL, TATA, Jindal, MAN, SAW, Welspun, Prakash, PSL, MSL.</td>
</tr>
<tr>
<td></td>
<td>b) DI</td>
<td>Electro Steel Casting</td>
</tr>
<tr>
<td>10.</td>
<td>MS/GI Pipe Fittings</td>
<td>Tube bends, Stewards &amp; Lloyds, BST, Jindal.</td>
</tr>
<tr>
<td>12.</td>
<td>Fire hydrants</td>
<td>New Age Industries, Steelage Industries, ASCO, Strumech, Vijay Fire, Zenith</td>
</tr>
</tbody>
</table>

Valves

1. **C.S. Gate /Globe Valve**
   A. **(Non-IBR- for all Sizes and Ratings)**:
      - M/s. BHEL, Tiruchirapalli.
      - M/s. K.S.B. Pumps Ltd, Kolkata.
      - M/s. Larsen & Toubro Ltd., (Audco), Chennai.
      - M/s. Leader Valves Ltd., Jalandhar.
      - M/s. Oswal Industries Ltd., Ahmedabad.

2. **Butterfly Valve**:
   - M/s. Avcon Control Pvt. Ltd., Mumbai (For Actuator operated Valves)
   - M/s. Fisher Xomox Sanmar, Trichinapalli.
   - M/s. Inter Valves (Pvt.) Ltd., Pune.
   - M/s. Larsen & Toubro Ltd., (Audco), Chennai.
3. **Ball Valve:**

- M/s. Fisher Xomox Sanmar, Trichinapalli.
- M/s. Flowchem Ind., Ahmedabad.
- M/s. Inter Valves, Pune.
- M/s. Larsen & Toubro Ltd., (Audco), Chennai.
- M/s. Oswal Industries Ltd., Ahmedabad.
- M/s. Virgo Engineers Ltd., Pune.

4. **CI/Sluice Gate Valves**

   **A. For all Sizes and Ratings:**

- M/s. Calsens Private Ltd., Kolkata.
- M/s. Hawa Engineers Ltd., Ahmedabad.
- M/s. Kirloskar Brothers, Nagpur.
- M/s. Leader Valves Ltd., Jalandhar.
- M/s. Neta Valves Pvt. Ltd., Jalandhar

   **B. For Sizes upto NB 100 mm & PN 10 Rating:**

- M/s. Ronex Engg. Company, Kolkata
- M/s. Upadhyaya Valve Manuf. Pvt. Ltd., Kolkata
- M/s. Steam & Mining Industries, Kolkata.

   (Vendors appearing under ‘A’ shall be eligible for ‘B’ also)

5. **Plug Valve:**

- M/s. Fisher Xomox Sanmar Ltd., Chennai.

6. **Cock Valve for Gas applications:**


7. **Check Valve/Non Return Valve:**

- M/s. Inter Valves (Pvt.) Ltd., Pune.
- M/s. K.S.B. Pumps Ltd, Kolkata.
- M/s. Oswal Industries Ltd., Ahmedabad.
8. **Fabricated Gate Valve.**

- M/s. Zimmermann & Janseen, Duren, Germany.

9. **Piston Valve:**

- M/s. Uni -Klinger Ltd., Pune.

10. **Knife Edge Gate Valve:**

- M/s. Energo Engg., Delhi.
- M/s. Orbinox India Pvt. Ltd., Coimbatore.

11. **Non-Ferrous Valve:**

- M/s. Leader Valves Ltd., Jalandhar.
- M/s. Zoloto Ind., Jalandhar.
10.00 Technical Particulars furnished by the Contractor

A. Air compressors

01. Manufacturer's Name & address : 
Model No. : 
Type : 
No. provided : 
Rated capacity Nm³/min : 
Rated discharge pressure, kgf/cm²/g : 
kW input at motor terminal : 
Motor rating : 
Air temp. at delivery after after-cooler at rated capacity and pressure, deg.C.

Screw Speed, rpm
  1st stage (male & female) :
  2nd stage (male & female) :

Oil content in the air at outlet of air compressor, ppm.

Noise level at source when the compressor running at rated capacity, dB (A).

Cooling water requirement :

Pressure drop across compressor :

Temp. rise :

02. **Inter cooler & after cooler**

<table>
<thead>
<tr>
<th>Design standard/code</th>
<th>:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make</td>
<td>:</td>
</tr>
<tr>
<td>Max. working pressure, kgf/cm²g</td>
<td>:</td>
</tr>
</tbody>
</table>

  i) Water side :

  ii) Air side :

<table>
<thead>
<tr>
<th>Tube material, size and thickness</th>
<th>:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell material and thickness, mm</td>
<td>:</td>
</tr>
</tbody>
</table>

| Moisture content in air after aftercooler, ppm | : |

| Space required for pulling out tube assembly of intercooler & aftercooler | : |

03. **Moisture separator**

| Make | : |
| Type | : |
| Model | : |
| Number | : |

| Design standard/code for pressure vessel | : |

| Shell material and thickness | : |
Design pressure, kgf/cm² (g) : 
Moisture content after separator : 

B. Motor

Type : 
Make : 
Rated kW at 50 deg.C : 
Rated kW at 40 deg.C : 
Rated voltage & system condition : 
Frame size. : 
Class of insulation : 
Rated speed & direction of rotation : 
Starting system : 

C. Air Receiver

Number : 
Design Standard/ Code : 
Capacity : 
Overall dimensions : 
Wall plate thickness : 
Plate material : 
Design Pressure : 
Working Pressure : 
04.08 WATER SYSTEM

04.08.00 Scope of work

The scope of work shall include design, engineering, fabrication, manufacturing, assembly & supply, erection/construction/laying, commissioning, testing & performance guarantee tests etc of plant & equipment and piping etc of complete water supply facilities including pump house buildings, civil & structural work & technological structures, electrics, instrumentation, automation, telecommunication, air-conditioning & ventilation, material handling & hoisting equipment etc as specified and required for complete water systems technological structures, pipe-support structures, etc as specified and required for the complete water system for proposed plant as specified in this chapter as well as various chapters of this contract specification in line with General Technical Specification (GTS) and subject to Employer’s approval, complete in all respect on turnkey basis.

