

TD-106-1  
Rev.5

Form No.



**PRODUCT STANDARD  
TURBINES & COMPRESSORS  
HYDERABAD**

TC-6-2721

Rev.No. 00

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This job specification shall be completely filled-in, duly signed by supplier and enclosed along with offer.

**TECHNICAL SPECIFICATION OF 1 X 660MW WBPDCS SAGARDIGHI  
OXIDATION BLOWER**

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**1.0 SCOPE:**

This specification describes the requirements of oxidation blower for 1X660 MW WBPDC, SAGARDIGHI FGD projects.

**2.0 LIST OF ANNEXURES:**

| Annexure No. | Annexure Description                           |
|--------------|--|
| 3K           | Provenness Criteria                            |
| I            | Qualification requirement                      |
| II           | Technical Data Sheet                           |
| III          | Schedule of guarantees                         |
| IV           | List of commissioning spares                   |
| V            | Mandatory instrument spares as applicable      |
| VI           | List of Deviations/ Exceptions                 |
| VII          | Reference List                                 |
| VIII         | Documents to be submitted along with offer     |
| IX           | Documents to be submitted after award of offer |
| X            | Various clauses of inspection & testing        |
| XI           | General instruments specifications             |
| XII          | P & ID drawing indicating scope of supply      |

**3.0 APPLICABLE CODES & REGULATIONS:**

The design and materials shall conform to the requirements of applicable codes and regulations of the latest edition. The design, manufacture, installation and testing of the Oxidation Blower shall follow the latest applicable Indian/International (AISI / ASME/EN) Standards.

**4.0 PROJECT INFORMATION:**

The West Bengal Power Development Corporation Limited (WBPDC) proposes to extend their on-going Phase-II extension project of 2x500 MW at Sagardighi by adding one super critical unit of 660 MW as Phase-III extension unit. Sagardighi TPS is located in the village Manigram in Murshidabad district of West Bengal, India. The West Bengal Power Development Corporation Limited, a Company fully owned by the Government of West Bengal formed in the year 1985, have commissioned 2x300 MW Thermal Power Plant together with all other infrastructure at Sagardighi Thermal Power Project. Presently WBPDC is also working on their underconstruction Phase- II extension project of 2x500 MW at Sagardighi.

Sagardighi Super Thermal Power Station site is located at Manigram village, 13 KM north of Sagardighi town by the side of the SMGR (Sagardighi- Manigram-Gankar-Raghunathganj) Road at a distance 20 KM from National Highway 34 in Murshidabad District, West Bengal and around 240 KM from Kolkata, India. The nearest rail station is Manigram adjacent to the site on Bandel - Barhawara branch line and 6.5 KM from Sagardighi Railway Station on Sainthia - Azimgunj line of Eastern Railway.

|    |                     |   |
|----|---------------------|---|
| a. | Owner               | WBPDC                                   |
| b. | Buyer               | Sagardighi TPS, Murshidabad West Bengal |
| c. | Process/Application | Flue Gas Desulphurization               |

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**A) SITE CONDITIONS**

**Design point**

| 1. Ambient Temperature and Relative Humidity |            |
|--|------------|
| Ambient Temperature (Design)                 | : 45 deg C |
| Relative Humidity                            | : 60 %     |

**B) WATER ANALYSIS**

The following water to be used for quenching the Oxidation air discharge temperature <70 deg C.

| S.No | Constituents                       | As    | Content in ppm |
|------|------------------------------------|-------|----------------|
| 1.   | Calcium                            | CaCo3 | 105            |
| 2.   | Magnesium                          | CaCo3 | 52.0           |
| 3.   | Sodium & Potassium                 | CaCo3 | 138            |
| 4.   | Hydrogen (FMA)                     | CaCo3 | ---            |
| 5.   | Total Cations                      | CaCo3 | 295            |
| 6.   | Bicarbonates                       | CaCo3 | 196.5          |
| 7.   | Carbonates                         | CaCo3 | ---            |
| 8.   | Chlorides                          | CaCo3 | 41             |
| 9.   | Sulphate                           | CaCo3 | 57.5           |
| 10.  | Nitrate                            | CaCo3 | ---            |
| 11.  | Total anions                       | CaCo3 | 295            |
| 12.  | M.O. Alkalinity                    | CaCo3 | 196.5          |
| 13.  | P Alkalinity                       | CaCo3 | ---            |
| 14.  | Total Hardness                     | CaCo3 | 157            |
| 15.  | Carbon-di-oxide                    | Co2   | 3.5            |
| 16.  | Dissolved Silica                   | Sio2  | 20             |
| 17.  | Total Iron                         | Fe    | 1              |
| 18.  | pH value                           | --    | 7.9-8.0        |
| 19.  | Turbidity                          | NTU   | 20             |
| 20.  | Organic matter content in terms of |       | 5              |

**5.0 INTENT OF SPECIFICATION**

This specification covers the minimum requirements for the complete design, material, manufacturing, shop inspection, testing at the manufacturer's works, supervision of erection & commissioning and performance testing of Oxidation blower along with accessories which is to be furnished in the Flue Gas Desulphurization plant of 1X660MW WBDCL Sagardighi Project. The following points may be noted.

- a. There is one unit of 660 MW and each unit is envisaged with one FGD system. Each FGD system will be provided with 2 numbers of Oxidation Blower (1 working + 1 standby) which are located inside the Recirculation Pump & Oxidation Blower shed.
- b. Bidder shall assume full unit responsibility for the entire equipment assembly and make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.

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- c. The Bidder shall offer only proven design which meets the proveness criteria indicated in **Annexure-I of TC62721**. Necessary document evidences as per **Annexure-3K of TC62721** for qualification shall be submitted along with the bid. If the Bidder doesn't meet the specified proveness criteria, then the Bidder will not be allowed to participate in the tender.
- d. In case, deviations are considered essential by the Bidder (after exhausting all possible efforts), the same shall be separately listed in the Bidder's proposal under separate section, titled as "List of Deviations/Exceptions to the Enquiry as listed in **Annexure VI of TC62721**."
- e. Any deviation, not listed under the above section, even if reflected in any other portion of the proposal, shall not be considered applicable.
- f. No deviation or exception shall be permitted without the prior written approval of the purchaser.
- g. Compliance to this specification shall not relieve the Bidder of the responsibility of furnishing equipment and accessories/auxiliaries of proper design, materials and workmanship to meet the specified start up and operating conditions.
- h. In case, the Bidder considers requirement of additional instrumentation, controls, safety devices and any other accessories/auxiliaries essential for safe and satisfactory operation of the equipment, the same shall be recommended along with reasons in a separate section and include the same in scope of supply.
- i. All accessories, items of work, though not indicated but required to make the system complete for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically excluded.

#### **6.0 PROVENESS CRITERIA:**

The Bidders are required to meet the Qualification Requirement (QR) for Oxidation Blower as per **Annexure-I of TC62721** & necessary documents evidence requirement as per **Annexure-3K of TC62721** along with necessary supporting documents. Bidder's offer will be rejected if the bidder fails to meet the Qualification criteria.



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## 7.0 TECHNICAL INFORMATION

| Sl. No | Description  | Requirement   |
|--------|--|---|
| 1.     | Quantity   | 2 Nos (1 Working + 1 standby) per unit .Total 2 Nos.  |
| 2.     | <b>Parameters</b>  |   |
|        | Operating Points   | Design Point  |
|        | <b>Blower capacity</b>   | <b>14400 Nm<sup>3</sup>/hr-wet.</b>   |
|        | <b>Discharge pressure</b>  | <b>11100 mmWC</b>   |
|        | Relative humidity  | 60%   |
|        | Suction temperature  | 45.0° C   |
|        | Atmospheric pressure   | 1009 hPa  |
|        | Discharge temperature  | <70° C  |
|        | Type of Blower   | 2x100% electric driven, Roots type oxidation blowers complete with gearbox system (if applicable), lube oil system (if applicable), instrumentation and accessories.  |
|        | Duty   | Continuous  |
| 3.     | <b>Cooling water</b>   |   |
|        | Inlet temperature  | 39° C   |
|        | Outlet temperature   | <49° C  |
|        | Pressure loss  | <0.14 MPa   |
|        | Supply pressure  | 0.65 MPa  |
| 4.     | <b>Air Composition (Wet)</b>   | Design point  |
|        | H <sub>2</sub> O   | 5.76 vol%   |
|        | O <sub>2</sub>   | 19.79 vol%  |
|        | N <sub>2</sub>   | Balance   |
| 5.     | <b>Material of construction</b>  |   |
|        | Casing   | Vendor to provide   |
|        | Shaft  | Vendor to provide   |
|        | Impeller   | Vendor to provide   |
| 6.     | Voltage level for Motors   | a) Up to 0.2KW – Single phase 240V AC/ 3phase 415V AC<br>b) Above 0.2 KW and up to 200 KW- 3phase 415V AC<br>c) Above 200 KW and up to 1500 KW- 3phase 3.3kV AC<br>d) Above 1500KW-11 kV  |
| 7.     | Air filter filtering efficiency  | Vendor to provide along with name of vendor supplying the Air Filter  |
| 8.     | Blower Driver  | Motor   |
| 9.     | Cooling system for reducing the temperature of air at the blower outlet to <70 deg Celsius | Quenching/Cooling arrangement with water injection arrangement to be provided. Heat exchanger should not be provided.<br>Water analysis is given in Table -Water Analysis Below<br>Refer Annexure-1- Reference drawing of Quenching Nozzle from MHPS<br>Quenching Nozzle back pressure- <1.0 bar(g) |
| 10.    | Instrumentation execution  | a) All field transmitter like pressure, temperature, flow, level, DP etc. shall be foundation fieldbus or profibus  |

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| Sl. No | Description | Requirement  |
|--------|-------------|--|
|        |             | <p>type. The exact type shall be informed during detail engineering. Vendor shall quote foundation fieldbus type transmitter in its base offer. Vendor to include 'price implication' if any, in its commercial offer as a separate line item against heading "Price implication (+ / -) for Profibus type transmitters". In case there is no price implication, vendor to indicate the same in the technical offer.</p> <p>b) Control Valve Actuators: Electrical actuators shall to be of Fieldbus type.</p> <p>c) Vibration Sensors: 02 nos on DE side and 02 nos on NDE side.</p> <p>d) Bearing Temperature Sensors: 02 nos on DE side and 02 nos on NDE side.</p> |

|    |  |   |
|----|--|---|
| 11 | <b>POWER SUPPLY</b>  |   |
|    | <b>The following voltage levels shall apply:</b>   |   |
|    | 3.3 kV $\pm 6\%$ , 50 Hz   | Voltage for motors equal to / bigger than 200 KW and for power distribution within the plant.                                     |
|    | 415 V $\pm 10\%$ , 50Hz  | Standard voltage for power supplies to small electric power consumers and motors up to 200 KW lighting and domestic power outlets |
|    | Bidder shall design and supply the equipment suitable for satisfactory operation under above mentioned power supply condition. |   |

**Note: Stand by oxidation blower should start automatically once the working oxidation blower trips due to failure.**

## 8.0 MATERIAL CODES

| Var No | Description  | Material Code |
|--------|--|---------------|
| 01     | 2x100% electric driven, Roots type oxidation blowers complete with gearbox system (if applicable), lube oil system (if applicable), instrumentation. | TC9762721012  |
| 02     | Impeller Assembly  | TC9762721020  |
| 03     | Set of Bearings (Required 1No. each for complete replacement of all bearings in one Blower)  | TC9762721039  |
| 04     | Commissioning spares   | TC9762721047  |
| 05     | Blower instrumentation spare – (Spare list as per Annexure V philosophy which is applicable)   | TC9762721055  |

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**9. SCOPE OF SUPPLY:**

Scope for the bidders shall include Design, Supply, and Supervision of Erection & Commissioning

**Design:** Includes basic engineering, detail engineering, preparation and submission of engineering drawings/calculations/datasheets/quality assurance documents/field quality plans, storage instructions commissioning procedures, operation & maintenance manuals, performance guarantee test procedures and assisting BHEL in obtaining time bound approval from customer.

**Supply:** Includes manufacturing/fabrication, stage inspections, final inspections, shop floor testing, painting & packing

**Supervision of Erection & commissioning:** Includes supervision of erection & commissioning, supervision of trial operation, training of customer's O&M Personnel.

Supplier's scope shall cover complete air blower unit including sub-systems, start-up spares and special tools (typically) as given below. The scope of supply for air blower shall include but not limited to the following:

| Sl. No | Scope of Supply for each Blower  |
|--------|--|
| 1.     | Suction filter including silencer along with filter support structure  |
| 2.     | Suction expansion joint, if required   |
| 3.     | Suction piping from filter up to blower suction nozzle   |
| 4.     | Air Blower   |
| 5.     | Gear Box (or) Belt & Pulley ( if required)   |
| 6.     | Coupling between motor & gear box (or) Belt and Pulley (as applicable)   |
| 7.     | Non sparking coupling guards (between motor & gear box and between gear box & Blower as applicable or Belt and Pulley)                             |
| 8.     | Discharge expansion joint  |
| 9.     | Blow-off control valve with required accessories such as solenoid valve limit switches, positioner etc completely tubed and wired to junction box. |
| 10.    | Blow-off silencer  |
| 11.    | Complete Blow-off piping   |
| 12.    | Discharge non return valve   |
| 13.    | Discharge Silencer   |
| 14.    | Motor operated isolation valve in discharge  |
| 15.    | Discharge piping from Blower outlet up to isolation valve  |
| 16.    | Foundation bolts for complete blower and Motor frame.  |
| 17.    | Anti-vibration pad, if required  |
| 18.    | Common Base frame for Blower, gear box (as applicable) and motor   |
| 19.    | Lube Oil System for blower and gear box (details to be provided by vendor)   |
| 20.    | Casing drain terminated at battery limit with flange   |
| 21.    | Acoustic hood to meet specified noise level (if applicable)  |
| 22.    | Accessory Piping within the skid   |
| 23.    | Companion flanges with gaskets and fasteners at all terminal points  |
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|--|--|
| 24.  | Differential pressure Indicator across suction filter  |
| 25.  | Vibration Monitoring: Provision for Vibration Monitoring & Temperature elements wired up to JB.  |
| 26.  | Pressure Indicator in the discharge line   |
| 27.  | All Cabling up to junction boxes with double compression cable glands  |
| 28.  | Junction Boxes   |
| 29.  | Safety Valves required for the blower  |
| 30.  | Electrical items as required like lube oil pump motors, heaters etc are to be included in vendor scope   |
| 31.  | Mechanical Running at shop with vendor's shop motor  |
| 32.  | Performance test at shop   |
| 33.  | Supervision of erection / commissioning , start-up and trial run of blower   |
| 34.  | Start-up & Commissioning spares as applicable to be included in base quote   |
| 35.  | O&M spares with price breakup  |
| 36.  | Special tools & Tackles as applicable  |
| 37.  | Painting as per specification  |
| 38.  | Packing & Forwarding   |
| <b>Common Scope: For two Blower</b>  |  |
| 39.  | Discharge air piping from individual blower isolation valve to flow element in common discharge line.  |
| 40.  | Quenching system to bring the discharge temperature to <70 deg C .   |
| 41.  | Cooling water supply to Gearbox or Bearing and return will be provided at one point near battery limit. Further distribution is in vendor scope. |
| 42.  | Instrument air supply will be provided at one point near battery limit. Further distribution is in vendor scope.                                 |
| All the instruments/items which have to be supplied by Blower vendor is indicated in the P&ID enclosed . Any other items / components not indicated in the P&ID , but required as per blower manufacturer's standard practice or required for blower operation shall also be provided. |  |

|            |  |
|------------|--|
| <b>9.1</b> | <b>CONSTRUCTION FEATURES</b>   |
| a.         | Each blower shall be a complete unit with casing, rotor, shaft and drive unit etc.   |
| b.         | The Blowers shall be Positive displacement type with lube oil system, instrumentation and accessories. It shall be compact and simple in design requiring minimum number of spares.  |
| c.         | The oxidation blowers should be complete with drive arrangement consisting of coupling, coupling guard, base frame shock absorbers, mounting bolts, air filter, Acoustic enclosures, silencers, safety valves and check valves etc.  |
| d.         | The oxidation blowers shall be designed for continuous operation along with suitable quenching arrangement with temperature measurement and control to meet the exit temperature < 70 deg C. The Bidder shall specify the cooling water requirement for reducing the temperature of discharge air. |
| e.         | The rotor shall be ground all over and accurately machined. The rotor along with other rotating parts shall be statically balanced and then dynamically balanced as per ISO 1940 to ensure efficiency, vibration, performance and long bearing life.   |