The scope of work shall include the following activities.

i) Design, engineering, manufacture /fabrication, assembly, shop testing, painting, packing sequential delivery FOR site, unloading, unpacking, storage at site, preparation & submission of all drawings for civil, mechanical, structural, piping, construction & erection drawings, construction & erection as per approved drawings, site-testing, painting, commissioning and fulfillment of guarantee performance of all plant & equipment of water supply facilities for the proposed plant including drinking water system, industrial service/make-up water system and water based fire-fighting system, in accordance with the water system requirements of the proposed plant.

ii) Supply of pipeline supports, thrust blocks/ anchor blocks, R.C.C. pedestals etc. for over head / on-ground /underground pipelines.

iii) Supply of all technical literature, drawings & documents, general arrangement drawings, assembly & sub-assembly drawings of all the plant & equipment, construction & erection drawings, as-built drawings, operation & maintenance manuals, manufacturing drawings, etc.

iv) Submission of all drawings at (iii) above, design calculations, data sheets for various equipments, pipeline sizing calculation and for approval of Employer/ Consultant and finalizing the same as per approval of Employer/ Consultant. The approval of the same however does not absolve the contractor from his responsibilities.
v) Supply of commissioning spares & consumables; a list there of shall be submitted by the Contractor.

vi) Contractor shall submit an itemized price-list of two years operation and maintenance spares.

vii) Supply of special tools, tackles for construction, erection operation and repair & maintenance of the plant & equipment.

viii) Supply of special tools and tackles, spares as mentioned in GTS shall be in the scope of Contractor.

ix) All necessary connections for hook-up with Employer’s system at battery limits.

x) Supply of erection, testing & commissioning equipment and material.

xi) Piping network flushing fluids, chemicals & consumables.

xii) First fill of oils, lubricants, filter media, resins, chemicals reagents and other consumables.

xiii) Inspection and performance testing of individual equipment and system as a whole.

xiv) Participation in design conference with the Employer & Consultant as and when called for.

xv) Contractor shall provide two nos drainage pumps for each underground premises, one working, one standby, of suitable capacity and head to drain out the seepage water and rain water from the underground premises. The pumps shall be capable of handling slurry water. The exact numbers, capacity and type of pump shall be finalised during engineering stage.

The Contractor’s scope also covers extension of fire-fighting line, drinking water line and industrial water line from the battery limits to various consumer points of the proposed plant in line with the present Contract technical specification and GTS.

Water supply system/ sub-systems shall be complete in all respects and any equipment or material not specifically mentioned in this specification, but required for safe, efficient & smooth operation and guaranteed performance of the plant shall be deemed to be included under the scope of work of the Contractor. Diversion of existing overhead / underground water pipelines (including those identified
during package execution) required for installation of the proposed units covered under this package is included in the scope of work of the Contractor. However, the price & other terms and conditions shall be mutually discussed and agreed during the execution of job by the Contractor.

04.08.01 Battery Limit

a) Industrial water

Industrial quality make-up water (quality as indicated in GTS, Maroda-I) will be made available to the Contractor at only one point within 100m from the proposed plant at a pressure of approx 1.5 to 2.0 kgf/ cm² (g). The top of the pipeline (carbon steel) shall be approximately 1.2 m below the area ground level. Tapping of industrial make-up water shall be based on two points feeding and shall conform to provisions of GTS. Contractor shall extend the same through isolation gate valves in valve-pit alongwith flow meter (complete with isolation valves and by-pass arrangement) to his proposed systems for service/make-up water requirement for the entire plant area.

Contractor shall indicate the make-up water quantity requirement, pipe size, end connection, MOC of pipeline, etc. at the battery limit.

b) Drinking water

Drinking water will be made available to the Contractor at only one point within 100m from the proposed plant at a pressure of approx 1.0 kgf/ cm² (g). The top of the pipeline (carbon steel) shall be approximately 1.2 m below the area ground level. Tapping of drinking water shall be based on two points feeding and shall conform to provisions of GTS. Contractor shall extend the same from the battery limit through isolation gate valves in valve-pit to his proposed systems/ shops, offices, toilets, drinking water platforms, water coolers, etc. for the entire plant area.

The Contractor shall indicate the drinking water quantity requirement, pipe size, end connection, MOC of pipeline, etc. at the battery limit.

c) Fire-fighting water

Industrial quality water (quality as indicated in GTS) will be made available to the Contractor at one point within 100m from the proposed plant at requisite pressure. The top of the pipeline (carbon steel) shall be approximately 1.2 m below the area ground level. Tapping of industrial make-up water shall be based on two points feeding and shall conform
to provisions of GTS. Contractor shall extend the same from battery limit through isolation gate valves in valve-pit to the entire plant area.

d) Construction Water

Construction water arrangement shall be in the scope of contractor. The location of borewells, if planned by the Contractor for construction water requirement would require clearance / approval from BSP/MECON.

04.08.02 Specification and Description of Work

Water System Facilities:

Water system shall in general include the following facilities:-

a) Cooling water system,
b) Make-up water system,
c) Water conditioning system,
d) Water supply system for air conditioning & ventilation system,
e) Drinking water system,
f) Water based fire-fighting system,
g) Service Water System,
h) Dewatering system for underground premises
i) Interplant pipelines,
j) Water pollution control & conservation.

a) Cooling Water System

1. For cooling of plant and equipment of the air-compressor unit there shall be a separate cooling water re-circulation system for each unit / sub-system with pumps, cooling towers and piping network. Contractor shall provide a separate pump house to house compatible group of pumps. Separate group of pumps and separate piping shall be provided for each sub-system to enable flexibility in operation.

2. The cooling water system shall be supplied in line with the GTS with regard to design norms (including no. of standby pumps, type of pumps, valves and piping design) and subject to Employer’s approval.

3. The cooling water circuits shall be provided with chemical conditioning system to control corrosion and scaling and prevent bio-fouling. To reduce blow-down higher cycle of concentration shall be targeted.
4. Pump houses shall be provided with air-washer based air-conditioning and ventilation system.

5. With a view to conserve and save upon fresh water requirement, the Contractor will plan to utilize/reuse/recycle the reject/blow-down from the cooling water systems in the plant with necessary treatment etc. as specified by the Employer.

**b) Make-up Water System**

1. Make-up water for various usage including cold sump of cooling water circuit for air-compressor, air-conditioning and ventilation systems etc. and for supply of industrial service water will be tapped from the existing industrial water network and will be conveyed to the various consumers through a pipe network, preferably over-ground.

2. Quality of industrial make-up water is furnished in the GTS. This water will be supplied as make-up water to proposed plant unit for process & cooling needs at only one point for the entire needs of the proposed plant unit at battery limit as specified. The Contractor shall provide necessary treatment facility, wherever required, to make the water suitable for cooling and other purposes.

3. The water loss in the various processes in evaporation, process/system, minor leakages including service water requirement etc. shall be replenished by a separate common make-up water system to be provided by the Contractor.

4. The Contractor shall indicate make-up water requirement duly corroborated by back-up calculation.

5. Make up water system will include extension of pipelines from the battery limit with isolation gate valves in valve pit, along with pumps (if required), valves, valve pits, sumps etc., to the cooling water recirculation system, ACVS, service water requirement as well as process needs.

6. Online booster shall not be accepted. A makeup water sump with pumps and piping (pump house and sump are to be provided by the Contractor), if required, shall be provided.
c) Water Conditioning System

1. To prevent the circulation water system from corrosion and scale formation and to bring the make up water to the condition suitable for the cooling water requirement in the proposed plant there shall be a water conditioning facility as per system requirement and inline with the details given in GTS.

2. It shall consist of dosing tanks, pumps, valves, pipes, fitting, pipe supports and associated civil, structural, electrical, instrumentation, material handling, air-conditioning & ventilation etc. The scope of work for all these remains the same as specified for cooling water system.

3. These pumps may also be housed in the same pump-house for cooling water system or separately.

4. The Contractor shall furnish the details of chemical dosing proposed for the system.

5. The Contractor shall include in the scope of supply three months chemicals requirement for the chemical conditioning system.

d) Water Supply System for air-conditioning & ventilation

1. The entire piping network for water supply for air-conditioning and ventilation and other Systems/ Sub-systems is in the scope of the Contractor.

2. It shall consist of pumps, valves, pipes, fitting, pipe supports and associated civil, structural, electrical, instrumentation, material handling, air-conditioning & ventilation etc.

3. The details and specification of pumps, valves, pipes, fitting, pipe supports and associated civil, structural, electrical, instrumentation, material handling, air-conditioning & ventilation etc. as specified for cooling water system is applicable for this system also.

4. Makeup water for the system shall be provided by the Contractor from the make-up water network provided for the main plant. No separate connection at battery limit will be provided for this purpose.
5. Pumphouses shall be provided with air-washer based air-conditioning and ventilation system.

e) Drinking Water System

1. The drinking water shall be made available at one point near proposed plant within battery limit as specified. The Contractor shall extend the pipeline from battery limit with isolation gate valves in valve-pit upto various drinking water consumers.

2. The Contractor shall indicate drinking water requirement duly corroborated by back-up calculation.

3. If the pressure, as indicated in battery limit parameters, is felt inadequate for the area under the scope of the Contractor. Contractor shall provide separate sump and drinking water pumps along with piping and electrics etc. to meet the requirement. Online booster shall not be accepted.

4. The details and specification of pumps, valves, pipes, fitting, pipe supports and associated civil, structural, electrical, instrumentation, material handling, air-conditioning & ventilation etc. for cooling water system is applicable for this system also.

f) Water based Fire-Fighting System

To cater to the needs of water based fire-fighting system, a fire water piping network shall be planned with provision of yard hydrants and internal hydrants at regular intervals. The proposed network shall be connected with the existing network at the battery limits with isolation gate valves in valve-pit.

The following specification of work shall be considered:-

i) Category of hazard - ordinary (as par TAC)

ii) Yard hydrants - at 45 m intervals

iii) Internal hydrants - at 30 m intervals

iv) Min. pressure at remotest hydrant - 3.5 kg/cm²

Two nos. of 15 m long hose shall be provided alongwith fittings for each yard hydrant and 2 nos. of 15 m long hose shall be provided along with fittings for each internal hydrant.

The water based fire fighting system shall be designed, supplied & erected in line with the stipulations under various clauses of GTS-02 and
subject to Employer’s / Consultant’s approval. The details of the MVWS system have been dealt with separately.

The Contractor shall indicate fire fighting water requirement duly corroborated by back-up calculation.

g) **Service Water System**

For Service Water, pipeline network shall start from common pump house to all the transfer points of each floor and conveyor gallery. In each floor, 1 no. tapping point will be provided and for the conveyor gallery the tapping point shall be provided at every 50metre interval. For each tapping point 1 no. gate valve, hose and quick fix connection shall be provided.

For service water line each tapping point discharge rate will be 2m³/hr. and maximum 6 Nos. points can be operated at a time.

Service water system shall be supplied in line with the GTS with regard to design norms (including no. of standby pumps, type of pumps, valves and piping design) and subject to Employer’s approval.

h) **Dewatering system for underground premises**

Dewatering system for underground sumps shall be provided for underground portion of the proposed plant. The water from the sumps will be pumped to the nearest surface drainage system through pumping arrangement to be provided as per GTS and subject to Employer’s approval.

i) **Interplant Pipelines**

Industrial water for make-up water supply and general plant usage will be met through the proposed pipeline to be laid from the tapping point to these units.