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|            |  |
| f.         | The air intake filter cum silencer, preferably dry type, to prevent dust and other atmospheric impurities from entering the blower shall be provided for each blower. Air filter shall have better filtering efficiency.   |
| <b>9.2</b> | <b>COOLING ARRANGEMENT</b>   |
| a.         | The discharge air temperature <70 Deg C may be obtained by quenching arrangement with water injection at the common discharge with temperature measurement.  |
| b.         | In case of casing cooling, the vendor shall consider the water quality available and accordingly select the casing material to withstand the corrosion, if any. The inside of the casing also to be coated with corrosion resistant materials of adequate thickness to enhance corrosion resistance of the Blower.   |
| c.         | The vendor to provide the following accessories along with cooling arrangement (with auto drain) <ul style="list-style-type: none"><li>▪ Required pipe fittings within the scope of terminal points</li><li>▪ Required number of spray nozzles</li><li>▪ Water quantity required</li><li>▪ Required flow control devices like valves, pressure gauges and other instruments.</li><li>▪ Scheme &amp; arrangement drawing shall be mentioned in offer.</li></ul> |
| <b>9.3</b> | <b>CASING</b>  |
| a)         | Casing shall be of robust construction. It shall be made from Casting or fabricated from heavy gauges steel sheets or plates or bidder's proven design standard.   |
| b)         | In case of castings, the casing will be of Gray Cast Iron confirming to IS: 210 grade 25 or equivalent, designed for the duty conditions or proven design standard. Castings shall be free from all defects and blowholes and shall be machined to close tolerance. In case of fabricated casings, it shall be rigidly reinforced and supported by structural members. Weld seams shall be continuous to have air-tight enclosure.                             |
| c)         | Casings shall also have smooth interior to avoid accumulation of dense particles. Inlet shall be spun to have a smooth contour.  |
| d)         | If necessary, provision for ready access to the interiors of casings and other possible trouble points shall be made by means of readily removable, bolted on plates or by hinged and latched doors.   |
| e)         | Any connections shall be flanged. Flange diameter and drilling shall conform to ANSI B16.5 Class 150   |
| <b>9.4</b> | <b>ROTORS &amp; IMPELLERS</b>  |
| a)         | The rotor shall be made of cast iron or forged steel or proven design standard.  |
| b)         | Rotor assemblies shall be statically balanced and then dynamically balanced as per ISO 1940.   |

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| <b>9.5</b> | <b>SHAFT, SHAFT SEALS AND BEARINGS:</b>  |
| a)         | The shaft shall be made of alloy steel or bidder's proven design standard.   |
| b)         | Shafts shall be conservatively designed to transmit maximum power required and to assure rigidity. Shafts shall be machined and ground to close tolerances and shall be tapered to permit easy removal of the seals and bearings.  |
| c)         | Shaft shall run in high precision heavy duty bearings. Lubrication system provided shall be such that visual checking of lubricant level is possible   |
| d)         | The shaft shall be finished to close tolerance at the rotor, coupling, pulley and bearing diameters. The size of shaft shall be calculated on the basis of maximum combined shear stress. This shear stress shall not exceed 30 percent of the elastic limit in tension or 18 percent of ultimate tensile strength.  |
| e)         | The design of shaft shall also take into consideration the critical speed of the shaft, which shall be at least 20% above the operating speed or 60 to 75% of the operating speed to minimize vibrations. Shafts shall be tapered to permit easy removal of the seals and bearings   |
| f)         | Shaft seals shall be provided to seal rotating shafts. Shaft seals shall be of the labyrinth type, of non-sparking material and shall be horizontally split to facilitate maintenance. The housing shall be of cast iron or fabricated steel construction and shall be horizontally split to provide access to all bearings and shafts.                      |
| g)         | The bearings may be ball, roller or sleeve bearing. If sleeve bearings are used these shall be machined for close running fit. The bearings shall be designed to take the necessary radial load as well as the net axial thrust. Bearings shall be lubricated properly and sized for an operating life minimum of 50,000 hours on the basis of maximum load. |
| h)         | Blower induced vibration due to flow pulsations shall be avoided through suitable design.  |
| i)         | Bearing temperature sensor shall be provided for remote monitoring of the bearing metal temperature of blowers. 2 Nos of Duplex RTD shall be provided to measure bearing temperature at DE and NDE ends.   |
| <b>9.6</b> | <b>BELT &amp; PULLEY/ COUPLING</b>   |
| a)         | The HT drive motor is excluded from the scope of supply. However, the bidder shall supply coupling or belt and pulley for secondary transmission.  |
| b)         | Coupling shall be of flexible type. The Bidder shall furnish both halves of the coupling. Both the Coupling halves shall be bored and keyed to fit shafts of the blower and the motor by bidder.   |
| c)         | All rotating parts such as coupling or belt & pulley shall be covered with suitable protective guards. Guards shall be easily removable type.  |
| <b>9.7</b> | <b>BASE PLATE</b>  |
| a.         | A common base plate shall be provided for Blower assembly & Motor and same shall be rigidly constructed, adequately braced and provided with finish pads for mounting blower.  |
| b.         | Suitable holes shall be provided for grouting and these shall be so located that the base plate can be grouted in place without disturbing the blower and motor.   |

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| <b>c.</b>  | Common base plate for Blower and Motor shall be in the scope of the bidder and the details of the Motor will be furnished to the bidder to provide Motor mounting bolts.   |
| <b>9.8</b> | <b>MOTORS</b>  |
|            | <ul style="list-style-type: none"><li>▪ Above 0.2 kW and upto 200 kW: 3 phase 415 V AC-VENDOR SCOPE</li><li>▪ Above 200 kW and upto 1500 kW: 3.3 KV- BHEL SCOPE</li><li>▪ Above 1500 kW: 11 KV-BHEL SCOPE</li></ul>  |
| <b>9.9</b> | <b>ACCESSORIES:</b>  |
| <b>1.</b>  | <b>Lube Oil Unit : (If applicable)</b>   |
| a)         | Each blower shall be furnished with an integral lubricating oil package. Each package shall be complete with single water to oil heat exchanger, full flow oil filter and oil pump. The oil pump shall be direct driven from the blower shaft. The complete package shall be factory wired, assembled and mounted on the base plate. Air cooled LO System shall be applied. If cooling water is required, bidder shall provide the supply requirements(flow, pressure) and the return conditions(temperature, pressure drop) |
| b)         | Emergency power supply is not available. The Lubricating oil system shall be designed that will satisfy the required lubrication for bearing at the time of electric power failure also.   |
| c)         | Oil Bath System for Lubrication can also be provided instead of Lube oil system for machine to coast down  |
| <b>2.</b>  | <b>Coupling Guards-</b> All rotating parts outside casing such shall be covered by the guard.  |
| <b>3.</b>  | <b>Timing Gears</b>  |
| a)         | Timing gears shall be of the wide faced spur or helical type, hardened & ground to DIN Class V or better accuracy.   |
| b)         | Bearings shall be of anti-friction type only. The bidder shall provide the countermeasure for the fretting corrosion on the fitting surface of the thrust disc and separated outer race of anti-friction bearings.   |
| c)         | Lubrication is required for timing gear pair and bearings.   |
| <b>4.</b>  | <b>Intake Air Filter Silencers:</b>  |
| a)         | Each blower shall be provided with an inlet filter silencer of dry type and a conical shaped screen ahead of the filter. Filters shall be capable of removing minimum 82 percent of all particles 10 microns and larger. Suitable filter area shall be provided for air suction. The suction area shall be minimum of twice the inlet pipe area. Differential pressure gauges shall be provided in filters to monitor any clogging in filters. Silencers shall be provided in discharge also.                                |
| <b>5.</b>  | <b>Expansion Joints:</b>   |
| a)         | Expansion Joints shall be provided at the suction and discharge of each blower   |
| <b>6.</b>  | <b>Safety Valves:</b>  |
| a)         | Each blower shall be provided with a safety relief valve on its discharge.   |
| b)         | The valve, valve operator and controller shall be remotely mounted to prevent vibration damage.  |

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|           | The valve shall be mounted in an easily accessible location to allow for maintenance and testing   |
| c)        | The safety valve discharge piping shall be routed to a location such that personnel exposure to the discharge is prevented.  |
| <b>7.</b> | <b>Piping and Valves:</b>  |
| a)        | All interconnecting piping whichever is necessary for operation of each unit shall be provided complete with shut off valves, check valves, strainers and fittings.<br>Details of Oxidation blower piping : Material: A53-B or equivalent suitable for specified application   |
| b)        | Details of valves are given below:<br><br><b>i) BUTTERFLY VALVE</b><br><br>Rating: CL 150, Body: A216WCB, Trim:13CR, Lining: EPDM, Connection: WAFER<br>Operation: Electrically operated with hand wheel integral starter type.<br><br><b>ii) CHECK VALVE:</b><br><br>Rating: CL 150, Body: A395, Trim: 13CR, connection: RF , Type: BC,SWING.<br><br><b>iii) GATE VALVE:</b><br><br>Rating: CL 150, Body: A105, Trim:13CR, Lining: Seat STL, Connection: SW,<br>Operation: Hand wheel, Bonnet: BB,OS&Y  |
| <b>8.</b> | <b>Blower control:</b>   |
| a)        | Bidder to provide the control logic for the oxidation blower   |
| b)        | Control of the blower shall be done from the DCS located in the FGD control room. Bidder shall provide all inputs for the same.  |
| <b>9.</b> | <b>Blower Shut Down:</b>   |
| a)        | Following is a typical list of abnormal conditions which might require blower shut down/Alarm. The contractor shall propose the exact conditions which require shutdown/alarm<br>Blower shutdown signals:<br><br>a) Discharge air temperature high<br><br>b) Discharge pressure low or high.<br><br>Temperature transmitter for initiating shutdown of blower during when “Discharge air temperature high” shall be supplied by Bidder.<br><br>Pressure Switch for initiating Shutdown of blower during when “Discharge pressure low or high” shall be supplied by Bidder. |
| b)        | In addition to the Instrumentation & Control devices, sensing conditions which require shut down an emergency stop push button shall be provided. The push button shall be wired to the terminal blocks in the control cabinet for external connection to the blower controller.   |

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| c)         | Provision shall be made to shut off the blower automatically when the level of lubricating oil falls below the design value. Suitable provision shall be made to take the signal to PLC / DCS system. In case of water cooling, the blower shall be shut off automatically whenever the pressure of the cooling water supply line falls below preset value.                            |
| <b>10.</b> | <b>PROVISSION FOR VIBRATION MONITERING:</b>  |
|            | Bidder shall make provision for mounting 2 vibration sensors per measurement location - Driven end & non driven end (one for horizontal & one for vertical measurement). For mounting of vibration pads/pickups flat surfaces shall be provided, both in X & Y directions, by the bidder on the bearing housing in such a way, so that welding/screwing of the pads shall be possible. |
| <b>11</b>  | <b>INSTRUMENTS AND ACTUATORS:</b>  |
|            | All instruments which are in blower vendor scope is indicated in P&ID. All electrical actuators shall be with integral starters. Bidder shall refer to Annexure for specification of Instruments.  |

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| <b>10.0</b> | <b>GENERAL REQUIREMENTS</b>   |
| 1.          | Metric unit shall be used in the drawings and in the any displays on the equipment's.   |
| 2.          | Descriptions in the drawings, in the documents, and in the displays shall be in English   |
| 3.          | All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type.  |
| 4.          | The equipment shall be designed to withstand the corrosive and moist environment in which these are proposed to operate.  |
| 5.          | Noise level produced shall not exceed 85 dB measured at a distance of 1.0 meters from the source in any direction and 1.5m above operating floor. Predicted sound pressure levels for the blower drive assemblies shall be submitted as part of the proposal data. The Acoustic enclose should be suitably designed to meet the required Noise Level.   |
| 6.          | The overall vibration level shall be as per ISO 10816.  |
| 7.          | Suitable drain connections shall be provided.   |
| 8.          | The equipment shall be suitable for stable operation continuously.  |
| 9.          | Limit of connection: The buyer (BHEL) has an intention to minimize interface for utilities as much as possible. The bidder shall consider this requirement in the planning stage of layout for the equipment. The bidder shall provide the header piping for utilities and branch piping to each nozzle. Terminal points for all utilities shall be located at skid edge. The bidder shall specify all terminal points with tie-in number in the P&ID and submit it in the proposal to confirm the scope of supply. |
| 10.         | Service life: Entire equipment except wearing parts shall be designed and fabricated for a minimum service life of 30 years of operation or 200,000 full load operating hours whichever is longer.  |
| 11.         | Corrosion allowance: Corrosion allowance for entire equipment shall be in accordance with latest applicable international standard.   |

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| 12. | Unless otherwise specified , flanges shall be in accordance with ANSI B16.5 Class 150   |
| 13. | Name plate: All equipment shall be provided with nameplates indicating the item number and service name. Name plates shall be of 304 Stainless steel plate and placed at a readily visible location. Nameplate of main equipment shall have enough information, which will be confirmed during engineering phase. Stainless steel nameplates for all instruments and valves shall be provided.  |
| 14. | Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.   |
| 15. | Unless otherwise specified, all equipment items where the weight exceeds 15 kg shall be provided with suitable lifting lugs, ears or ring bolts or tapped holes for lifting rings. Minimum shock factor for lifting lugs shall be minimum 2.0. The position of lifting lugs and reference dimension shall be shown on GA and/or outline drawings. NDT shall be conducted for lifting lugs. When any spreader bars are required for lifting and laydown, the bidder shall provide spreader bar with equipment. |
| 16. | Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.  |
| 17. | Two pieces of stainless steel earth lugs shall be provided with equipment diagonally. The position of earth lugs shall be shown on each GA and/or outline drawing.  |
| 18. | Provide double nuts for anchor bolts  |
| 19. | Bidder shall provide allowable vibration level on foundation in foundation drawings and/or general arrangement drawings.  |
| 20. | If the driver/driven equipment train is in the resonance condition or any vibration problems occur, the bidder shall solve the problems in a timely manner.   |
| 21. | The bidder shall have full responsibility for vibration control of the equipment train at the site and the unit's satisfactory performance, even if the foundation and drivers are provided by the BHEL.  |
| 22. | Bidder shall provide the mating flanges with the necessary gaskets.   |
| 23. | All the surfaces of the carbon steel should be rust prevented before shipment for the period of at least 12 months for storage and construction.  |
| 24. | Bidder to specify capacity of crane or hoist required for material handling and the details of heaviest component to be handled.  |
| 25. | The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted.   |
| 26. | Quality Plan to be submitted along with the offer.  |
| 27. | During entire period of the equipment / project erection, commissioning & operation, the bidders shall strictly follow and adhere to the guidelines for effective Health & Safety Management. Supply of safety gears/PPE for bidder's/bidder's sub vendor personnel deputed at site for Supervision of E&C, PG tests etc. shall be in bidder's scope.   |
| 28. | Cost towards the participation in discussions/meetings, technical discussions/meetings with   |

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|     | customer for approval of drawing/documents etc. shall be included in bidder scope. TA/DA, boarding and lodging to attend these meetings shall be borne by the bidder.   |
| 29. | Material of construction for all equipment/components shall be subject to BHEL/ End customer approval during detail engineering. Accordingly bidder shall consider MOC for all equipment/component as per best engineering practice, global standard and global references.   |
| 30. | Bidder to provide sub vendor list and Bidder shall strictly adhere to BHEL/END CUSTOMER approved vendor list.   |
| 31. | It shall be the complete responsibility of the successful bidders to obtain "Sub Vendor Approval" from END CUSTOMER for all equipments & components. Any delay in sub vendor's approval should not affect the project schedule. If any of the sub vendors does not have the approval of END CUSTOMER, the same may be replaced with another END CUSTOMER approved sub-vendor only, without any price implications to BHEL   |
| 32. | <p>The modalities of inspection (Stage, Final, In-process) shall be finalized during detail engineering after submission of quality assurance plan (QAP). It shall be reviewed by END CUSTOMER &amp; BHEL. Bidder shall follow the procedures of inspection as per the approved QAP. Bidder has to submit the following documents along with inspection call and if any other documents required as per approved QAP.</p> <ul style="list-style-type: none"><li>- Raw material inspection certificate</li><li>- Internal test reports</li><li>- Statutory certificates as required.</li><li>- All inspection &amp; testing shall be carried out based on the following documents:<ul style="list-style-type: none"><li>a. Relevant Standards</li><li>b. Specifications</li><li>c. Approved drawings</li><li>d. Data Sheets</li><li>e. Calibration certificate for all the measuring instruments</li><li>f. Bidder should also coordinate in getting the MDCC's (Material Dispatch clearance certificate) and all types of IC's (Inspection Certificates) from the customer/customer's consultant along with BHEL.</li></ul></li></ul> |
| 33. | Minor Chipping i.e. up to 50 mm thk, micro leveling and providing shim plates for erection of equipment / item at site shall be in the scope of bidder.   |
| 34. | During detail engineering, bidder to strictly adhere to BHEL/ END CUSTOMER drawing formats, document numbering, quality plan & FQP formats.   |
| 35. | The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with the VGB guideline RDS-PP (Reference Designation System for Power Plants - KKS system).  |