Drinking water network and fire water network will be provided to various consumption points in the proposed industrial premises.

All the water lines including make-up water, fire water and drinking water lines, process and cooling water lines will generally be laid over-ground preferably on structural trestles.
j) Water Pollution Control and Conservation

Extensive recycling shall be adopted in the design of plant water systems. Quality of circulating water will be maintained through dosing of conditioning chemicals for controlling corrosion, scale deposit and microbial growth.

Through cascaded reuse of blow down, the water scheme will ensure minimization of waste water discharge from the industrial water circuits.

Any discharge being made into the Employer’s existing network shall conform to the local pollution control norms fulfilling the statutory requirements.

The cooling water systems will generally comprise the following main units:

a) Open Indirect Industrial Water Cycle:
   - Cooling tower,
   - Pumpsets,
   - Strainers,
   - Interconnecting piping,
   - Chemical conditioning System,
   - Electrics, instrumentation & control system.

b) Miscellaneous and Common Facilities:
   - Make-up water system,
   - Interplant pipelines,
   - Water based Fire Fighting system,
   - Drinking Water System.

04.08.03 Design Criteria

Efficiency, reliability and flexibility of operation and maintenance will be the guiding criteria of the design of the water system for the proposed plant. Following design criteria in addition to GTS provisions shall be followed:

1. Water System will be designed as per the provisions of GTS in respect of various design aspects including type of pumps, no. of standby pumps, piping, pipe specification, type of valves, cooling
2. Each circulation system shall be connected with two nos. of delivery headers from the pumphouse and two nos hot return water headers from the consumers to the cooling tower/pumphouse/treatment unit. The water carrying capacity of each header shall be such that incase one of the headers is under maintenance the other header should be in a position to carry the required quantity of water to the consumers, i.e., 100% of designed flow so that normal production of unit is not affected with only one delivery/return header in operation. There shall be proper isolating facilities in these headers so that supply of water in any circuit or to any area of the Complex is not affected due to leakage in one of header line.

3. All sumps shall be compartmentalised as per GTS and each pump shall have independent suction.

4. Each pump shall have independent suction. Each pump shall be provided with a gate valve on the suction side and a non-return valve and gate valve on delivery side. The delivery line of each pump shall be connected to the main header with isolating header gate valves for isolating pumps’ delivery valves. Motorised gate valves shall be provided in automated pumping system for pumps’ suction & delivery.

5. Suitable number of header valves shall be provided such that delivery valve of a pump can be isolated for maintenance without affecting other stand-by pump’s availability.

6. All the valves of diameter 450 mm and above and the valves requiring remote control operation shall be electrically/pneumatically operated. Electrically operated valves shall be provided with limit switches as a safety measure. Electrically operated valves shall have provision for manual operation also. All manual valves of sizes DN 350 and above shall be gear operated. Frequently operated delivery valves and header valves below diameter 450 mm shall also be electrically operated.

7. Total no. of pumps in a pumping circuit shall be as per GTS. Pump type shall be as per the provisions of the GTS. Pump rpm shall be governed by the kW rating in line with the provisions of the GTS.
8. Drainage pumps (split casing, self priming and horizontal centrifugal pumps) will be one reserve pump for one working pump. The pumps shall not be of mono-block design.

9. All gate valves shall be cast steel with SS internals, NRVs shall have SS internals, rest of the design features shall be as per GTS.

10. Following MOC to be considered for valves:

   a) **Gate valve:**
   

   b) **Butterfly valve:**
   
   Body: ASTM A216 Gr WCB, Disc: CF8, Seat: EPDM (integral with the body), shaft: AISI 410 self-lubricated PTFE lined bearings for both drive end and non-drive end, hand lever /hand wheel: pressed/forged steel, end connection: Flanged to IS6392, T-17.

11. Pipe materials shall be as per CRLA,RSP,SAIL.

12. Sluice gates will have SS internals.

13. Butterfly valves usage shall be accepted for non-critical applications for flow modulation purpose at the express approval of the Employer.

14. Contractor will consider provision of strainers in each header as follows:

   - open industrial water circuit : for 100% flow, simplex strainers, 1W+1S,

15. Material handling facility for the units of the Water System shall be as per GTS.
16. Pump houses shall be provided with air-washer based air-conditioning and ventilation system.

17. Design criteria of the cooling tower shall be as per GTS.

18. Special maintenance tools and spares as mentioned in cl. no. 01.05 in ‘Design Criteria for Cooling Towers’, list of spares & tools & tackles as listed in cl. no. 8.18, list of tools and tackles as listed in cl. no. 8.18.02 of GTS for Water System shall be supplied by the Contractor.

19. Tapping of industrial make up water, drinking water & fire-fighting water shall be based on two points feeding as explained elsewhere in this chapter and shall conform to provisions of GTS.

20. Pipe thicknesses shall be as per GTS provisions.

21. As far as possible pipelines shall be laid above ground or in concrete trenches / tunnels. Wherever, it is not possible then only pipelines shall be laid underground.

**04.08.04 Description of Cooling Water System**

**Open Industrial Water Cycle**

Open industrial water circuits with filtered industrial water as the cooling medium shall be provided for indirect cooling of compressor unit.

Hot industrial cooling water after cooling compressor unit will reach the cooling towers under residual pressure for cooling. Cold water from the cooling tower basin will flow into the cold well of the pump house. From the cold well separate group of pumps shall pump water to the various consumers.

Make-up water shall be added in the cold well to make-up the losses in the system.