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| 36.         | Complete detail engineering drawings, calculations, selection of components etc. shall be reviewed & subject to approval of BHEL during detail engineering  |
| 37.         | Bidder shall furnish necessary inputs & drawings of all equipment in editable Auto CAD/ MS-Word /Excel format.  |
| 38.         | During detail engineering, successful bidder shall ensure flow of drawings/documents as per schedule. Any comments from BHEL should be addressed timely by the bidder.  |
| 39.         | Bidder to note that list above is not exhaustive and any work /items required for completing the smooth operation and ensuring satisfactory running of the machines till final hand over to the end user shall also be in the scope of the bidder.  |
| 40.         | Bidder shall submit the signed and stamped copy of all the pages which constitutes this technical enquiry specification signed by authorized signatory and clearly mentioning each clause under following two categories to avoid any ambiguity in scope understanding & the scope division along with technical offer.<br>a. "Accepted without deviation and considered in scope of work"<br>b. "Not considered in scope of work"  |
| <b>11.0</b> | <b>PACKING INSTRUCTIONS</b>   |
| 1.          | Proper packing to be ensured.<br><br>Each package or shipping units shall be clearly marked or stenciled on at least two sides as follows.<br><br><b>WBPDCL 1X660MW SAGARDIGHI TPS<br/>MIRSHIDABAD DISTRICT<br/>WEST BENGAL, INDIA</b><br><br><b>EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LIMITED, INDIA</b><br>In addition, each package or shipping unit shall have the symbol painted in red on at least two sides of the package, covering one fourth of the area of the side.  |
| 2.          | Indigenous Supply: Oxidation Blower & sub system assembly shall be wrapped in polythene bags & packed in a strong rigid wooden crate. Rain water should not enter into the Oxidation Blower internals during storage in the outer yard of power plant.<br><br>Imported Supply: All imported supply (supplies from outside India) should be packed as per standard packaging norms.  |
| 3.          | Equipment and process materials shall be packed and semi-knocked down, to the extent possible, to facilitate handling and storage and to protect bearings and other machine surfaces from oxidation. Each container, box, crate or bundle shall be reinforced with steel strapping in such a manner that breaking of one strap will not cause complete failure of packaging. The packing shall be of best standard to withstand rough handling and to provide suitable protection from tropical weather while in transit and while awaiting erection at the site. |
| 4.          | Equipment and materials in wooden cases or crates shall be properly cushioned to withstand the abuse of handling, transportation and storage. Packing shall include preservatives suitable to tropical conditions. All machine surfaces and bearings shall be coated with oxidation preventive compounds. All parts subject to damage when in contact with water shall be coated with suitable grease and wrapped in heavy asphalt or tar impregnated paper.  |

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| 5.  | Crates and packing material used for shipping will become the property of owner.  |
| 6.  | Packaging or shipping units shall be designed within the limitations of the unloading facilities of the receiving ports and the ship will be used. It shall be the bidder's responsibility to investigate these limitations and to provide suitable packaging and shipping to permit transportation to site.  |
| 7.  | Packing shall be part of the equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of equipment during transportation. In case of equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the material and weight characteristics are to be indicated. |
| 8.  | Each package should have the following inscriptions and signs stenciled with an indelible ink legibly and clearly:<br><br>a. Destination<br><br>b. Package Number<br><br>c. Gross and Net Weight<br><br>d. Dimensions<br><br>e. Lifting places<br><br>f. Handling marks and the following delivery marking  |
| 9.  | Separate packing has to be done for each unit. Each package or shipping units shall be clearly marked or stenciled on at least two sides as per the Dispatch Address given in the indent/enquiry. In addition, each package or shipping unit shall have the symbol painted in red on at least two sides of the package, covering one fourth of the area of the side.                          |
| 10. | Each part of the equipment which is to be shipped as a separate piece or smaller parts packed within the same case shall be legibly marked to show the unit of which it is part, and match marked to show its relative position in the unit, to facilitate assembly in the field. Unit marks and match marks shall be made with steel stamps and with paint.                                  |
| 11. | Each case shall contain a packing list showing the detailed contents of the package. When any technical documents are supplied together with the shipment of materials no single package shall contain more than one set of such documents. Shipping papers shall clearly indicate in which packages the technical documents are contained.   |
| 12. | The case number shall be written in the form of a fraction, the numerator of which is the serial number of the case and the denominator the total number of case in which a complete unit of equipment is packed.   |
| 13. | Wherever necessary besides usual inscriptions the cases shall bear special indication such as "Top", "Do not turn over", "Care", "Keep Dry" etc. as well as indication of the center of gravity (with red vertical lines) and places for attaching slings (with chain marks)  |
| 14. | Marking for Safe handling: To ensure safe handling, packing case shall be marked to show the following:<br><br>a. Upright position  |

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|             | <p>b. Sling position and center of Gravity position</p> <p>c. Storage category</p> <p>d. Fragile components ( to be marked properly with a clear warning for safe handling)</p>  |
| 15.         | <p>Each crate or package is to contain a packing list in a waterproof envelope. All items are to be clearly marked for easy identification against the packing List. All cases, packages etc. are to be clearly marked on the outside to indicate the total weight where the weight is bearing and the correct position of the slings are to bear an identification mark relating them to the appropriate shipping documents. All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or varnish to prevent obliteration in transit.</p>  |
| 16.         | <p>The packing slip shall contain the following information: -<br/>Customer name, Name of the equipment, Purchase Order number with Date, Address of the delivery site, Name and Address of the Sender, Serial Number of Blower &amp; accessories, BHEL item Code, Gross Weight and Net weight of Supplied items.</p>  |
| 17.         | <p>Prior to transport from manufacturer's work to destination, components of the unit shall be completely cleaned to remove any foreign particles. Flange faces and other machined surfaces shall be protected by an easily removable rust preventive coating followed by suitable wrapping.</p>   |
| 18.         | <p>All necessary painting, corrosion protection &amp; preservation measures shall be taken as specified in painting schedule. Supplier shall consider the coastal environment zone which is defined as "very severe" during final finishing/shipping.</p>  |
| 19.         | <p>Successful bidder shall furnish the detail packing /shipment box details with information like packing box size, type of packing, weight of each consignment, sequence no. of dispatch, no. of consignment for each deliverable item against each billing break up units/ billable blocks. Without these details the BBU shall not be approved during detail engineering.<br/>Also, complete billing break-up with above mentioned details shall be submitted within 10days of LOI.</p>   |
| 20.         | <p>All items/equipment shall be dispatched in properly packed condition (i.e. no item shall be dispatched in loose condition such that it becomes difficult to store/identify its location at site at a later stage).</p>  |
| 21.         | <p>Cases which cannot be marked as above shall have metal tags with the necessary markings on them. The metal tags shall be securely attached to the packages with strong steel binding wire. Each piece, Skid, Case or package shipped separately shall be labelled or tagged properly.</p>   |
| <b>12.0</b> | <b>SUPERVISION OF ERECTION, TESTING AND COMMISSIONING</b>  |
| 1.          | <p>The erection of Oxidation Blower will be done by owner as per Erection Manual and check List. However, the bidder shall make one visit per FGD system for the supervision of erection, pre-commissioning &amp; post- commissioning check-up, start-up, testing and trial runs of all the items covered under the scope of supply.<br/>There will be one visit for one FGD system. The bidder will be informed well in advance for the visit. Bidder shall include 6 working days per visit in the offer with minimum 1 visit. For one unit 6 working days must be included.</p> <p>BHEL shall conduct performance test of FGD package at site. Vendor shall provide supervision services for site performance test on per diem basis for each unit.</p> |

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| 2.          | TA/DA, boarding and lodging for bidder supervisor/ site engineers shall be borne by the bidder and shall be inclusive in supply portion.  |
| 3.          | Price comparison for evaluating the lowest bid will be considered all main supply, supervision of E&C charges and mandatory spares price all together.  |
| <b>13.0</b> | <b>EXCLUSION</b>  |
|             | The following work associated with the air blower will be by others:<br><br>a. Supply of main drive HT motor<br><br>b. Civil foundations<br><br>c. Walkways, platforms and ladders<br><br>d. Element handling hoists  |
| <b>14.0</b> | <b>INSPECTION AND TESTING</b>   |
|             | The General inspection requirements to be considered are as below:  |
| 1.          | Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings to be used on the Blowers for review by BHEL/ END CUSTOMER prior to manufacture.   |
| 2.          | The Bidder shall furnish MRT & Performance test procedure in line with international standard. The test procedure will be reviewed and approved by the BHEL/ END CUSTOMER.  |
| 3.          | Out of 2 Oxidation Blower, performance test of 1 No will be witnessed by BHEL/ TPI/ END CUSTOMER before dispatch of machine at the Bidder's works or where the test facilities are available. A notice of minimum three (3) weeks shall be given for witnessing the test. |
| 4.          | The Bidder shall conduct performance test for the remaining blowers and submit the reports.   |
| 5.          | Final inspection and release by BHEL/ END CUSTOMER is a mandatory requirement unless specially waived.  |
| 6.          | A dynamic balancing certificate stating that the rotating assembly has been balanced dynamically shall be sent to BHEL/ END CUSTOMER within one (1) week of the successful completion of balancing.   |
| 7.          | Acceptance tolerance of actual versus guaranteed performance for capacity, Static head, efficiency and power absorbed shall be as per applicable standard.  |
| 8.          | Vibration levels shall be measured during shop running/performance tests.   |
| 9.          | Contract shaft seals shall be used during shop tests, unless the seal design is unsuitable for the shop-test condition.   |
| 10.         | Blower shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.  |
| 11.         | Bidder should furnish performance guarantee as per applicable standard guarantee for the design, manufacture, material and safe operation of the equipment's.   |

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| 12.   | Bidder shall arrange all calibrated gauges, Instruments during testing.   |                     |
| 13.   | Mechanical running and the performance test shall be carried out. Bidder shall arrange Motor for the shop test and inspection.  |                     |
| 14.   | The performance test may be carried out using air at shop and shall be converted to the design condition.   |                     |
| 15.   | Inspection and testing will be done as per END CUSTOMER approved Quality Plan. In case of order placed on foreign Vendor, Vendor shall engage and appoint at their cost of any reputed third Party Inspection Agencies having international presence for carrying out inspection of equipment's and material at vendor's & sub vendors works. Sample QP(indicative) is attached as <b>Annexure-IX of TC62721</b> .  |                     |
| <b>15.0</b>   | <b>PAINTING</b>   |                     |
| 1.  | <b>Surface Preparation :</b><br>Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm   |                     |
| 2.  | <b>Primer Coat :</b><br>Two coats of Epoxy Zinc phosphate primer as per IS 13238 DFT-35µ/coat<br>DFT – 70 µ   |                     |
| 3.  | <b>Finish:</b><br>Two coats of Epoxy based Polyamide cured finish paint to IS 14209 DFT-35µ/coat<br>Shade: Light grey<br>Shade no. 631 of IS:5<br>Total 70 µ  |                     |
| 4.  | Total DFT – 140 (µm min.)   |                     |
| 5.  | Rust preventive paint after inspection at shop floor before dispatch shall be in bidder's scope   |                     |
| 6.  | Corrosion protection, coating and galvanizing, painting shall be taken care by the bidder. The above painting schedule is tentative and shall be subject to approval of BHEL / END CUSTOMER during detailed Engg/after placement of PO.   |                     |
| <b>16.0</b>   | <b>SPARES,TOOLS &amp; TACKLES</b>   |                     |
| <b>16.1</b>   | <b>START UP &amp; COMMISSIONING SPARES</b>  |                     |
|   | Start-up & Commissioning Spares shall be part of the main supply of Oxidation blowers. Start-up & commissioning spares are those spares which may be required during the start- up and commissioning of the equipment/system. All spares required for successful operation till commissioning of Oxidation blowers shall come under this category. Bidder shall provide an adequate stock of such start up and commissioning spares to be brought by him to the site for the equipment erection and commissioning. The spares must be available at site before the equipment's are energized. These start-up & commissioning spare part list shall not be included in "Initial Spare Parts List". |                     |
| <b>16.2</b>   | <b>INITIAL SPARE PARTS (MANDATORY SPARES):</b>  |                     |
|   | Bidder shall quote for the “mandatory spares” as per the enquiry, and it will be considered for L1 evaluation. Initial spare parts items shall be handed over separately and shall not be mixed with the supply of the main equipment parts. Spares shall be sent in pre-decided lots in containers/secure boxes. All boxes/containers are to be distinctly marked in red color with boldly written “S” mark on each face of the containers. Spares shall not be dispatched before dispatch of corresponding main equipment's. Each item shall be labelled in English and be  |                     |

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|             | <p>packed against damage and sealed to prevent deterioration from corrosion. The protection shall be sufficient for a minimum of 10 years' storage in a dry weatherproof building.</p> <p>All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. All the mandatory spares shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan.</p> <p>All spares to be used during this contract shall be strictly inter-changeable with the parts for which they are intended for replacements.</p>  |
| <b>16.3</b> | <b>RECOMMENDED SPARES</b>  |
|             | <p>In addition to the spare parts mentioned above, the bidder shall also provide a list of recommended spares for 3 years of normal operation of the plant and should be independent of the list of the mandatory spares. Prices of recommended spares will not be used for evaluation of the bids. The price of these spares shall remain valid up to 6 months after placement of Notification of Award for the main equipment.</p>   |
| <b>16.4</b> | <b>SPECIAL TOOLS &amp; TACKLES:</b>  |
|             | <p>Any special tools &amp; tackles required for the entire equipment to disassemble, assemble or maintain the units (<b>One set for each unit</b>), they shall be included in the quotation and furnished as part of the initial supply of the machine. List of special tools &amp; tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as "Special Tools for (tag / item number)." Each tool shall be stamped or tagged to indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools.</p>  |
| <b>17.0</b> | <b>PERFORMANCE GUARANTEE</b>   |
|             | <p>All performance tests for blowers shall be carried out in accordance with any latest international codes/standards.</p> <ol style="list-style-type: none"><li>1) Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Oxidation Blower and its accessories</li><li>2) Capacity and head of the blower to be guaranteed as per <b>Annexure-I of TC62721</b>.</li><li>3) The bidder shall guarantee 98% availability of equipment for a continues period of 120 days</li><li>4) Noise level of blower train shall be <math>\leq 85</math> dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed.</li><li>5) Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions.</li><li>6) Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for END CUSTOMER's approval.</li><li>7) In the event that the performance test is unsuccessful in meeting performance guarantees, bidder shall take necessary remedial action at his cost and the performance test shall be repeated.</li></ol> |

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|-------------|--|
| <b>18.0</b> | <b>BID EVALUATION CRITERIA FOR POWER CONSUMPTION:</b>  |
| 1.          | <b>POWER GUARANTEE</b><br>Bidder to specify the guaranteed Shaft power per blower operating at the design point of clause 7.0 of this specification in their offer. This power value shall be used for loading and penalty criteria.   |
| 2.          | <b>BID EVALUATION CRITERIA FOR POWER CONSUMPTION:</b><br><br>Power consumption quoted by bidder shall be limited to the ceiling value specified below.<br><br>The Lowest of the power consumption quoted by any qualified bidder shall be taken as the base or ceiling value. Bid prices of other bidders will be loaded for every KW excess over the ceiling value as per the formula given below.<br><br>In case, Guaranteed Shaft power offered by the bidder exceeds the ceiling value specified above, his bid price will be loaded for excess power consumption as per the formula given below.<br><br>Adjustment factor for excess power consumption in INR = $(GPC-CV) \times PL \times 2$ No's of Blowers<br><br>GPC- Guaranteed Power Consumption quoted by bidder in KW<br><br>CV- Lowest of the power consumption quoted by any bidder<br><br>PL- Power Loading @ 462000 INR /KW   |
| <b>19.0</b> | <b>LIQUIDATED DAMAGES FOR POWER CONSUMPTION</b>  |
| 1.          | If actual Power Consumption of blower during shop PG Test measured at compressor coupling for the Guarantee point exceeds the value guaranteed by the bidder., liquidated damages for shortfall in performance shall be deducted from contract price as per the formula given below<br>$\text{Liquidated damage deductible in USD} = (GPC-APC) \times P \times 2 \text{ No's of Blowers}$ <ul style="list-style-type: none"><li>• GPC- Guaranteed Power Consumption quoted by bidder in KW</li><li>• APC- Actual Power Consumption in KW</li><li>• P- Penalty @ 462000 INR/ KW</li></ul> Penalty for short fall in performance as mentioned above shall be deducted from contract price, however the penalty shall be limited to 15% of contractual value plus GST.<br><br>Since performance test is witnessed for the first blower, LD charges are applicable for remaining 1 No of blower based on performance result of first blower. |
| 2           | Minimum Acceptance Level: 105% of Functional Guarantee Value. END CUSTOMER/ BHEL reserves the right to reject the equipment if actual power consumption exceeds the minimum acceptance level.  |
| <b>20.0</b> | <b>WARRANTY/ DEFECT LIABILITY</b>  |
| 1.          | The warranty period shall be 12 months from the date of completion of trail operation of each FGD. Provided that the successful bidder shall extend the provisions of this warranty to cover all repaired and replacement parts furnished under the warranty obligations hereunder, subject to the warranty period for the same being for a period of 24 months from the date on which replacement or renewal work is completed.   |

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|---|---|---------------------|
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|   | <p>The Defect Liability Period shall be eighteen (18) months from the date of successful Completion of the Facilities or twelve (12) months from the date of Operational Acceptance of the Facilities.</p> <p>At the end of the Defects Liability Period, the contractor liability ceases except for latent defects. The contractor's liability for latent defects warranty shall be limited to a period of five (5) years from the end of Defects Liability Period. For the purpose of the this clause, the latent defects shall be the defects inherently lying within the material or arising out of design deficiency which do not manifest themselves during the Defects Liability Period.</p>   |                     |
| 2.  | In case of failure of the equipment to meet the guarantee, END CUSTOMER/BHEL reserves the right to reject the equipment. However, END CUSTOMER/ BHEL reserves the right to use the equipment until new equipment supplied by bidder meets the guaranteed requirement.   |                     |
| <b>21.0</b>   | <b>FIRST FILL OF CONSUMABLES:</b>   |                     |
| 1.  | Bidder's scope shall also include supply and filling of all chemicals, reagents, resins, lubricants, grease, filters and consumable items for operation up to COD including top up requirements at the time of issuance of PAC/declaration of COD. All lubricants proposed for the plant operation shall be suitable for all operating and environmental conditions that will be met on site consistent with good maintenance procedures as instructed in the maintenance manuals.  |                     |
| 2.  | Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals including items qualities and quantities required per month of the plant operation for the END CUSTOMER/BHEL's approval herein shall be furnished eighteen (18) months prior scheduled COD of the 1st unit. On completion of erection complete list of bearings/equipment giving their location and identification marks shall be furnished to END CUSTOMER along with lubrication requirements. All types of chemicals, consumables, lubricants and grease shall be readily obtainable locally and the number of different types shall be kept to a minimum. For each type and grade of lubricant recommended, bidder shall list at least three equivalent lubricants manufactured by alternative companies. |                     |
| <b>22.0</b>   | <b>TRAINING</b>   |                     |
|   | Successful bidder shall provide comprehensive training for END CUSTOMER Engineering, O&M, Erection & Commissioning staffs at site covering all aspects of the Oxidation blower-Operation & Maintenance, Troubleshooting etc.  |                     |
| <b>23.0</b>   | <b>CONFLICT</b>   |                     |
|   | Bidder's equipment shall be designed for and shall meet the service, performance and minimum level of quality requirements specified. Bidder shall be solely responsible for advising BHEL in writing of any conflicts between the specifications and Bidder's design, including performance and levels of quality. Bidder agrees that its obligations, liabilities and warranties shall not be diminished or extinguished due to its meeting the requirements of the Specification.  |                     |
| <b>24.0</b>   | <b>DOCUMENTATION</b>  |                     |
|   | <p>The Successful bidder shall submit necessary data, documents, reports (including lateral analysis report) and drawings for review, approval with requirements as specified in this specification.</p> <p>Drawings that are reviewed by the END CUSTOMER/BHEL will be returned to bidder with a transmittal letter with any comments and / or questions marked on the drawings or noted in the letter. All comments and questions must be resolved before resubmission of drawings / documents. If the design has not developed enough to resolve some of the comments or</p>   |                     |

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questions, bidder shall place a “hold” on those items or areas of design.

END CUSTOMER / BHEL reserves the right to return drawings unprocessed to bidder if there exists any evidence that bidder has not acknowledged all comments and questions.

All necessary GA drawings, sections, sub-assembly drawings, specifications of main and sub components and necessary set of operation & maintenance manual as asked by END CUSTOMER must be furnished by bidder in soft and hard copy forms. For all documents softcopy format shall be searchable pdf, however in addition all drawings, diagrams like P&IDS shall be supplied in ACAD or other editable format and all lists in Excel format. Further break up of technical documents will be discussed during finalization of the purchase contract.

Unless agreed otherwise, ten (10) hard copies and five (05) sets of electronic copies of all documents are to be submitted in the English language. Electronic Copies shall be submitted in primary original data format (e.g. DOC, XLS, DWG) as well as in a printable non-proprietary document format (e.g. PDF). Especially P&IDs shall be submitted as DWG files and PDF files. Bidder to ensure submission of hard copies as per END CUSTOMER’s requirement for all engineering drg/doc and for all subsequent revisions along with a soft copy through email to concerned project team. However all the engineering related information shall be furnished in soft form to BHEL.

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| <b>25.0 PRICE SCHEDULE</b> |  |                      |                 |                   |                    |
|----------------------------|--|----------------------|-----------------|-------------------|--------------------|
| <b>Sl No</b>               | <b>Description</b>   | <b>Material Code</b> | <b>Quantity</b> | <b>Unit Price</b> | <b>Total Price</b> |
| 01                         | 2x100% electric driven, Roots type oxidation blowers complete with gearbox system (if applicable), lube oil system (if applicable), instrumentation and accessories. | TC9762721012         | 2 set           |                   |                    |
| 02                         | Impeller Assembly  | TC9762721020         | 1 set           |                   |                    |
| 03                         | Set of Bearings (Required 1No. each for complete replacement of all bearings in one Blower)  | TC9762721039         | 1 set           |                   |                    |
| 04                         | Commissioning spares   | TC9762721047         | 2 set           |                   |                    |
| 05                         | Blower instrumentation spare – (Spare list as per Annexure V philosophy which is applicable)   | TC9762721055         | 1 set           |                   |                    |

**Remarks:**

Vendor shall provide Per Diem rate for supervision of commissioning. This is inclusive of travel, boarding and lodging. 6 no of working days at site will be considered for evaluation purpose. Refer clause no. 12.0 for details

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**ANNEXURES:**

**ANNEXURE -3K**

**Provenness Criteria/Qualification Requirement (SUB-QR) for**

**Oxidation Blower Project Project: WBPDC Sagardighi (1X660 MW)**

**Clause No.**

**4.00.00 QUALIFYING REQUIREMENTS FOR EQUIPMENTS/SYSTEMS**

**4.01.00 Provenness criteria for critical equipment, auxiliaries, systems and bought out items:**

Only Blower manufacturers can seek for Qualification and order will be placed on Blower Manufacturer only. The Bidder is required to meet the provenness criteria and/or qualification requirement for Oxidation Blower as per criteria stipulated below:

**4.01.01** Oxidation Blowers for Flue Gas Desulphurisation (FGD) System offered by the Bidder shall be only from such manufacturer(s) who has previously designed (either by itself or under collaboration / licensing agreement), manufactured the respective equipment(s) of the type, application and minimum equipment rating as stipulated below such that the respective equipment(s) should have been in successful operation in at least one (1) plant for a period not less than one(1) year reckoned as on enquiry floating date.

| <b>Name of Equipment</b> | <b>Type of Equipment</b>                                     | <b>Application</b>   | <b>Equipment Rating</b>  |
|--------------------------|--|--|--|
| Oxidation Blowers        | Rotary, positive displacement type oxidation blowers (roots) | Wet Limestone based FGD application in Coal fired power plant or any other process application | 80% of the flow & 100% of the head of the offered Oxidation Blower |

Bidder shall offer and supply only the type of the above equipment(s) for which he himself is qualified

**4.01.03** A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.01.01 above in India, can also manufacture such equipment(s), provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.01 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). Before taking up the manufacturing of such equipment(s), the bidder/ his sub-vendor(s) must create /have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system for such equipment(s).

Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its holding company/ subsidiary company, at least

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26% equity participation in the Indian Joint Venture Company/ Subsidiary Company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/ Subsidiary or upto the end of defect liability period of the contract, whichever is later.

4.01.04

In case the Bidder or the proposed sub-vendor is not manufacturer of proven Oxidation Blowers as per clause 4.01.01 above but is a manufacturer of Blowers/compressors for minimum 50 NM<sup>3</sup>/min capacity, the Bidder or the proposed sub-vendor can also manufacture Oxidation Blowers, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Oxidation Blowers in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 above for the Oxidation Blowers. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments.

4.01.05

Before taking up the manufacturing of such equipment(s) as per clause 4.01.01,4.01.03,4.01.04 above, the Bidder must create (or should have created) manufacturing and testing facilities at its works as per Collaborator / licenser's design, manufacturing and quality control system for such equipments duly certified by the Collaborator / licensor. Further, the Collaborator / Licenser shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments.

**Note to clause 4.01.01**

Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/lignite.

**Bidder shall submit the Annexure 3K enclosed along with Supporting Documents. Also, Bidder has to submit Reference list of Plants where Oxidation Blowers have been supplied.**

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**Oxidation Blowers:** We declare that we/ our Sub-vendor, have designed (either by itself or under collaboration/ licensing agreement), \*manufactured/ \* got manufactured and supplied at least one (1) number of oxidation blower of minimum 80% of the flow and 100% of head of the offered blower working in FGD application or any other process application and which has been in successful operation for minimum one (1) year as reckoned as on enquiry floating date as per the details furnished below:

| Sl. No. | Description  | Reference Work  |
|---------|--|---|
| 1.      | Name of the reference plant & location:  |   |
| 2.      | Client name and his address: Oxidation   |   |
| 3.      | No. of units and capacity in MW of unit:   |   |
| 4.      | Whether power plant is coal fired  | -*Yes/*No   |
| 5.      | Whether operating in a Wet Limestone based FGD application in Coal fired power plant   | -*Yes/*No   |
| 6.      | Name of equipment manufacturer & address:  |   |
| 7.      | Date of commission of the <u>equipments</u> :  |   |
| 8.      | Model no. of the equipment:  |   |
| 9.      | Brief Technical particulars of the <u>equipments</u> :   |   |
| 10.     | Flow-  | .....Nm <sup>3</sup> /h   |
| 11.     | Head-  | ..... mmWC  |
| 12.     | Whether the equipment(s) are in successful operation in atleast one (01) plant for a period not less than one (01) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder | -*Yes/*No   |
| 13.     | Flue gas Desulphurization system details:  | *Technical extract/ *paper letter/ *email/ *Drawing from user or *contract document or *scheme or *any document in public domain enclosed at annexure....to Attachment-3K |
| 14.     | Scope of Work:   | *Letter of Award or *Contract or *P.O. enclosed at Annexure.....to Attachment-3K  |
| 15.     | Performance details:   | *Certificate/*Letter/*E-mail from End user enclosed at Annexure.....to Attachment-3K  |

\* Strike off whichever is not applicable.

Signature of authorized signatory.....

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|   |  |                     |
|---|--|---------------------|
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**ANNEXURE –I QUALIFICATION REQUIREMENT.**

The Bidders are required to meet the Qualification Requirement (QR) for Oxidation Blowers as per criteria stipulated below and necessary documents evidence requirement as per Annexure-3K.

System offered by the bidder shall be only from such manufacturer(s) who has previously designed (either by itself or under collaboration/ licensing agreement), manufactured/ got manufactured the equipment of the type, application and minimum equipment rating as stipulated below such that the equipment should have been in successful operation in at least 1 plant for a period not less than 1 year reckoned as on enquiry floating date.

| Name of equipment | Type of equipment   | Application  | Equipment rating   |
|-------------------|---|--|--|
| Oxidation Blowers | Rotary, positive displacement type oxidation blowers(roots) | Wet Limestone based FGD application in coal fired power plant or any other process application | 80% of the flow & 100% of head of the offered oxidation Blower |

SIGNATURE OF BIDDER -----

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**ANNEXURE –II- TECHNICAL DATA SHEET**

| Sl. No     | Description  | Data   |
|------------|--|--|
| <b>1.0</b> | <b>GENERAL</b>   |  |
|            | a. Client  | : BHEL-HPEP Hyderabad  |
|            | b. Project   | : Sahardighi TPS (1X660 MW)                                      |
|            | c. Ultimate Customer                                       | : WBPDCL   |
|            | d. Location  | : Murshidabad<br>West Bengal, India                              |
|            | e. Service   | : Continuous   |
|            | f. Installation  | : In-door  |
|            | g. No of Blowers for each unit                             | : 1 Working + 1 Standby  |
|            | h. Total number of Blowers                                 | : Unit-1 - 2 No's  |
| <b>2.0</b> | <b>MANUFACTURER DETAILS</b>                                |  |
|            | a. Model   | :  |
|            | b. Type  | : Rotary, positive displacement type<br>oxidation blowers(roots) |
|            | c. Type of Driver  | : As per specification   |
|            | d. Area classification                                     | : Safe   |
|            | e. No of Stage   | : Applicable/ Not Applicable                                     |
| <b>3.0</b> | <b>OPERATING CONDITION</b>                                 |  |
|            | a. Gas composition % by weight / %<br>Mole percent         | : Atmospheric air  |
|            | b. Solids at suction g/m <sup>3</sup>                      | : As per ambient condition                                       |
|            | c. Relative humidity at suction %                          | : As per ambient condition                                       |
|            | d. Molecular weight  | : As per ambient condition                                       |
|            | e. Specific weight at suction Kg/m <sup>3</sup>            | : As per ambient condition                                       |
|            | f. Capacity at suction Nm <sup>3</sup> / Hr                | : As per clause 5.0  |
|            | g. Suction pressure KPa                                    | : As per clause 5.0  |
|            | h. Discharge pressure mmWc                                 | : As per clause 5.0  |
|            | i. Differential Pressure                                   | : Bidder to confirm  |
|            | j. Suction temperature Deg C                               | : Ambient  |
|            | k. Discharge temperature Deg C                             | : <70  |
| <b>4.0</b> | <b>PERFORMANCE DATA</b>                                    |  |
|            | a. Capacity Nm <sup>3</sup> /Hr                            | : #  |
|            | b. Static efficiency %                                     | : #  |
|            | c. BKW Normal / Maximum KW                                 | : #  |
|            | d. BKW at minimum suction<br>temperature KW                | : #  |
|            | e. Motor rating KW   | : #  |
|            | f. Motor Speed rpm   | : #  |
|            | g. Discharge pressure static (inclusive<br>of losses) mmWc | : #  |
|            | h. Differential pressure (inclusive of<br>losses) mmWc     | : #  |
|            | i. Speed Maximum/ Normal/Minimum                           | : #  |
|            | j. Noise level   | : #  |
|            | k. Performance curve                                       | : #  |
| <b>5.0</b> | <b>CONSTRUCTION DATA</b>                                   |  |
|            | a. Manufacturer  | :  |
|            | b. Model No.   | : #  |

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|            |  |    |                                 |   |
|------------|--|----|---------------------------------|---|
|            | c. Suction   | :  | Single                          |   |
|            | d. Suction Rating / Size   | :  | #                               |   |
|            | e. Discharge Rating / Size   | :  | #                               |   |
|            | f. Type of rotor   | :  | #                               |   |
|            | g. Size of rotor Dia   | mm | :                               | # |
|            | h. Journal bearing: Type / Size:   | :  | #                               |   |
|            | i. Thrust bearing: Type / Size:  | :  | #                               |   |
|            | j. Bearing cooling required  | :  | Yes / No - Bidder to confirm    |   |
|            | k. Cooling water required  | :  | Bidder to confirm the quantity  |   |
|            | l. Type of drive   | :  | As per specification            |   |
|            | m. Shaft seal  | :  | Packing / Rubber seal           |   |
|            | n. Size / Code   | :  | #                               |   |
|            | o. Type of coupling  | :  | #                               |   |
|            | p. Service factor  | :  | #                               |   |
|            | q. GD <sup>2</sup> at drive shaft end  | :  | #                               |   |
|            | r. Rotation viewed from coupling end   | :  | Clock wise / Counter clock wise |   |
|            | s. Fluid Coupling  | :  | Yes / No - Bidder to confirm    |   |
|            | t. Fluid Coupling make   | :  | #                               |   |
|            | u. Fluid Coupling control  | :  | #                               |   |
|            | v. Suction filter  | :  | Required                        |   |
|            | w. Degree of filtration  | :  | #                               |   |
|            | x. Base plate common to Blower. Inboard bearing housing and fluid coupling & Motor | :  | Yes / No - Bidder to confirm    |   |
|            | y. Total weight  | kg | :                               | # |
|            | z. Maximum Erection weight   | kg | :                               | # |
| <b>6.0</b> | <b>MATERIALS</b>   |    |                                 |   |
|            | a. Casing  | :  | #                               |   |
|            | b. Rotor   | :  | #                               |   |
|            | c. Shaft   | :  | #                               |   |
|            | d. Packing Seal  | :  | #                               |   |
|            | e. Suction filter elements/ housing  | :  | #                               |   |
|            | f. Base frame  | :  | #                               |   |

**Note - Vendor to full up the columns marked with “ # “**

SIGNATURE OF BIDDER -----

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**ANNEXURE III- SCHEDULE OF GUARANTEES**

| Sl. No | Description   | Data |
|--------|---|------|
| 1.     | Rated capacity of Blower Nm <sup>3</sup> /hr  | :    |
| 2.     | Total head at design capacity mmWc  | :    |
| 3.     | Guaranteed power consumption at rated capacity & head kW  | :    |
| 4.     | Noise level at a distance of 1.0 meter from the equipment at site and 1.5 m above operating floor dB(A) | :    |
| 5.     | Maximum vibration (peak to peak amplitude at site) microns  | :    |
| 6.     | Equipment Availability (%)  | :    |

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**ANNEXURE IV- VENDOR TO PROVIDE THE LIST OF COMMISSIONING  
SPARES**

| Sl. No. | Description | Quantity |
|---------|-------------|----------|
| 1.      |             |          |
| 2.      |             |          |
| 3.      |             |          |
| 4.      |             |          |
| 5.      |             |          |

**Qty will be Number or Set as applicable**

- Vendor to identify each and every item which they consider as commissioning spares. Each and every part that is considered to fall under guarantee clause shall be indicated in this list.
- Rubber items which are having a **Shelf-Life** will also be considered as wear item.