**04.08.05 Erection, Testing and Commissioning**

i. The erection of all plant and equipment shall be carried out according to the latest engineering practices and according to the drawings, specifications, instructions etc. duly approved by the Employer/Consultant.
ii. The welding work should be carried out as per the approved WPS and PQR.

iii. The Contractor shall supply all required manpower, tools and related equipment, all hoisting equipment, all necessary scaffoldings, all necessary transporting equipment, consumables. Construction and erection materials, petrol, diesel oil, kerosene, solvents, sealing compound, tapes, brazing and soldering materials, welding and brazing gases, erection bolts, nuts and packing sheets/compounds, temporary supports, wooden blocks, spacers, templates, jute and cotton wastes, sand/emery paper etc. as required for the satisfactory completion of work.

iv. After erection, all equipment having moving part, subject to pressures or voltages shall be given trial operation. The trial operation shall consist of 72 hours of continuous operation. All modifications and rectifications required during the trial operation or required for proper operation shall be done at his own cost by the Contractor as accepted by the Employer/Consultant.

v. Rotating equipment shall be checked for proper direction of rotation and shaft alignment. Equipment subject to pressures shall be carefully examined for leakage. All equipment, such as pressure taps, temperature measurement connections, flow measurement devices etc. shall be provided by the Contractor.

vi. On completion of the work, the Contractor shall remove and dispose off all rubbish and other unsightly materials caused by his working to a distance of five kilometer from the proposed plant area, or as directed by the Employer and thereby leaving the premises in good, clean, safe and operable condition.

vii. Before giving call for final inspection, all the documents shall be furnished to the Employer. The record of manufacturing details, inspection and tests carried out by the Contractor shall be made available to the final inspecting authority. However, approval and final inspection at the manufacturing works shall not relieve the Contractor of responsibility of replacing at his cost any defective part/material which may be detected by the employer during erection and commissioning or guarantee period.

viii. All materials required for fabrication, construction, testing and inspection shall be supplied by the Contractor. No material shall be free issue to the Contractor.
ix. No equipment or part item shall be dispatched without final inspection and issuance of inspection certificate.

tax. All equipment, assemblies, sub-assemblies shall be shop tested as per relevant standards and the test certificates shall be submitted by the supplier.

xi. Erection, testing & commissioning of various equipments and piping etc shall be done also inline with details given in various chapters of GTS.

04.08.06 Painting

The Contractor shall follow the painting procedure as mentioned in GTS.

04.08.07 Drawings & documents

04.08.08 Drawings/documents to be furnished by the Contractor for approval

1. Process flow diagram indicating the water consumption figures complete with temperature, pressure and quality requirements.
2. Process & instrumentation diagrams for the water systems indicating location of all instruments, alarms and interlocks functions using ISA symbols.
3. General arrangement and cross-sectional drawings, characteristics curves and technical details of all the equipments (pumps, diesel engine, , cooling tower, , sluice gates, , fire hydrants, etc.) , valves and piping including GA drawings showing plan, elevation and sectional views of the water system.
4. List of instruments comprising bill of materials and instrumentation data sheets.
5. Layout of piping system indicating pipe routing, location of supports, valves and other fittings as required.
6. General arrangement drawings of pump houses and sump / tank (including civil, structural and other facilities) showing dispositions of various equipment and piping.
7. Data sheets, characteristic curves and technical details of all the equipments, valves and piping.
8. List of safety interlocks.
9. Test procedures for preliminary and final acceptance tests.
11. All equipment and piping sizing calculations.
12. GA drawings and details of air conditioning & ventilation facilities.
13. Test certificates for the following:
14. Material test certificate for all major equipment and their components.
15. Hydraulic test of equipment, pipe fittings & valves.
16. Static and dynamic balancing of all rotary parts/ equipments
17. Any other drawing/ documents as required by the Employer.

04.08.09 Drawings / documents to be furnished by the Contractor for reference and record

1. The Contractor shall submit required sets of all the approved drawings, documents and manuals for Employer’s record and use. After erection of equipment, the Contractor shall submit one set of linen tracings/ reproducible in required number of prints along with soft copies in CD (in AutoCAD format) of each “As built drawings”.
2. Operating and maintenance manual.
3. Spare parts recommendation and price list.
4. Instruction for erection, testing and commissioning.
5. Manufacturer’s test certificates.
6. Lubrication schedule and quantity and quality of lubricant for one year’s normal operation.
7. Various equipment assembly drawings and bill of material.
8. Welding procedure.
11. Characteristics curves of the pumps, motors and other equipments.
12. Operation and maintenance manuals for all equipments, valves and complete water system along with soft copies.
13. Test and calibration certificates.
15. Technical literature, catalogues and manufacturer’s drawings for all brought out equipment, valves and other items.
16. All inspection/ test report/ certificates.
17. Any other drawing/ documents as required by the Employer/Consultant.

04.08.10 Preferred Makes
The Contractor shall follow the list of proffered makes as per the following:

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Item Description</th>
<th>Manufactures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Horizontal centrifugal Pumps</td>
<td>Kirloskar Brothers, KSB, Beacon Weir, Voltas, Mather &amp; Platt, Jyoti, WPIL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Worthington).</td>
</tr>
<tr>
<td>2.</td>
<td>Submersible pumps</td>
<td>KSB, SU Motors, Kirloskar Brothers.</td>
</tr>
<tr>
<td>3.</td>
<td>Dosing Pump</td>
<td>Shapo Tools, Asia LMI (Madras), Toshniwal, Milton Roy India.</td>
</tr>
<tr>
<td>5.</td>
<td>Sluice Gates</td>
<td>Jash, IVPL.</td>
</tr>
<tr>
<td>7.</td>
<td>Rubber expansion joints</td>
<td>BDK, CORI Engineers.</td>
</tr>
<tr>
<td>8.</td>
<td>Hoses</td>
<td>Senior Flexonics, Hydrocrimp</td>
</tr>
<tr>
<td>9.</td>
<td>Pipe a) MS/GI</td>
<td>SAIL, TATA, Jindal, MAN, SAW, Welspun, Prakash, PSL, MSL.</td>
</tr>
<tr>
<td></td>
<td>b) DI</td>
<td>Electro Steel Casting</td>
</tr>
<tr>
<td>10.</td>
<td>MS/GI Pipe Fittings</td>
<td>Tube bends, Stewards &amp; Lloyds, BST, Jindal.</td>
</tr>
<tr>
<td>12.</td>
<td>Fire hydrants</td>
<td>New Age Industries, Steelage Industries, ASCO, Strumech, Vijay Fire, Zenith</td>
</tr>
</tbody>
</table>
Valves

1. **C.S. Gate /Globe Valve**
   
   **A. (Non-IBR- for all Sizes and Ratings):**
   
   - M/s. BHEL, Tiruchirapalli.
   - M/s. K.S.B. Pumps Ltd, Kolkata.
   - M/s. Leader Valves Ltd., Jalandhar.
   - M/s. Oswal Industries Ltd., Ahmedabad.