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**ANNEXURE V- VENDOR TO PROVIDE APPLICABLE MANDATORY INSTRUMENTATION SPARE LIST AS PER FOLLOWING SPARE INSTRUMENTATION PHILOSOPHY:**

Vendor shall submit the bill of material of each item on applicable mandatory spare, indicating the quantity used in main as well as spares.

| <b>S.NO</b> | <b>OXIDATION BLOWER INSTRUMENT SPARE ITEM DESCRIPTION / SPARE PHILOSOPHY</b>   | <b>QTY</b>  |
|-------------|--|---|
| 1           | MOTOR OF EACH TYPE AND RATING<br>(NOTE : MOTORS COVERED IN MECHANICAL SPARE ITEMS NEED NOT TO BE INCLUDED HERE AGAIN) 10% OF THE INSTALLED QUANTITY OR M | 10%- AS APPLICABLE ITEMS WILL BE SUPPLIED FOR OXIDATION BLOWER            |
| 2           | END SHIELD COVER DRIVING & NON-DRIVING END   | 1 SET- AS APPLICABLE ITEMS WILL BE SUPPLIED FOR OXIDATION BLOWER          |
| 3           | HEATERS  | 2 SET- AS APPLICABLE ITEMS WILL BE SUPPLIED FOR OXIDATION BLOWER          |
| 4           | BEARINGS (DE AND NDE) FOR EACH TYPE AND RATING OF MOTOR  | 2 SET- AS APPLICABLE ITEMS WILL BE SUPPLIED FOR OXIDATION BLOWER          |
| 5           | COOLING FAN FOR ALL TYPE AND RATING OF LT MOTORS   | 1 SET- AS APPLICABLE ITEMS WILL BE SUPPLIED FOR OXIDATION BLOWER          |
| 6           | MOTOR TERMINAL BLOCK   | 1 EACH- AS APPLICABLE ITEMS WILL BE SUPPLIED FOR OXIDATION BLOWER         |
| 7           | COMPLETE SET OF COUPLING   | 1 SET- AS APPLICABLE ITEMS WILL BE SUPPLIED FOR OXIDATION BLOWER          |
| 8           | PRESSURE   | 1 (ONE) NO. COMPLETE SET FOR EACH TYPE AND MODEL/RANGE USED IN THE SYSTEM |
| 9           | DIFFERENTIAL PRESSURE  | 1 (ONE) NO. COMPLETE SET FOR EACH TYPE AND MODEL/RANGE USED IN THE SYSTEM |
| 10          | LEVEL  | 1 (ONE) NO. COMPLETE SET FOR EACH TYPE AND MODEL/RANGE USED IN THE SYSTEM |
| 11          | FLOW TRANSMITTER   | 1 (ONE) NO. COMPLETE SET FOR EACH TYPE AND MODEL/RANGE USED IN THE SYSTEM |

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| S.NO | OXIDATION BLOWER INSTRUMENT<br>SPARE ITEM DESCRIPTION / SPARE<br>PHILOSOPHY               | QTY   |
|------|---|---|
| 12   | PRESSURE SWITCH   | 2 NOS.  |
| 13   | DIFFERENTIAL PRESSURE SWITCH  | 2 NOS.  |
| 14   | THERMOCOUPLE  | 10% OF EACH TYPE AND<br>LENGTH USED IN ONE UNIT   |
| 15   | RTD   | 10% OF EACH TYPE AND<br>LENGTH USED IN ONE UNIT   |
| 16   | COMPLETE SOLENOID VALVE ASSEMBLY  | 2 NOS.  |
| 17   | COIL (SINGLE OR DOUBLE COIL<br>TYPE)  | 10% OF TOTAL NOS. USED<br>IN THE SYSTEM OR MINIMUM<br>1 (ONE) NO. WHICHEVER IS<br>MORE FOR EACH TYPE AND<br>RANGE |
| 18   | PNEUMATIC DIAGHRAGM FOR<br>DIAGHRAGM ACTUATED VALVE                                       | 2 NOS.  |
| 19   | ACTUATOR SEAL KIT FOR PNEUMATIC<br>CYLINDER ACTUATED VALVE                                | 2 NOS.  |
| 20   | GLAND PACKING   | 1 SET   |
| 21   | AIR FILTER REGULATOR INCLUDING<br>MOISTURE SEPARATOR COMPLETE SET<br>WITH PRESSURE GAUGES | 10 NOS.   |
| 22   | GAUGE GLASS   | 1 NO  |
| 23   | PNEUMATIC DIAGHRAGM FOR<br>DIAGHRAGM ACTUATED VALVE                                       | 2 NOS.  |
| 24   | ACTUATOR SEAL KIT FOR PNEUMATIC<br>CYLINDER ACTUATED VALVE                                | 2 NOS.  |
| 25   | GLAND PACKING   | 1 SET   |
| 26   | STEM  | 1 NO  |
| 27   | PLUG  | 1 NO  |
| 28   | SEAT  | 1 NO  |
| 29   | CAGE  | 1 NO  |
| 30   | RETAINER RING   | 1 SET   |
| 31   | SEAL RING   | 1 SET   |
| 32   | GASKET  | 2 SET   |

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| <b>S.NO</b> | <b>OXIDATION BLOWER INSTRUMENT<br/>SPARE ITEM DESCRIPTION / SPARE<br/>PHILOSOPHY</b>                | <b>QTY</b>  |
|-------------|---|---|
| 33          | SMART POSITIONER OF THE VALVE   | 10% OF TOTAL QUANTITY<br>USED IN THE SYSTEM OR<br>MINIMUM 2 (TWO) NOS.<br>WHICHEVER IS MORE FOR<br>EACH TYPE AND MODEL. |
| 34          | SEAL KIT FOR THE POSITIONER   | 2 SET   |
| 35          | POSITION FEEDBACK<br>TRANSMITTER (APPLICABLE IF IT IS<br>NOT INTEGRAL WITH THE SMART<br>POSITIONER) | (TWO) SETS FOR EACH OF<br>POSITIONER  |
| 36          | COMPLETE SET OF SOLENOID VALVE<br>FOR PNEUMATIC TYPE ON/OFF VALVE                                   | 2 NOS.  |
| 37          | SOLENOID COIL FOR PNEUMATIC TYPE<br>ON/OFF VALVE  | 5 NOS.  |

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**ANNEXURE –VI: LIST OF DEVIATIONS/EXCEPTIONS TO THE ENQUIRY DOCUMENT**

| <b>Sl No</b> | <b>Clause No</b> | <b>Page No</b> | <b>Description of Deviation</b> |
|--------------|------------------|----------------|---------------------------------|
|              |                  |                |                                 |
|              |                  |                |                                 |
|              |                  |                |                                 |
|              |                  |                |                                 |
|              |                  |                |                                 |
|              |                  |                |                                 |
|              |                  |                |                                 |

Note- 1. Supplier shall submit this form indicating technical deviation if any, indicating each clause no. If there is no technical deviation, Supplier shall submit this form indicating "NO DEVIATION"

2. Deviation Listed elsewhere other than the above format shall not be considered for offer evaluation.

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**ANNEXURE – VII: REFERENCE LIST as per format shown below.**

| S.No | Project Name ,<br>Customer & Plant<br>capacity | Coal<br>fired<br>Yes/<br>No | Wet<br>Lime<br>stone<br>Based<br>FGD<br>Yes/<br>No | Mo<br>del | Capacity<br>Nm <sup>3</sup> /hr. | Head<br>mm<br>Wc | Speed<br>rpm | Year<br>of<br>Comm<br>g | Qty |
|------|--|-----------------------------|--|-----------|----------------------------------|------------------|--------------|-------------------------|-----|
|      |  |                             |  |           |                                  |                  |              |                         |     |
|      |  |                             |  |           |                                  |                  |              |                         |     |
|      |  |                             |  |           |                                  |                  |              |                         |     |

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**ANNEXURE –VIII: DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER**

| Sl. No. | Description  | Purpose                           |
|---------|--|-----------------------------------|
| 1.      | <b>Annexure to qualification requirements : Attachment -3K</b>   | Qualification Requirement (QR)    |
| 2.      | Reference plant details of similar or higher capacity oxidation blower supplied as per Annexure-VI   | Qualification Requirement (QR)    |
| 3.      | Proforma Invoice of Supply   | Consideration of Bid              |
| 4.      | Proforma Invoice of Mandatory Spares   | Consideration of Bid              |
| 5.      | Proforma Invoice for Supervision of Erection & Commissioning   | Consideration of Bid              |
| 6.      | Seal & Sign of bidder on all pages of specification  | Technical Evaluation of Bid (TEB) |
| 7.      | Filled Data Sheets of & All accessories as per Annexure-II   | TEB                               |
| 8.      | Deviation List (if any) as per Annexure-V  | TEB                               |
| 9.      | Schedule of Guarantee as per Annexure-III  | TEB                               |
| 10.     | Blower & Motor Sizing Calculation  | TEB                               |
| 11.     | GA drawing including cross sectional view & BOM of Oxidation Blower  | TEB                               |
| 12.     | P & ID diagram of oxidation blower & Lube oil system   | TEB                               |
| 13.     | Performance curves<br>i. Flow v/s Total Pressure<br>ii. Flow v/s Efficiency<br>iii. Flow v/s Power consumption<br>iv. Torque v/s Speed curve for motor selection | TEB                               |
| 14.     | Required Electric power & other Utility List   | TEB                               |
| 15.     | Make of all bought out items & sub vendor list   | TEB                               |
| 16.     | Quality Plan   | TEB                               |
| 17.     | List of Start-up & Commissioning Spares  | TEB                               |
| 18.     | List of Special Tools  | TEB                               |
| 19.     | Delivery Schedule  | TEB                               |
| 20.     | Catalogue  | TEB                               |
| 21.     | Price bid  | Price Bid                         |

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**ANNEXURE –IX: DOCUMENTS TO BE SUBMITTED AFTER AWARD OF  
CONTRACT**

| Sl. No. | Description  | Handing over of Documents after Contract (in weeks) | Purpose           |
|---------|--|---|-------------------|
| 1.      | Utility Consumption & Lubricating Oil List   | 2   | Customer Approval |
| 2.      | Foundation Drawing, Anchor Bolts, static & dynamic details   | 2   | Customer Approval |
| 3.      | GA drawing including cross sectional view of Oxidation Blower & Accessories with bill of material (in PDF & Autocad format)                                      | 2   | Customer Approval |
| 4.      | P&ID drawing of Oxidation Blower & Lube Oil System in PDF & AUTOCAD format   | 3   | Customer Approval |
| 5.      | Filled Data Sheets of Oxidation Blower & All accessories   | 3   | Customer Approval |
| 6.      | Quality Plan with Inspection & Performance Test Procedure at site  | 3   | Customer Approval |
| 7.      | Blower & HT Motor Sizing Calculation   | 4   | Customer Approval |
| 8.      | Performance curves<br>i. Flow v/s Total Pressure<br>ii. Flow v/s Efficiency<br>iii. Flow v/s Power consumption<br>iv. Torque v/s Speed curve for motor selection | 4   | Customer Approval |
| 9.      | Motor Rating in Kw   | 4   | Customer Approval |
| 10.     | Sub vendors List   | 4   | Customer Approval |
| 11.     | Manufacturing Schedule   | 4   | Customer Approval |
| 12.     | List of Special Tools  | 8   | E&C               |
| 13.     | List of Start-up & Commissioning Spares  | 9   | E&C               |
| 14.     | Required Electric power  | 10  | E&C               |
| 15.     | Pre- Commissioning Check List  | 10  | E&C               |
| 16.     | Installation & assembly procedure  | 10  | E&C               |
| 17.     | Erection & Commissioning Schedule  | 10  | E&C               |
| 18.     | Recommended Repair Procedure   | 10  | E&C               |
| 19.     | Operation and Maintenance Manual (10 hardcopies and 5 electronic copies in English)  | 10  | E&C               |
| 20.     | Electrical Load List with Single Line Diagram  | 10  | BHEL Review       |
| 21.     | Control Logic of Oxidation Blower  | 10  | BHEL Review       |
| 22.     | Catalogue  | 10  | BHEL Review       |
| 23.     | Proforma Packing List  | 12  | Dispatch          |

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**ANNEXURE-X:**

Refer to various clauses of inspection and Testing. Sample QP enclosed.

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**INSPECTION AND TESTING REQUIREMENT**

| Sl.No | Annexure to Enquiry no:   | Date | #Specific confirmations by the manufacture |
|-------|---|------|--|
|       | BHEL / Customer Requirement   |      |  |
|       | <b>Quality Plan Requirement:</b>  |      |  |
|       | (i) MQP (Manufacturing Quality Plan) shall be submitted in attached format for BHEL/ Customer review & approval. Typical MQP is attached for indicative purposes for guidance & use.  |      |  |
|       | (ii) MQP shall invariably cover w.r.t Inward inspection including on Raw material Procurement, In process and Final inspection in elaborated way/ details.  |      |  |
|       | (iii) Bidder shall also to give specific confirmation that on need basis, their competent officials shall visit to BHEL/ customer for finalization of Quality plan including test procedure/ methodology during pre-award / post-award approval / detailed engineering in the event of an order.  |      |  |
|       | (iv) No deviation on BHEL/ Customer approved MQP is acceptable.   |      |  |
| 1     | (v) Bidder shall agree to submit all cross referred documents other than codes/standards to BHEL/ Customer/ Consultant.   |      |  |
|       | <b>Important Notes shall be included in MQP :</b><br>(a) Latest revision of Standards & Specification shall apply. Only International Standards are applicable. Indian & Chinese Standards are not applicable<br>(b) Materials shall be procured in compliance to Functional Technical Specification.<br>(c) Inspection shall be in compliance with Approved Quality Control Procedure for the Product.<br>(d) NDT shall be carried out by Qualified Personnel with compliance to Approved NDT Procedures and Acceptance Norms, as per ASME Section V.<br>(e) Gauges and measuring Instruments, with valid calibration only shall be used.<br>(f) Cleaning and Painting of products shall be carried out as per Approved Painting Schedule.<br>(g) Finished Products shall be packed to comply with Approved Packing Schedule.<br>(h) Welding shall be carried out by Qualified Personnel with compliance to Approved NDT Procedures and Acceptance Norms, as per ASME Section V. |      |  |
| 2     | <b>Domestic / Inland Inspection</b> will be carried out by BHEL/ BHEL appointed Third Party Inspection Agency (TPIA) / Customer/ Customer Appointed Inspection Agency/ Consultanat. This is applicable for all Stage inspection and Final Inspection identified as "W" - Witness or "CHP" - Customer Hold Point as per customer approved Quality Plan/ Technical specification / Approved Drawing/ Approved Data sheet / Scheme / PID / PFD / SLD (Process Instrumentation Diagram / Process Flow Diagram / Single Line Diagram) etc (As applicable).   |      |  |
| 3     | <b>Inspection Agency for Foreign Bidders and also for Indian Bidder but importing from Foreign Sources:</b><br>(1) Any one of the following Third Party Inspection Agency (TPIA) shall be appointed by the bidder and same shall be furnished by the bidder in techno commercial bid itself.<br>(2) The details of TPIA with contact details like Name of the official, Phone no, Email id shall also to be submitted during pre/ post award. However cost for such inspection agency shall be borne by the bidder only. Inspection charges for such inspection agency shall be indicated separately so that if BHEL/ Customer is undertaking the inspection by on their own, then these charges non claimable by the bidder.<br><u>List of TPIA</u><br>1.M/s Bureau Veritas<br>2.M/s TUV-Nord<br>3.M/s TUV-SJD<br>4.M/s TUV Rheinland<br>5.M/s Lloyds Register<br>6. M / s DNV   |      |  |

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| S.No | BHEL / Customer Requirement   | ## Specific confirmations by the manufacture |
|------|---|--|
| 4    | <b>Stage Inspection during manufacturing Process :</b> Stage Inspection during manufacturing shall be carried out as per approved quality plan and all necessary documents shall be provided for review, verification and clearance for further processing. This inspection call shall be given well in advance (atleast 2 weeks before) to TPV Bidder's own Inspection agency to avoid delay in the manufacturing processes.   |  |
| 5    | <b>Inspection before despatch for domestic supplier :</b> Inspection before despatch at supplier's works shall be carried out by BHEL/ BHEL appointed Inspection agency. Inspection shall be done as per approved Quality plan/ Technical specification/ Approved Drawing/ Approved Data sheet .  |  |
| 6    | <b>Inspection at Foreign Source/ Supplier:</b><br>(a) As in sl no: 3, shall be ensured without fail<br>(b) No material/ Items shall be despatched without getting the written communication from BHEL/ Customer inspection carried out by BHEL/ BHEL appointed Third Party Inspection Agency (TPA)/ Customer/ Customer Apointed Inspection Agency/ Consulatnal. This is applicable for all Stage Inspection and Final Inspection Identified as "W" - Witness or "CHP" - Customer Hold Point as per customer approved Quality Plan/ Technical specification / Approved Drawing/ Approved Data sheet / Scheme / PID/ PFD/ SLD (Process Instrumentation Diagram / Process Flow Diagram / Single Line Diagram) etc (As applicable).<br>Inspection before despatch for Foreign supplier : Inspection before despatch at supplier's works shall be carried out by bidder appointed inspection agencies having international presence at vendors and or vendor's sub vendor works. Inspection shall be done as per approved Quality plan/ Technical specification/ Approved Drawing/ Approved Data sheet by TPA mentioned in Sl no: 03 at supplier's cost. |  |
| 7    | <b>Painting</b> shall be done strictly as per BHEL/ Customer approved painting schedule / scheme only. Paint Thickness / Paint shade shall be ensured as per BHEL/ Customer approved painting schedule / specification / data sheet etc. No deviation is acceptable unless otherwise accepted by BHEL/ Customer in writing. Any conflict if any among BHEL/ Customer approved painting schedule / Spec / data sheet etc shall be brought to the notice to BHEL well in advance before proceeding including the BOI being procured for assy / skid like motors etc   |  |
| 8    | <b>Specific conformation for document package</b> in the event of an order (2 Hard copies & soft copy in PDF file) is to be given containing the following with proper linkages<br>(i) Index Sheet<br>(ii) MQP/ RQP/ Endorsement Sheet (As applicable)<br>(iii) TCs Identified by BHEL/ Customer for record for "CHP" / "W" and Verification portion ("V") as given in approved QP.<br>(iv) Final Inspection report + TC Including Chemical + Mechanical + HT + NDT etc<br>(v) Third party Inspection report + TC<br>(vi) Customer CHP/ MDCC<br>(vii) Type test / Performance Test reports conducted<br>(viii) Type test / Performance Test approval/ clearance obtained from BHEL/ Customer<br>(ix) BOM with As Build Drgs with actual make / rating used with BHEL/ customer approved drawings.   |  |
| 9    | <b>Packing / Seaworthy Packing</b> shall be as per BHEL Packing schedule / approved drg/ sketch. This shall be ensured to take care tarrest / handling / transhipment In Road / Sea/ Air. Photographs are to be submitted for BHEL review before despatching the material as per contract conditions.   |  |
| 10   | <b>Outsourcing of test facilities:</b> Bidder shall ensure all the testing facilities in house. However if any of the test facilities are not available with successful bidder, then bidder shall ensure the same at NABL accredited third party lab / Govt / Govt Lab for major testing such as NDT, Electrical & Mechanical testing.  |  |
| 11   | <b>Important Note:</b> No deviation on the above requirement 01 to 10 is acceptable w.r.t Quality Requirement and those offers not meeting these specific customer requirement is liable for rejection and hence the bidder shall submit all the required documentary evidences in the offer itself.  |  |
| 12   | ## Necessorily to be filled up by the bidder at the time of offer itself otherwise the offer may not be considered w.r.t Quality Requirement being customer specific requirement.   |  |

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**SAMPLE QUALITY PLAN**

| <br>Ranipet | MANUFACTURER'S NAME AND ADDRESS                 |                 | <b>STANDARD QUALITY PLAN</b>          |               |                  |          |                    |                  |                  |    |        |  |  |         |
|-------------|---|-----------------|---------------------------------------|---------------|------------------|----------|--------------------|------------------|------------------|----|--------|--|--|---------|
|             | M/S BHEL: BAP: RANIPET<br>632 406<br>TAMIL NADU |                 | ITEM: OXIDATION BLOWER<br>SYSTEM: FGD |               |                  |          | QP NO              | FGS:722          |                  |    |        |  |  |         |
|             |   |                 |                                       |               |                  |          | REV. NO:           | 00               |                  |    |        |  |  |         |
|             |   |                 |                                       |               |                  |          | DATE:              | 12.02.2019       |                  |    |        |  |  |         |
|             |   |                 |                                       |               |                  | PAGE NO: |                    | Page 1 of 2      |                  |    |        |  |  |         |
| SL. NO      | COMPONENT & OPERATIONS                          | CHARACTERISTICS | CLASS                                 | TYPE OF CHECK | QUANTUM OF CHECK |          | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD |    | AGENCY |  |  | REMARKS |
|             |   |                 |                                       |               | M                | B        |                    |                  | M                | C  | N      |  |  |         |
| 1.          | 2.  | 3.              | 4.                                    | 5.            | 6.               |          | 7.                 | 8.               | 9.               | D* | ** 10. |  |  | 11.     |

|                                |   |   |                |  |                        |                      |  |                               |    |             |             |             |  |   |
|--------------------------------|---|---|----------------|--|------------------------|----------------------|--|-------------------------------|----|-------------|-------------|-------------|--|---|
| 1.1                            | Blower parts - (Casing Impeller Shaft etc.) | Chem.& Mech. Dimensions Surface Defects       | MA<br>MA<br>MA | Review of MTC<br>Measurement<br>Visual | 1/Heat<br>100%<br>100% | Appd. Dwg./Datasheet |  | TC & IR                       | √  | P<br>P<br>P | V<br>-<br>- | V<br>-<br>- |  |   |
| 1.2                            | Shaft                                       | UT  | MA             | Testing                                | 100%                   | ASME Section-V       | Tech. Spec./<br>Manufacturer UT<br>Procedure | UT Report                     | √  | P           | V           | V           |  |   |
| <b>2.0 CASING</b>              |   |   |                |  |                        |                      |  |                               |    |             |             |             |  |   |
| 2.1                            | Machining of Components                     | Dimensions<br>Surface Defects                 | MA             | Measurement<br>Visual                  | 100%<br>100%           | Appd.Dwg.            |  | IR                            |    | P           | -           | -           |  |   |
| 2.2                            | Hydro test of Casing                        | Hydro test 1.5times of Max work pr for 30 min | MA             | Measurement & Visual                   | 100%                   | Appd. Dwg            | No leakage                                   | IR                            | √  | P           | V           | V           |  |   |
| <b>3.0 ROTATING COMPONENTS</b> |   |   |                |  |                        |                      |  |                               |    |             |             |             |  |   |
| 3.1                            | Machining of components                     | Dimensions<br>Surface Defects(Rotor & Shaft)4 | MA             | Measurement<br>MT/PT                   | 100%<br>100%           | Appd. Dwg.           |  | IR                            |    | P           | V           | V           |  |   |
| 3.2                            | Assembly                                    | Dimensions<br>Completeness                    | MA             | Measurement<br>Visual                  | 100%<br>100%           | Appd. Dwg.           |  | IR                            |    | P<br>P      | -           | -           |  |   |
| 3.3                            | Rotor Assembly                              | Dynamic balance test                          | MA             | Measurement<br>Visual                  | 100%                   | ISO 1940             | G 2.5  | IR                            | √  | P           | V           | V           |  |   |
| <b>4.0 Blower Inspection</b>   |   |   |                |  |                        |                      |  |                               |    |             |             |             |  |   |
| 4.1                            | Assembly                                    | Dimensions,<br>Completeness                   | MA             | Measurement<br>Visual                  | 100%                   | 100%                 | Appd. Dwg.                                   | IR                            | √  | P           | W           | W           | Inspection at manufacturer works.<br>*1 No. for NTPC<br>100% for |   |
| 4.2                            | Performance Test                            | Volume, Power & Discharge Pressure            | MA             | Measurement                            | 100%                   | 100%                 | ASME PTC10                                   | Approved data sheet / drawing | TR | √           | P           | W           |  | W |
| 4.3                            | Mechanical Run                              | Noise   | MA             | Measurement                            | 100%                   | 100%                 | ANSI S5.1:1971                               | -DO-                          | TR | √           | P           | W           |  | W |

|   |   |   |
|---|---|---|
| <p>LEGEND: * RECORD, IDENTIFIED WITH "TICK" (√) UNDER COLUMN 'D' SHALL BE SUBMITTED TO CUSTOMER AS A QA DOCUMENTATION PACKAGE.<br/> <b>M:</b> MANUFACTURER / SUB SUPPLIER, <b>C:</b> MAIN CONTRACTOR(BHEL)/BHEL AIA<br/> <b>N:</b> CUSTOMER/CONSULTANT <b>P:</b> PERFORM <b>W:</b> WITNESS <b>V:</b> REVIEW OF RECORDS<br/> <b>MA:</b> MAJOR AND <b>MI:</b> MINOR</p> | <p><b>PREPARED BY</b></p><br><b>Rakesh Kumar Madhu,(Ser/QA)</b> | <p><b>REVIEWD &amp; APPROVED BY</b></p><br><b>K C Gandhi Parimalam,(DGM/QA)</b> |
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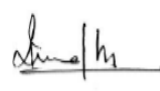

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| <br><b>Ranipet</b> | MANUFACTURER'S NAME AND ADDRESS<br><b>M/S BHEL: BAP: RANIPET<br/>632 406<br/>TAMIL NADU</b> |                 | <b>STANDARD QUALITY PLAN</b> |               |                  |   |                         |                     |                  |    |        |   |   |         |
|---|---|-----------------|------------------------------|---------------|------------------|---|-------------------------|---------------------|------------------|----|--------|---|---|---------|
|   | ITEM: OXIDATION BLOWER<br>SYSTEM: FGD   |                 |                              |               |                  |   |                         | QP NO<br>FGS:722    |                  |    |        |   |   |         |
|   |   |                 |                              |               |                  |   |                         | REV. NO:<br>00      |                  |    |        |   |   |         |
|   |   |                 |                              |               |                  |   |                         | DATE:<br>12.02.2019 |                  |    |        |   |   |         |
|   |   |                 |                              |               |                  |   | PAGE NO:<br>Page 2 of 2 |                     |                  |    |        |   |   |         |
| SL. NO  | COMPONENT & OPERATIONS  | CHARACTERISTICS | CLASS                        | TYPE OF CHECK | QUANTUM OF CHECK |   | REFERENCE DOCUMENT      | ACCEPTANCE NORMS    | FORMAT OF RECORD |    | AGENCY |   |   | REMARKS |
|   |   |                 |                              |               | M                | B |                         |                     |                  |    | M      | C | N |         |
| 1.  | 2.  | 3.              | 4.                           | 5.            | 6.               |   | 7.                      | 8.                  | 9.               | D* | ** 10. |   |   | 11.     |

|            |  |                                    |    |                    |      |       |                                  |      |    |   |   |   |   |      |
|------------|--|------------------------------------|----|--------------------|------|-------|----------------------------------|------|----|---|---|---|---|------|
|            | Test                                   | Vibration Level                    | MA | Measurement        | 100% | 100%  | ISO 10816-7                      | -DO- | TR | ✓ | P | W | W | BHEL |
|            |  | Bearing temperate rise,            | MA | Measurement        | 100% | 100%  | Approved Drawing /Data Sheet     |      | TR | ✓ | P | W | W |      |
| <b>5.0</b> | <b>BOUGHT-OUT PARTS (Gear Box)</b>     |                                    |    |                    |      |       |                                  |      |    |   |   |   |   |      |
| 5.1        | Heat Treatment of Gear Wheel           | Hardness                           | MA | Measurement        | 100% |       | Approved Data Sheet/Drawing      |      | TR | ✓ | P | V | V |      |
| 5.2        | Assembly                               | Dimensions Completeness            | MA | Measurement Visual | 100% | 100%  | Appd.Dwg.                        |      | IR |   | P | - | - |      |
| <b>6.0</b> | <b>FINAL BLOWER PACKAGE INSPECTION</b> |                                    |    |                    |      |       |                                  |      |    |   |   |   |   |      |
| 6.1        | Final Complete Assembly                | Dimensions, Completeness           | MA | Measurement Visual | 100% | 01 No | Appd. Dwg                        |      | IR | ✓ | P | W | V |      |
| <b>7.0</b> | <b>PAINTING</b>                        |                                    |    |                    |      |       |                                  |      |    |   |   |   |   |      |
| 7.1        |  | Surface treatment and inspection   | MI | Visual             | 100% |       | NTPC Approved Painting Schedule  |      | IR | ✓ | P | V | - |      |
| 7.2        |  | Paint Quality - Colour & DFT Check | MI | Visual Measurement | 10%  |       |                                  |      | IR | ✓ | P | V | - |      |
| 8.0        | Review of QA Documents                 | Verification of QA Documents       | MA | Verification       | 100% |       | As per Appd. MQP                 |      | IR | ✓ | P | V | - |      |
| 9.0        | Inspection before Delivery             |                                    |    |                    |      |       |                                  |      |    |   |   |   |   |      |
| 9.1        | Packing                                | Size, appearance & Firmness        | MI | Measurement Visual | 100% |       | As per Appd. "Packing Procedure" |      | IR |   | P | - | - |      |

**Note :** Motor for Oxidation Blower is Separate MQP will be submitted for same.

|  |  |   |
|--|--|---|
| LEGEND: * RECORD, IDENTIFIED WITH "TICK" (✓) UNDER COLUMN 'D' SHALL BE SUBMITTED TO CUSTOMER AS A QA DOCUMENTATION PACKAGE.<br><b>M:</b> MANUFACTURER / SUB SUPPLIER, <b>C:</b> MAIN CONTRACTOR(BHEL)/BHEL AIA<br><b>N:</b> CUSTOMER/CONSULTANT <b>P:</b> PERFORM <b>W:</b> WITNESS <b>V:</b> REVIEW OF RECORDS<br><b>MA:</b> MAJOR AND <b>MI:</b> MINOR | <b>PREPARED BY</b><br><br><b>Rakesh Kumar Madhu,(SEr/QA)</b> | <b>REVIEWD &amp; APPROVED BY</b><br><br><b>K C Gandhi Parimalam,(DGM/QA)</b> |
|--|--|---|

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**ANNEXURE-XI:** Refer to enclosed instrument specification.

SIGNATURE OF BIDDER -----

NAME -----

DESIGNATION -----

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**SECTION-VI**

**TECHNICAL SPECIFICATION**

**CONTROL AND INSTRUMENTATION SYSTEMS**

**1.00.00 FIELD INSTRUMENTS**

This section provides general guidelines for field instruments and equipment to be supplied under this specification. All measuring instruments/equipment and subsystems offered by Bidder shall be from reputed experienced manufacturer of specified type and range of equipment, whose guaranteed and trouble free operation has been established. All instruments/equipment shall be of proven reliability, accuracy, repeatability requiring a minimum of maintenance and comply with the acceptable international standards. All instruments/equipment and accessories shall be supplied as per technical specifications, ranges, make as approved by Owner.

- i) HART management system shall be integral feature of the DDCMIS and shall be provided for centralised configuration, maintenance, diagnostics & record-keeping for all electronic transmitters.
- ii) Bidder shall provide following facilities as a minimum through software:
  - a) Constant scanning to monitor faults of changes to instrument configuration.
  - b) Owner-defined and standard calibration and configuration procedures for all transmitters.
  - c) Constant signal data collection facilities to maintain continuously updated records.
  - d) Automatic tracking of configuration changes made in the field, such as may be introduced by hand-held communicator. All configuration function associated with hand-held communicators shall be available in the system.
  - e) Event and log reports on screen as well as on printer.
  - f) Any addition/deletion of transmitter will be reported on printer and logged in hard disk.

**1.01.00 PRESSURE TRANSMITTER**

- |     |              |   |  |
|-----|--------------|---|--|
| 01. | Type         | : | Microprocessor based Smart, HART protocol compatible |
| 02. | Transmission | : | 2 - Wire   |



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03. Output Signal : Simultaneous transmission of digital and 4-20 mA DC signal.
04. Signal Processing : Silicon solid state electronic circuitry
05. Sensor type : Capsule / Diaphragm
06. Element material : AISI-316 or better
07. Static Pressure : 150 % of maximum span continuously, without affecting the calibration.
08. Turn-down ratio : 10 : 1 for vacuum/very low pressure application ; 30 : 1 minimum for other applications.
09. Span and Zero : Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span
10. Enclosure Class : Weather proof as per IP-65 with durable corrosion resistant epoxy coating (Explosion proof for NEC Class-1, Division 1 area wherever required)
11. Output Indicator : Backlit LCD type
12. Nameplate : Tag number, service engraved in stainless steel tag plate
13. Body : Forged Carbon Steel (SS for DM Water & corrosive service).
14. Power supply : 16 - 48 Volts D.C.
15. Load : 500 Ohms (min.) at 24 Volts D.C.
16. Ambient Temperature : 0 - 50°C
17. Performance :
- i) Accuracy :  $\pm 0.075\%$  of Span or better
- ii) Repeatability :  $\pm 0.05\%$  of Span or better
- iii) Response time : 100 msec or better
- iv) Stability :  $\pm 0.1\%$  of Calibrated Span for 6 months up to 70 Kg/cm<sup>2</sup> and  $\pm 0.25\%$  of Calibrated Span for more than 70 Kg/cm<sup>2</sup>
- v) Zero and span drift :  $\pm 0.015\%$  per deg. C at max span and 0.11% per deg. C at min span
18. Sealing/Isolation : Extended diaphragm with 5 meters SS armored capillary for corrosive, viscous and dirty fluid applications. Material for separator



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diaphragm shall be as per application. Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application

19. Diagnostics : Self indicating feature
20. Accessories : a) Universal mounting bracket suitable for 2" pipe mounting.  
b) High tensile carbon steel U- bolts.  
c) Installation accessories as per relevant installation drawing.  
d) Syphons for steam and hot water services.  
e) ½" NPT 2-valve stainless steel manifold for pressure transmitters constructed from SS316 bar stock. In case it becomes necessary to use a DP transmitter for gauge pressure measurement then a 2-valve manifold should be used in place of 5-valve manifold.  
f) Companion flange with nuts, bolts and gaskets.  
g) Hand held configurator kit for calibration of Smart Transmitter.