2. **Butterfly Valve:**

   - M/s. Avcon Control Pvt. Ltd., Mumbai (For Actuator operated Valves)
   - M/s. Fisher Xomox Sanmar, Trichinapalli.
   - M/s. Inter Valves (Pvt.) Ltd., Pune.
   - M/s. Tyco Valves, Baroda.
   - M/s. Virgo Engineers Ltd., Pune.

3. **Ball Valve:**

   - M/s. Fisher Xomox Sanmar., Trichinapalli.
   - M/s. Flowchem Ind., Ahmedabad.
   - M/s. Inter Valves, Pune.
   - M/s. Oswal Industries Ltd., Ahmedabad.
   - M/s. Virgo Engineers Ltd., Pune.

4. **CI/Sluice Gate Valves**

   **A. For all Sizes and Ratings:**

B. For Sizes upto NB 100 mm & PN 10 Rating:

- M/s. Ronex Engg. Company, Kolkata
- M/s. Upadhyaya Valve Manuf. Pvt. Ltd., Kolkata
- M/s. Steam & Mining Industries, Kolkata

(Vendors appearing under ‘A’ shall be eligible for ‘B’ also)

5. Plug Valve:

- M/s. Fisher Xomox Sanmar Ltd., Chennai.
- M/s. Larsen & Toubro Ltd., (Audco), Chennai.

6. Cock Valve for Gas applications:

- M/s. Larsen & Toubro Ltd., (Audco), Chennai.

7. Check Valve/Non Return Valve:

- M/s. Inter Valves (Pvt.) Ltd., Pune.
- M/s. K.S.B. Pumps Ltd, Kolkata.
- M/s. Oswal Industries Ltd., Ahmedabad.

8. Fabricated Gate Valve.

- M/s. Larsen & Toubro Ltd., (Audco), Chennai.
- M/s. Zimmermann & Janseen, Duren, Germany.

9. Piston Valve:

- M/s. Uni -Klinger Ltd., Pune.
10. **Knife Edge Gate Valve:**

- M/s. Energo Engg., Delhi.
- M/s. Orbinox India Pvt. Ltd., Coimbatore.

11. **Non-Ferrous Valve:**

- M/s. Leader Valves Ltd., Jalandhar.
- M/s. Zoloto Ind., Jalandhar.
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>
</tbody>
</table>

**Range:**

| DC Voltage –       | Selectable upto 1000 V min. |
| DC Current –       | Selectable upto 10 A min, and will be capable to measure mA signals for instrument use |
| AC Voltage –       | Selectable upto 1000 V min. |
| AC Current –       | Selectable upto 10 A min    |
| Resistance—       | Selectable upto 50 M Ohm min. |
| Capacitance—      | Selectable upto 10 mF min. |
| Frequency—        | 10.00 KHz to 199.99 KHz. |

**Other facilities:** 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 & operator’s guide. Multimeter will be suitable for true
RMS measurement of AC voltage and current.

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>
</tbody>
</table>
| 1.2 | **A). Pressure / Differential Pressure switches. (Mech. Type)** | 1. Switzer,  
2. Ashcroft,  
3. Solon  
4. Budenberg,  
5. Forbes Marshall |
| 1.2 | **B). Pressure / Differential Pressure switches. (Electronic Type)** | 1. Ifm.  
2. WIKA,  
3. Kobold |
| 1.3 | **Pressure / Differential Pressure Transmitters** | 1. Emerson (Rosemount),  
2. Honeywell,  
3. Yokogawa,  
4. Siemens,  
5. ABB  
6. Endress & Hauser. |
| 2. | **TEMPERATURE INSTRUMENTS/SENSORS** | |
| 2.1 | **Temperature gauges** | 1. WIKA,  
2. Ashcroft,  
3. Budenberg  
4. Waaree instruments |
| 2.2 | **Thermocouple & RTD / thermo well** | 1. Tempsens,  
2. Toshniwal Industries,  
3. Detriv.  
4. Temptech, |
| 2.3 | **Temperature Switch** | 1. WIKA,  
2. Switzer  
3. Ifm. |
| 2.4 | **Temperature transmitter** | 1. Emerson (Rosemount),  
2. Yokogawa,  
3. Honeywell,  
4. MTL  
5. Phoenix.  
6. Siemens |
| 2.5 | **Infrared radiation pyrometer/portable** | 1. Land,  
2. Ircon,  
3. Raytek, |
## 3 FLOW INSTRUMENTS

### 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,
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Manufacturers</th>
</tr>
</thead>
</table>
| 4.1     | Level gauge (magnetic & reflex type) | 1. Chemtrol  
2. Forbes Marshall  
3. Mobrey  
4. Hi-Tech (levelstat) |
| 4.2     | Level Switch (Conductivity type) | 1. Vega  
2. Endress & Hauser  
3. Pepperl & Fuchs |
| 4.3     | Level Switch (Capacitance/RF type) | 1. Vega  
2. Endress & Hauser  
3. EIP Bulk  
4. Sapcon |
| 4.4     | Level Switch (Tuning fork/Rod type) | 1. Chemtrol (Vega)  
2. Endress & Hauser  
3. Pepperl & Fuchs |
| 4.5     | Level Switch (Float type) | 1. Emerson  
2. Forbes Marshall  
3. V-Automat  
4. Mobrey |
| 4.6     | Level Switch/Transmitter (Displacer type) | 1. Emerson  
2. Chemtrols (Eckard)  
3. Mobrey  
4. Masoneilan |
| 4.7     | Level Switch/Transmitter (Ultrasonic type) | 1. Endress & Hauser  
2. Forbes – Marshall  
3. Siemens (Miltronics)  
4. Sick  
5. Pepperl & Fuchs |
| 4.8     | Level Switch/Transmitter (Radar type) | 1. Emerson (Rosemount)  
2. Endress & Hauser  
4. Sick  
5. Mobrey |
| 4.9     | Level Switch/Transmitter (Nucleonic type) | 1. Concord International (Dr. Berthold)  
2. Emerson (Kay Ray)  
3. E&H |

5  CONTROL VALVES AND ACCESSORIES
<table>
<thead>
<tr>
<th>Section</th>
<th>Component 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>5.6</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>
</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  

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.4</td>
<td>Bar graph Indicator</td>
<td>Masibus Instruments</td>
<td>Lectrotek</td>
<td>ABB</td>
<td>Yokogawa</td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td>Recorders (Chart less)</td>
<td>Eurotherm</td>
<td>Yokogawa</td>
<td>Honeywell</td>
<td>ABB</td>
<td></td>
</tr>
<tr>
<td>7.6</td>
<td>Microprocessor based controller</td>
<td>Yokogawa</td>
<td>Siemens</td>
<td>Honeywell</td>
<td>Eurotherm</td>
<td>Forbes Marshall</td>
</tr>
<tr>
<td>7.7</td>
<td>Digital scanners</td>
<td>Masibus Instruments</td>
<td>Lectrotek</td>
<td>Radix</td>
<td>Micro Controls</td>
<td>PEPL</td>
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<tr>
<td>7.8</td>
<td>DC Power Supply Unit</td>
<td>Aplab</td>
<td>Phoenix</td>
<td>Schneider</td>
<td>P&amp;F</td>
<td>Siemens</td>
</tr>
<tr>
<td>7.9</td>
<td>IS Interface/Zenner Barrier</td>
<td>Pepperl &amp; Fuchs</td>
<td>MTL</td>
<td>Stahl</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.10</td>
<td>Signal isolators</td>
<td>Pepperl &amp; Fuchs</td>
<td>MTL</td>
<td>Yokogawa</td>
<td>Forbes Marshall (Protech)</td>
<td>Phoenix</td>
</tr>
</tbody>
</table>
### 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

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### 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)
| 8.8  | Vibration sensors & monitors                             | 1. Bentley Nevada                                      |
|      | A. For turbines and other high speed critical machines   | 2. *Shinkawa (Forbes – Marshall)*                      |
|      | B. For other applications                                | 3. SPM                                               |
|      |                                                           | 4. Rockwell                                           |
|      |                                                           | 5. *Vibro-meter*                                      |
| 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(HP) & 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 & HMI will be housed in existing Control Room 1(CR-1). The existing HMI will suitably be upgraded to match the new HMI 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.
04.10.06. 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><strong>Electrical Rooms</strong></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</td>
<td>+ 35 Deg. C</td>
</tr>
<tr>
<td></td>
<td>panels, TR 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><strong>Control Rooms</strong></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 underground 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 despatcher / 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 up gradation, 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 up gradation 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
pad. Weatherproof enclosures will be used for outdoor control panels.

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).
04.10.13.03. Motorized Damper, Switching Device, Slide Valve, Diverter Gate, Flap Gate Etc.

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

02 Each actuator will be provided with '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></td>
<td>tunnels</td>
<td>High bay as required.</td>
<td></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,
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:

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

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

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

CHAP-04.10 ELECTRICAL POWER DISTRIBUTION, DRIVES, CONTROL & ILLUMINATION.doc ELECTRICAL
39. LOCATION OF TERMINAL BOX  
POSITION FROM DE SIDE

40. LUBRICATION TYPE  

41. CABLE SIZE  

42. PAINT SHADE  

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

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

45. PERFORMANCE CHARACTERISTICS  
YES/NO
CURVES VIZ. SPEED V/S CURRENT & 
SPEED V/S TORQUE ENCLOSED

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>No.</td>
<td>Equipment 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</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>complete with single phase / three phase power supply points and separate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>electronic 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>
- Thumb drives
- Backup Tape for Servers
- Cleaning Tape
- Disk Imaging S/W for Server & clients