**1.02.00 Differential Pressure Transmitter**

01. Type : Microprocessor based Smart, HART protocol compatible
02. Transmission : 2-Wire
03. Output signal : Simultaneous transmission of digital and 4-20 mA DC signal.
04. Signal Processing Unit : Silicon solid-state electronic circuitry
05. Sensor type : Capsule/Diaphragm
06. Element material : AISI-316 (Stainless Steel) or better
07. Static Pressure/



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- Overload Pressure : Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy
08. Turn-down ratio : 10 :1for vacuum/very low pressure application; 30 : 1 minimum for other applications.
09. Span and Zero : Locally adjustable, non-interacting
10. Enclosure class : Weather proof as per IP-65 with durable corrosion resistant epoxy coating (Explosion proof for NEC Class-1, Division 1 area wherever required))
11. Zero suppression / elevation : At least 100% of Span
12. Output Indicator : Backlit LCD type
13. Nameplate : Tag number and Service engraved in stainless steel tag plate
14. Body : Forged Carbon Steel (SS for DM Water)
15. Ambient temperature : 0 - 50° C
16. Power supply : 16 - 48 Volts DC
17. Load : 500 Ohms (min.) at 24 Volts DC
18. Performance :-
- i) Accuracy :  $\pm 0.2$  % of span or better
- ii) Repeatability :  $\pm 0.05$  % of span or better
- iii) Response time : 100 msec or better
- iv) Stability :  $\pm 0.1\%$  of Calibrated Span for 6 months up to 70 Kg/cm<sup>2</sup>
- v) Zero and span drift :  $\pm 0.015\%$  per deg. C at max span and 0.11% per deg. C at min span
19. Sealing/Isolation : Extended diaphragm with 5 meters. SS armored capillary for corrosive, viscous and dirty fluid applications. Material for separator diaphragm, depending on application.
20. Diagnostics : Self indicating feature
21. Accessories : a) Universal mounting bracket suitable for 2" pipe mounting.



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- b) High tensile carbon steel U-bolts.
- c) Installation accessories as per relevant installation drawing.
- d) Syphons for steam and hot water services.
- e) ½" NPT 5-valve stainless steel manifold, constructed from SS316 bar stock.
- f) Companion flange with nuts, bolts and gaskets.
- g) Hand held configurator kit for calibration of Smart Transmitter.

1.02.00 DISPLACER TYPE LEVEL TRANSMITTERS

- 01. Type : SMART
- 02. Stages of operation : Continuous
- 03. Material -
  - i) Displacer : AISI 316 SS
  - ii) Suspension wire : AISI 316 SS
  - iii) Torque tube housing : Carbon steel or SS as per application
  - iv) Torque tube : Inconel
  - v) Displacer chamber : Carbon steel or SS as per process application
  - vi) Transmitter Housing : Die cast aluminium or better
- 04. Power supply : 16-48 Volts D.C.
- 05. Transmission : 2-wire
- 06. Output Signal : Simultaneous transmission of digital and 4-20 mA DC signal. Standard HART protocol.
- 07. Signal processing : Solid-state electronic circuitry
- 08. Static / overload pressure : Maximum static pressure without permanent deformation or loss of accuracy.
- 09. Turn-down ratio : 10 : 1 or better



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- 10. Zero & Span : Easily accessible (local zero & span adjustment and non-interactive type)
- 11. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
- 12. Output Indicator : Yes, Backlit LCD type
- 13. Nameplate : Tag number and Service engraved in stainless steel tag plate
- 14. Ambient Temperature : 0 - 50°C
- 15. Load Impedance : 500 Ohms at 24 Volts (minimum)
- 16. Process Connection : 2" Companion flange with nuts, bolts and gaskets
- 17. Performance -
  - Accuracy :  $\pm 0.2\%$  of span or better
- 18. Accessories :
  - a) Counter Flange, nuts, bolts, gaskets etc.
  - b) Weights for 5 point calibration of instruments.
  - c) Vent and drain plugs
  - d) Special calibration tool/configurator, if any.
- 19. Preferred Features :
  - a) Test plug connection and cutout terminals physically separated from other electronics.
  - b) Electronic Damping facility (adjustable).

**1.03.00 MASS FLOW METER**

- A. Sensor
  - 01. Measuring Principle : Coriolis Mass flow.
  - 02. Primary Element : Flow Tube of 316SS or better
  - 03. Temperature Control : To be provided for heavy fuel oil application. Heating arrangement shall be integral. For Heating
  - 04. Process Connection : Flanged and rating as per process requirement.
  - 05. Drain : Self-draining facility



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06. Enclosure : Stainless steel
07. Accessories : Counter flanges, Mounting nuts, bolts, gaskets etc.
- B. Transmitter
01. Measured quantities : Mass Flow rate, Total Mass Flow, Density, Temperature as minimum.
02. Input Signal Processing : Digital Processing.
03. Display : Digital Display (LCD).
04. Output : 2 Nos. isolated output of 4-20mA DC with HART protocol, selectable from four measured quantities & field bus output for softlink with DCS
05. Load : < 750 ohms.
06. Power supply : "UPS", (if the external power supply is 230V AC, 50 HZ).
07. Turn Down : 100:1
08. Accuracy :  $\pm 0.2\%$  of measured value
09. Housing : IP 65 (Explosion proof for NEC Class-1, Division 1 area).
10. Hazardous duty Version : FM Standards.
11. Nameplate : Tag number, service engraved in stainless steel tag plate
12. Accessories : a) As required for field mounting  
b) Handheld configurator  
c) Mounting U-bolts, nuts, bolts, prfab cable etc.

1.04.00 Turbine Flow meter

- A. Sensor
01. Type : Turbine (in line full-bore, based on magnetic pick up pulses)



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02. Output Signal : Pulse
03. Material of Construction : a) Body : AISI 316  
b) Rotor: AISI 431 or 410  
c) Bearings: Tungsten Carbide /  
Stellited Sleeve
04. Flow rate range : As required.
05. Linearity :  $\pm 0.25\%$  or better.
06. Repeatability :  $\pm 0.02\%$  or better.
07. Ambient temperature : 50°C
08. Mounting : On-Line, flanged
09. Enclosure : IP 65
- B. Transmitter
01. Electronics : Solid State
02. Power Supply : "UPS", if the external power supply is 230V  
AC, 50 HZ.
03. Input : Input from Sensor
04. Display : Backlit LCD
05. Output : Isolated 4-20mA DC with HART protocol.
06. Measuring Accuracy :  $\pm 0.5\%$  of full scale range
07. Totalized Value : Required
08. Housing : IP-65 (Explosion proof for NEC Class-1,  
Division 1 area)
09. Nameplate : Tag number, service engraved in stainless  
steel tag plate
10. Accessories : a) Clamping strip, bracket, prefab cable etc.  
b) Calibration or configurator kit.

1.05.00 Vortex Flow meter

A. Sensor

01. Type : Vortex



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- 02. Output Signal : Pulse
- 03. Material of Construction : AISI 316
- 04. Sensor Seal : PTFE / higher based on temperature
- 05. Flow range : As required.
- 06. Linearity :  $\pm 1\%$  or better.
- 07. Repeatability :  $\pm 0.2\%$  or better.
- 08. Ambient temperature :  $50^{\circ}\text{C}$
- 09. Mounting : On-Line, flanged.
- 10. Enclosure : IP 65
- 11. Accessories : Nuts, bolts, gaskets etc.
- B. Transmitter
  - 01. Electronics : Solid State-remote mounting
  - 02. Power Supply : 24 V DC.
  - 03. Input : Input from Sensor
  - 04. Display : Backlit LCD
  - 05. Output : Isolated 4-20mA DC.
  - 06. Protocol : HART
  - 07. Totalized Value : Required
  - 08. Housing : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
  - 09. Nameplate : Tag number, service engraved in stainless steel tag plate
  - 10. Accessories : a) Clamping strip, bracket, prefab cable etc.  
b) Special tool kit for calibration/ configuration .



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1.06.00

Rotameter

01. Type : Online upto 2" and Bypass above 2" line size"
02. Metering tube : Borosilicate glass
03. Float : AISI 316-SS unless the process fluid demands some other material.
04. Body MOC : SS as per fluid condition.
05. Scale : Aluminium Graduated - Engraved black on white background.
06. Process connection : Flanged to line size or threaded for connection size 1/2" or less.
07. Accuracy :  $\pm 2\%$  of full scale detection or better for on-line type and  $\pm 4\%$  of full-scale detection or better for by-pass type.
08. Nameplate : Tag number, service engraved in stainless steel tag plate
09. Accessories : Slip-on orifice plate of 316-SS and taps of / SS as per application. Applicable SS Isolation valves and SS Range Orifice - for bypass type rotameters.
10. Housing protection class : IP- 65.

1.07.00

Pressure Gauge and Differential Pressure Gauge

01. Type : Bourdon/Bellows/Diaphragm
02. MOC Sensing & Socket : AISI-316 SS
03. Movement Material : AISI-304 SS
04. Case Material : Stainless steel..
05. Bezel Material : SS 304.
06. Socket Material : SS 316
07. Enclosure : IP-65.
08. Dial Size : 150 mm



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09. Scale : Black lettering on white background in 270 Deg. arc.
10. Window : Shatterproof glass
11. Range Selection : Normal process pressure – 50 ~ 70 % of range (approximately).
12. Over-range Protection: 125% of maximum range by internal stop. External stop at zero
13. Adjustment : Micrometer screw for zero adjustment. Internal micrometer screw for range adjustment.
- External zero adjustment for glycerine filled gauges.
14. Element Connection : Argon welding
15. Process Connection : 1/2" NPT(M) Bottom connection for local mounting, back connection for panel mounting.
16. Performance : Accuracy of  $\pm 1.0$  % of span or better.
17. Operating ambient temperature : 0 - 50°C
18. Safety Feature : Blow out disc/diaphragm at the back
19. Accessories : a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge.
- b) Stainless steel Diaphragm chemical seals for corrosive, viscous and solid-bearing or slurry type process fluids. diaphragm chemical seal shall be provided with the following:
- 1) Top chamber : SS 304
  - 2) Bottom Chamber: SS 316
  - 3) Sealing fluid: Silicon DC 200
  - 4) Diaphragm: SS 316
- c) 3-way SS gauge cock/ 2-Valve SS-316 barstock manifold for pressure gauges with 1/2" NPT process connection..



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- d) 5-valve SS316 manifold constructed from barstock for differential pressure gauge. Process connection ½" NPT.
- e) Union, nut & tail piece and other Installation accessories as required.
- f) Syphons for steam and hot water services.

- 20. Applicable standard : IS-3624 / 1996 , EN-837-1
- 21. Nameplate : Tag number, service engraved in stainless steel tag plate

**1.08.00 Temperature Gauge**

- 01. Type : Inert gas filled remote mounting system.
- 02. Sensing Element Material : Bourdon - AISI-316 SS
- 03. Capillary Armoring : Stainless steel flexible
- 04. Movement Material : AISI 304 SS
- 05. Bulb / Stem Diameter : 12 mm
- 06. Bulb / Stem Material : AISI 316
- 07. Capillary : Stainless Steel
- 08. Thermometer connection to well : ½" NPT
- 09. Case Material : Stainless steel
- 10. Dial Size : 150 mm in general (100 mm for SWAS gauges)
- 11. Scale : Black lettering on white background in 270 Deg. arc.
- 12. Mounting : Surface/Panel
- 13. Over range Protection : 125 % of range or more
- 14. Instrument connection: Bottom connection for local mounting and back connection for panel mounting.



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15. Range : Normal temperature – 50 ~ 70% of range approximately.
16. Zero adjuster : Micrometer screw adjustable from front.
17. Window : Shatterproof glass.
18. Accuracy :  $\pm 1\%$  or better
19. Enclosure Class : IP-65
20. Capillary : 5 meters (local)/15.0 meters (local panel) - armoured stainless steel
21. Compensation : Capillary and Case Compensation
22. Accessories : a) Forged/barstock SS316 thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). Material of construction of thermowell:  
1) SS 316: in general  
2) Inconel: For flue gas application  
3) Tungsten carbide: For coal mill application  
b) Installation accessories as required.
23. Nameplate : Tag number, service engraved in stainless steel tag plate
- 1.09.00 Thermocouples
01. Type : a) Type-K (Chromel Alumel) / Type-R (Pt-Rhodium Pt.) / Type-E (Chromel Constantan) [As per application]  
b) Duplex (Triplex incase of turbine/Generator/excitor bearing temperature may be used)  
c) Ungrounded
02. Wire gauge : 16 AWG for Type-K, 24 AWG for Type-R
03. Standard : ANSI-MC 96.1.
04. Protecting Tube :-  
i) O.D. : 8 mm  
ii) Material : 316-SS Seamless  
iii) Filling : Magnesium Oxide (Purity above 99.4%)



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05. Response time with Thermowell : a) Less than 20 seconds for measurement.  
b) Less than 10 seconds for control.
06. Accuracy :  $\pm 1.1^{\circ}\text{C}$  upto  $300^{\circ}\text{C}$  & 0.4% of measured temperature range above  $300^{\circ}\text{C}$ .
07. Head :
- i) Type : IP-65 universal screwed type. (Explosion proof for NEC Class-1, Division 1 area)
  - ii) Material : Die cast aluminum or better
  - iii) Terminal blocks : Nickel plated Brass - screw type / silver plated
  - iv) Instrument connection :  $\frac{1}{2}$ " NPT to well
  - iv) Cable connection :  $\frac{1}{2}$ " NPT gland and grommet.
  - v) Others : Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells"
08. Accessories : a) Adjustable nipple-union-nipple [1/2" Sch 80 X  $\frac{1}{2}$ " NPT (M)] with thermowell connection  
b) Compression fittings/unions  
c) Flanges etc. (for flanged connections only)  
d) Barstock thermowell of stepless tapered design as per ASME PTC19.3 code.  
Process connection M33x2 (M) in general or 1 1/2" flanged for flue gas/Furnace/air etc. application.  
Material of construction of thermowell:  
1) SS 316: in general  
2) Inconel: For flue gas application  
3) Tungsten carbide: For coal mill application.



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09. Nameplate : Tag number, service engraved in stainless steel tag plate

1.10.00 Passing condition of various drain valves shall be monitored by measuring drain pipe metal temperature at the downstream of the drain valves. Also Drum, SH, RH metal temperature measurement shall be provided. Necessary thermocouples shall be provided as per the following specification.

01. Measuring medium : Metal temperature
02. Metal of thermocouple element : Chromel-Alumel Type-K
03. Type of thermocouple ungrounded type. : Duplex with separate hot junctions,
04. Insulation : Mineral insulation Magnesium Oxide
05. Thermocouple wirer gauge : 16 AWG
06. Protective Sheath : SS 321
07. Protective Sheath Dia : 8 mm O.D.
08. Characteristics of thermocouple : Special limits of error as in ANSI MC 96.01.1975
09. Mounting Accessories : 1/2" BSP SS sliding end connector, weld pad, weld on clamps of heat resistant steel SS 310.
10. Cold end sealing : SS pot seal with colour coded PTFE headed sleeve insulated flexible tails. Sealing compound - Epoxy resin
11. Minimum Bending Radius : 30 mm
12. Length of T/C : 30 mtrs. (minimum)

1.11.00 Resistance Temperature Detector

01. Type : Platinum (Duplex), Ungrounded
02. Resistance : 100 ohm at 0°C
03. Base : Wound on ceramic (anti-inductive)
04. Wiring : 3/4 Wire



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05. Protecting Tube :-
- i) O.D. : 8 mm
  - ii) Material : SS-316, Seamless
  - iii) Filling : Magnesium oxide (Purity above 99.4%).
06. Response time : a) < 20 seconds for measurement.  
b) < 10 seconds for control.
07. Calibration : DIN 43760
08. Accuracy :  $\pm 0.5\%$  of range
09. Head :
- i) Type : IP-65 universal screwed type. (Explosion proof for NEC Class-1, Division 1 area)
  - ii) Material : Die cast aluminum or better
  - iii) Terminal blocks : Nickel plated Brass-screw type / silver plated
  - iv) Cable connection :  $\frac{1}{2}$ " NPT gland and grommet.
  - v) Others : Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells"
10. Accessories : a) Adjustable nipple-union-nipple [1/2" Sch 80 X  $\frac{1}{2}$ " NPT (M)] with thermowell connection  
b) Compression fittings/unions  
c) Flanges etc. (for flanged connections only)  
d) Barstock thermowell of stepless tapered design as per ASME PTC19.3 code.
- Process connection M33x2 (M) in general or 1 1/2" flanged for flue gas/Furnace/air etc. application.
- Material of construction of thermowell:
- 1) SS 316: in general
  - 2) Inconel: For flue gas application



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3) Tungsten carbide: For coal mill application.