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>Ethernet Analyzer</td>
<td>1 Set</td>
</tr>
<tr>
<td>36</td>
<td>Portable Oscilloscope</td>
<td>1 Set</td>
</tr>
<tr>
<td>37</td>
<td>Hydraulic fan puller</td>
<td>1 Set</td>
</tr>
<tr>
<td>38</td>
<td>Box Spanner Set</td>
<td>1 Set</td>
</tr>
<tr>
<td>39</td>
<td>Hydraulic Coupling Puller</td>
<td>1 Set</td>
</tr>
<tr>
<td>40</td>
<td>Hydraulic Bearing Puller</td>
<td>1 Set</td>
</tr>
<tr>
<td>41</td>
<td>Cable Fault Locator Machine</td>
<td>1 Set</td>
</tr>
<tr>
<td>42</td>
<td>Motorized torque range</td>
<td>1 Set</td>
</tr>
<tr>
<td>43</td>
<td>PCB Cutter</td>
<td>1 Set</td>
</tr>
<tr>
<td>44</td>
<td>Motor Checker</td>
<td>1 Set</td>
</tr>
<tr>
<td>45</td>
<td>Current Recording meter</td>
<td>1 Set</td>
</tr>
<tr>
<td>46</td>
<td>1.5 mm/ 2.5 sq.mm Crimping Tool</td>
<td>1 Set</td>
</tr>
<tr>
<td>47</td>
<td>AC/DC Digital tongue testor</td>
<td>1 Set</td>
</tr>
<tr>
<td>48</td>
<td>Welding Transformer</td>
<td>1</td>
</tr>
<tr>
<td>49</td>
<td>Power Hack Saw</td>
<td>2</td>
</tr>
<tr>
<td>50</td>
<td>Grinding machines</td>
<td>2</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>I.</td>
<td>Transformer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</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></td>
<td><strong>II. LT Switch Gear</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Auxiliary Contact Set</td>
<td>5% of each type &amp; rating. (minimum 1 set/No. of each type &amp; rating)</td>
</tr>
<tr>
<td>2</td>
<td>Closing Coils</td>
<td>- DO -</td>
</tr>
<tr>
<td>3</td>
<td>Tripping Coils</td>
<td>- DO -</td>
</tr>
<tr>
<td>4</td>
<td>Ammeters</td>
<td>- DO -</td>
</tr>
<tr>
<td>5</td>
<td>Voltmeters</td>
<td>- DO -</td>
</tr>
<tr>
<td>6</td>
<td>Coils for the Contactors &amp; Aux. Contactors</td>
<td>- DO -</td>
</tr>
<tr>
<td>7</td>
<td>Control Isolating &amp; Selector Switch</td>
<td>- DO -</td>
</tr>
<tr>
<td>8</td>
<td>Push Button of Various Colours</td>
<td>- DO -</td>
</tr>
<tr>
<td></td>
<td><strong>III. MCCs, PDBs, MLDB/LDBs</strong></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>Micropresssor 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>Equipment Description</td>
<td>Quantity</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>
</tbody>
</table>

### IV. LOCAL CONTROL STATIONS

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<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>
</tbody>
</table>

### V. MOTORS (OF EACH TYPE & RATING)

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<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>
</tbody>
</table>

### VI. PLC/automation

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<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>
</tbody>
</table>
## VII. UPS

1. **Thyristors cell (Complete assembly)**
   - 5% of each type & rating. (minimum 1 set/No. of each type & rating)

2. **Semiconductor fuses set consisting of 3 Nos.**
   - DO

3. **Diodes**
   - DO

4. **Regulation & pulse generation modules**
   - DO

5. **Static bypass control module**
   - DO

6. **Capacitors**
   - DO

7. **Resistors, varistors**
   - DO

8. **CTs**
   - DO

9. **Surge suppression unit**
   - 5% of each type & rating. (minimum 1 set/No. of each type & rating)

10. **Power transistors/IGBT**
    - DO

11. **DC MCCB**
    - DO

12. **Indication LED**
    - DO

13. **Pulse transformer unit**
    - DO

14. **Trigger pulse generator**
    - DO

## VIII. VVVF DRIVES / SOFT STARTER

1. **IGBT of each type**
   - 5% of each type & rating. (minimum 1 set/No. of each type & rating)

2. **Diode of each type**
   - DO

3. **Fuses of each type**
   - DO

4. **Regulation Cards of VVVF, each type**
   - DO

5. **Pulse transformer unit**
   - DO

6. **Trigger Pulse Generator**
   - DO

7. **RC Snubber Unit**
   - DO

8. **HRC Fuse Link**
   - DO

9. **Push Button actuator with contact element (Red & Green)**
   - DO

10. **Mushroom head push button actuator**
    - DO

11. **LED indication lamp (Red, Green, Yellow)**
    - DO

## IX. BELT SCALES

1. **Load Cell**
   - 5% of each type & rating. (minimum 1 set/No. of each type & rating)
<table>
<thead>
<tr>
<th></th>
<th>SAFETY AND LIMIT SWITCHES</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Electronic cards</td>
<td>-DO-</td>
</tr>
<tr>
<td>3.</td>
<td>Display Units</td>
<td>-DO-</td>
</tr>
</tbody>
</table>

**X. SAFETY AND LIMIT SWITCHES**

<table>
<thead>
<tr>
<th></th>
<th>Type &amp; rating</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**

<table>
<thead>
<tr>
<th></th>
<th>Type &amp; rating</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**

<table>
<thead>
<tr>
<th></th>
<th>Type &amp; rating</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>
### ANNEXURE – E-03

### 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>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 than 90 KW, and series rector 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:
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 duly 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)MEC/S/9101/11/E9/00/00/064.04/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. 0perator’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 topology 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/E9/00/00/064.01/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 CONTACTER 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.
DATA SHEETS
**TECHNICAL DATA SHEET**  (To be filled by the vendor)

### 1.0 CENTRIFUGAL PUMP for Water Supply System (To be furnished separately for all the systems)

1. Make and model no. : 
2. Type of pump : 
3. Capacity in m³/hr. : 
4. Total head in m WC : 
5. Quantity : 
6. Material of Construction of
   - Shaft : 
   - Impeller : 
   - Casing : 
7. Pump speed (rpm) : 
8. Shaft power : 
9. Drive details
   - Motor make : 
   - Motor kW : 
   - Class of insulation : 
   - Frame size : 
10. Bearing type & make : 
11. Type of coupling : 
12. Vibration level : 
13. Noise level at 1 m distance : 
14. Duty : 
15. Weight of pump & motor separately: 
16. Characteristic curves for pumps : 
17. Type of liquid to be handled :
1.1 WATER LINE VALVES for Water Supply System

1. Make & Model : 
2. Type : 
3. Quantity : 
4. Size : 
5. Pressure rating : 
6. Material of construction : 
7. Operating system : 
8. Drive details : 
9. Gland packing : 
10. End connections : 
11. Service : 
12. Test pressure : 

1.2 AIR LINE VALVES for Air Supply System

1. Make & Model : 
2. Type : 
3. Quantity : 
4. Size : 
5. Pressure rating : 
6. Material of construction : 
7. Operating system : 
8. Drive details : 
9. Gland packing : 
10. End connections : 
11. Service : 
12. Test pressure :
### 1.3 AIR RECEIVER

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