11. Nameplate : Tag number, service engraved in stainless steel tag plate
- 1.12.00 Pressure Switch
01. Type : i) Piston for high pressure application (above 40 bar)  
ii) Bellow /Diaphragm for low pressure application (below 40 bar)
02. Sensing element material : AISI SS-316. All other wetted part SS316.
03. Case Material : Die-cast aluminum alloy with neoprene gasket.
04. Setter Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.
05. Over range : 150 % of maximum pressure
06. Adjustments : a) Internal Set Point  
b) Differential adjustment
07. End Connection : 1/2" NPT (M) bottom connected
08. Switch configuration : Two SPDT
09. Switch Rating : 240V, 5A AC/220V, 0.5A DC
10. Switch Type : Snap acting, shock & vibration proof
11. Terminal Block : Suitable for full ring lugs for cable connection.
12. Elect connection : Plug in socket
13. Enclosure Class : IP-65 weather and dust proof (Explosion proof for NEC Class-1, Division 1 area).
14. Performance : a) Repeatability  $\pm 0.5\%$  of full range  
b) Accuracy of Setting Indication of  $\pm 1.5\%$
15. Ambient temperature : 0 – 50°C



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16. Nameplate : Tag number, service engraved in stainless steel tag plate
17. Accessories : a) Remote diaphragm seal with SS-316 capillary for viscous & corrosive application. MOC of seal material shall be as per process fluid requirement.
- b) Snubbers for pulsating fluid application.
- c) Syphons for steam and hot water services.
- d) Retention ring and screws for surface mounting.
- e) 1/2" NPT 2 Valve SS-316 manifold constructed from barstock
- f) Brass cable gland

**1.13.00 Differential Pressure Switch**

01. Type : Bellows / Diaphragm / Piston actuated
02. Sensing element material : AISI SS-316. For all other wetted part SS 316
03. Case Material : Die-cast aluminum alloy with neoprene gasket.
04. Setter Scale : Black graduation on white scale with 0-100% graduation and provided with red pointer for set point adjustment
05. Over range : Static pressure on any one side, the other side being open to atmosphere.
06. Adjustments : a) Internal set point adjustment  
b) Differential adjustment
07. Process Connection : 1/2" NPT (M) bottom connected / back connected.
08. Switch configuration : Two SPDT
09. Switch rating : 240V, 5A AC/220V, 0.5A DC.
10. Switch type : Snap acting type contacts, shock and vibration proof.



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11. Terminal Blocks : Suitable for full ring lugs for cable connection.
12. Elect connection : Plug in socket
13. Performance : a) Repeatability  $\pm 0.5\%$  of full range  
b) Accuracy of set point Indication:  $\pm 1.5\%$
14. Operating Ambient Temperature : 0 - 50°C
15. Enclosure : IP-65 (Explosion proof for NEC Class-1, Division 1 area).
16. Accessories : a) Snubbers for pulsating fluid application.  
b) Syphons for steam and hot water services.  
c) Retention ring and screws for surface mounting.  
d) 1/2" NPT 3-Valve SS-316 manifold constructed from barstock
17. Nameplate : Tag number, service engraved in stainless steel tag plate
18. Remote Seal type for special application : a) Silicone oil / fluorolube filled remote diaphragm seal for dirty / viscous / corrosive fluid.  
b) SS armoured capillary at least 3 meters each.  
c) Adapter flanges with nuts, bolts and gaskets for instrument and process side.

**1.14.00 Temperature Switch**

01. Type : Inert gas filled-in
02. Sensing Element Material : Bellow / Bourdon AISI SS-316
03. Bulb Material : AISI SS-316
04. Capillary : Stainless steel armoured
05. Movement Material : AISI SS-304
06. Case material : Epoxy coated steel plate or die-cast aluminum alloy with neoprene gasket and



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clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).

- 07. Scale : Black lettering on white background
- 08. Over range Protection : 120 %
- 09. Instrument connection : Bottom
- 10. Switch configuration : Two SPDT
- 11. Switch rating : 240V, 5A AC/220V, 0.5A DC
- 12. Switch type : Snap acting, shock and vibration-proof.
- 13. Adjustability : Internal Set point adjustable over span range
- 14. Elect connection : Plug in socket
- 15. Compensation :
  - a) Capillary compensation with invar wire throughout the capillary length.
  - b) Case compensation
- 16. Performance :
  - i) Scale Accuracy :  $\pm 1.0$  % of full scale
  - ii) Repeatability :  $< 0.5$  % of full range
  - iii) Response time : Less than 40 seconds with thermowell
- 17. Capillary length : 5 meters (minimum) for local mounting/15 meters for local panel mounting.
- 18. Nameplate : Tag number, service engraved in stainless steel tag plate
- 19. Accessories : Thermowell from SS barstock, Mounting accessories,  $\frac{1}{2}$ " NPT cable gland.

1.15.00 Level Switch

- 01. Type : External cage float operated. Magnetically coupled.
- 02. Float Material : AISI-316 stainless steel or better
- 03. Other wetted parts : AISI-316 stainless steel or better
- 04. External Cage : Carbon steel / Stainless steel or better as per process requirements, welded type / flanged



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construction. Cage pressure rating shall equal or exceed the rating of the main vessel.

05. External cage mounting : Side-Side.
06. External cage connection : 25 NB socket welded.
07. Switch housing : Epoxy coated die-cast aluminum alloy with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
08. Type of switch configuration : 2 SPDT (two nos.)
09. Contact rating : 5A, 240V/AC, 0.25A, 220V DC
10. Accessories : a) Counter flange, nuts & bolts, suitable gasket etc.  
b) Steel globe type drain valve.  
c) 1/2"NPT cable gland  
d) Stainless steel alpha-numeric engraved for service and tag.  
e) Globe drain valve
11. Preferred feature : Switch operating point marked on cage
12. Mounting : On standpipe

1.16.00 Conductivity Type Level Switch

01. Type : Conductivity discrimination.
02. Application : Drain pots viz. on CRH line
03. Mounting : Flanged – on external cage.
04. Probe MOC : Stainless steel with high purity ceramic.
05. Probe rating : > Maximum design pressure of vessel.
06. Input : Four independent channel with selectable switching threshold for water conductivity.
07. Relay Output : Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.



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- 08. Contact type & rating : 2SPDT or 1 DPDT @ 5A 30V DC.
- 09. Local Display : Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault.
- 10. Power supply : Dual 240V AC, 50 Hz, 1Ph UPS supply.
- 11. Enclosure : IP-65, corrosion resistant & wall mounting type (Explosion proof for NEC Class-1, Division-1 area).
- 12. Accessories :
  - a) PTFE cable from probe to electronics
  - b) Mounting accessories
  - c) External cage
  - d) Washer & gasket
- 13. Test pressure : Two times rated pressure
- 14. Elect connection : Plug in socket

**1.17.00 Capacitance Type Level Switch**

- 01. Type : Capacitance type
- 02. Probe :
  - a) Rod or suspended electrode
  - b) Rope type probes may be used only where required probe length is greater than 1.5 meters.
  - c) Reference rod for non grounded tank.
- 03. Probe Mounting : 1-1/2" Flanged
- 04. Material of construction : 316 SS and to suit fluid type
- 05. Insulation : PTFE/PP/Kynar Part/Full as required
- 06. Enclosure : Powder coated Die cast aluminium. with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
- 07. Ambient temperature : 0-60°C.
- 08. Mounting : Top Mounting
- 09. Supply voltage : 240V AC, 50 Hz, 1Ph UPS supply/ 24V DC



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10. Relay output : 2 SPDT
11. Contact rating : 5A min. at 240V AC on resistive load
12. Response time : 100 msec or better
13. Elect connection : Plug in socket
14. Accessories : Counter flange, cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.

**1.18.00 RF Type Level Switch**

Sensing Probe :

01. Type : Rigid
02. Material : SS-316
03. Mounting : Threaded
04. Probe Head Housing : Cast Aluminium
05. Protection : IP-66

Electronic Controller :

01. Supply Voltage : 240V AC (UPS)
02. Relay Output : 2 nos. SPDT
03. Contact Rating : 240V AC, 5A/ 220V DC, 0.25A
04. Housing Material : Cast Aluminium
05. Protection : IP-65
06. Local LED Indication : Power On, Alarm Level, Probe Healthy
07. Switching Repeatability :  $\pm 0.5\%$
08. Accessories : Coaxial cable probe connection to controller  
 $\frac{1}{2}$ "NPT Cable Gland

**1.19.00 Ultrasonic Level Switch**

01. Principle of operation : Ultrasonic contact level technology
02. Input Power : 24V DC/ 240V AC



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- 03. Output Contact : 2 SPDT (240V AC, 5A/ 220V DC, 0.25A)
- 04. Switch Mounting : Integral
- 05. Sensor Material : SS-316
- 06. Enclosure : Cast Aluminium (IP-65)
- 07. Process Connection : 2" Flanged
- 08. Repeatability : 2 mm
- 09. Power supply : 240V AC, 50 Hz, 1Ph UPS supply/ 24V DC
- 10. Cable connection : ½" NPT with cable gland
- 11. Accessories : Cable gland, cable, companion flange, bolts & nuts, gaskets etc. along with all mounting hardware

**1.20.00 Ultrasonic Level Transmitter**

- 01. Principle of operation : Detection of reflected ultrasonic pulse
- 02. Signal processing : Microprocessor Controlled Signal Processing
- 03. Type : Smart
- 04. Display : Large alpha-numeric back lit LCD/LED
- 05. Calibration & configuration : Accessible from front of panel
- 06. Diagnostic : On-line
- 07. Status : For power, Hi / Lo / V. Hi / V. Lo-level indication, fault etc.
- 08. Construction : Plug-on board
- 09. Power supply : 240V AC, 50 Hz, 1Ph UPS supply/ 24V DC
- 10. Signal Output : 4-20 mA DC (isolated) - 500 Ohm load with HART protocol.
- 11. Hysteresis : Fully adjustable preferred
- 12. Output contacts : 2SPDT Potential free changeover contacts @ 5A 230V AC.



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13. Accuracy & Repeatability : 0.25% of span or better
14. Resolution : 0.1% of span
15. Operating temp. : Transmitter- 0 to 50° C and Sensor 0 to 80° C
16. MOC Sensor : SS 316 in general / PTFE, PP for corrosive application.
17. Humidity : 1% to 95% non condensing.
18. Enclosure : IP-65 powder coated die cast aluminium
19. Cable connection : ½" NPT with cable gland
20. Mounting : 2" flanged for sensor and Transmitter on panel / surface.
21. Accessories : Cable gland, prefab cable, mounting accessories.

**1.21.00 Conductivity Type Electronic Level Indicator**

01. Type : Conductivity discrimination.
02. Application : Separator drum Level .
03. No. of Probes : As per manufacturer standard.
04. Probe Mounting : Flanged – on standpipe.
05. Probe MOC : Stainless steel with high purity ceramic.
06. Probe rating : > Maximum design pressure of vessel.
07. Input : Independent channel with selectable switching threshold for water conductivity.
08. Relay Output : Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
09. Contact type & rating : 2 SPDT or 1 DPDT @ 5A 30V DC.
10. Current output : Isolated 4-20 mA DC
11. Local Display : a) Coloured (Red & Green) LEDs for level.  
b) Flashing LEDs for fault.
12. Remote Display : Red, Green & flashing yellow LEDs for steam, Water & Fault indication respectively.



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13. Power supply : Dual 240V AC, 50 Hz, 1Ph UPS supply.
14. Enclosure : a) IP-65, corrosion resistant & wall mounting type for local electronics.  
b) IP-42 for remote indicator
15. Accessories : a) PTFE cable from probe to electronics  
b) Mounting accessories.  
c) Standpipe  
d) Washer & gaskets  
e) Double isolation valves on each connection, double drain valves & double vent valves with mechanical lock.  
f) 1/2" NPT cable gland
16. Test pressure : Two times design pressure
- 1.22.00 Air Filter Regulator
01. Filter Element : Sintered Bronze
02. Filter Size : 5 microns
03. Input Air : 10.0 Kg/Sq. cm (maximum)
04. Output : Adjustable from 0-2.0 Kg / Sq. cm or 0-7.0 Kg / Sq. cm (continuous) as applicable.
05. Effect of Supply : Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm
06. Bowl Material : Metallic.
07. Accessories : 2" dial size output pressure gauge
08. Feature : No perceptible drop of pressure on opening the drain port.
- 1.23.00 SOLENOID VALVE
01. Operating Principle : Electromagnetic (noiseless)
02. Coil voltage rating : 24V DC (in general) other 220V DC /240V AC /110V AC as required



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03. Ways : 3 ways in general other depending on requirement
04. Port size : 1/4" NPT all ports
05. Body : SS Bar Stock
06. Trim : AISI SS-316
07. Manual Operator : In built
08. Duty : Suitable for continuous energization
09. Sealing : Airtight and leak proofing with nitrile (NBR) and polyurethane (PUR) material
10. Ambient Temperature : 0 - 50° C
11. Fluid Temperature : 0-150° C (approx.)
12. Coil Enclosure : Stainless Steel
13. Insulation : Class-H
14. Coil Casing : IP-65 (Explosion proof for NEC Class-1, Division-1 area)
15. Response time : 4-7msec
16. Mounting : On pipe or on panel
17. Cable Connection : ½" NPT cable gland
18. Accessories : Mounting brackets, nuts and bolts
19. Special feature : (i) LED indication for power  
(ii) Double coil type for open & close operation of valve / damper.  
(iii) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity

**1.24.00 ORIFICE PLATE**

01. Application : Low fluid velocity flow measurement
02. Design Standard : Concentric as per ASME PTC-19.5 (Part -II), ISA RP-3.2 or BS-1042, Part-I
03. Number of Tapings : As required plus one additional pair of taps
04. Diameter Ratio : Between 0.34 to 0.7



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- |     |                |   |   |
|-----|----------------|---|---|
| 05. | Thickness      | : | 3mm for main pipe of diameter upto 250mm, 6mm for main pipe of diameter above 250mm and 10mm for diameter above 500 mm              |
| 06. | Document       | : | Beta ratio calculation, assembly drawing and Flow vs. DP curve.   |
| 07. | Meter run pipe | : | Same as pipe material   |
| 08. | Accessories    | : | Flanges, gaskets, nuts & bolts, root valves (1" 316 SS globe) jack screw, meter run pipe, Drain & vent hole as per application etc. |

NOTE: One flow element of each type shall be calibrated in the test laboratory for validation of computed flow calculations.

1.25.00 **FLOW NOZZLE**

- |     |                 |   |  |
|-----|-----------------|---|--|
| 01. | Application     | : | High fluid velocity flow measurement   |
| 02. | Design Standard | : | ASME PTC 19.5  |
| 03. | Tapings         | : | D and D/2 ( Numbers as required plus one additional pair of taps)  |
| 04. | Diameter Ratio  | : | Between 0.4 and 0.7  |
| 05. | Material        | : | 316 SS (321 SS for high temperature)   |
| 05. | Document        | : | Beta ratio calculation, assembly drawing and Flow vs. DP curve.  |
| 06. | Meter run pipe  | : | Same as pipe material  |
| 07. | Accessories     | : | Meter run pipe, nipples and root valves (1" 316 SS globe).(Inspection port assembly for nozzles used in plant performance purpose) |

NOTE: One flow element of each type shall be calibrated in the test laboratory for validation of computed flow calculations.

1.26.00 **GAUGE GLASS**

- |     |                 |   |  |
|-----|-----------------|---|--|
| 01. | Type            | : | Reflex   |
| 02. | Glass           | : | Toughened borosilicate. Resistant to mechanical and thermal shocks.              |
| 03. | Body material   | : | Carbon steel / stainless steel- As per process requirements (Flanged Connection) |
| 04. | Pressure rating | : | Twice the maximum working pressure   |



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- 05. Temperature rating : 300° C
- 06. Bolts and nuts : Rust proof alloy steel
- 07. Accessories : Suitable ball check valves of SS-304/316 body, gaskets, companion flange etc.

**1.27.00 LEVEL GAUGE (FLOAT & BOARD)**

- 01. Type : Float and Board
- 02. Float & Tape MOC : AISI 316
- 03. Pulley and Pulley Housing material : SS 304
- 04. Guide wire : SS 316 Stainless steel
- 05. Accuracy : +/- 2 mm
- 06. Indication : Vertical dial
- 07. Rating : Twice the design pressure
- 08. Spring tension assembly : SS 304
- 09. Anchor plate : SS304
- 10. Calibrated scale board: Aluminium with black graduation

Note: The measuring rope/tape shall be passed through conduits

**1.28.00 POWER CYLINDERS (PNEUMATIC)**

- 01. Mounting Type : a) Fixed position mounting (End mounting).  
: b) Trunnion mounting
- 02. Control Signal : 4-20 mA DC to smart positioner with HART protocol for modulating purposes. 24V/48VDC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive.
- 03. Supply Air : 0-7 Kg / Cm<sup>2</sup>.
- 04. Selection : Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation.
- 05. Casing : IP-65.



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06. Accessories (as required) :
- a) Air lock relay
  - b) Hand wheel.
  - c) Air filter regulator with gauge.
  - d) Volume Booster.
  - e) Limit Switches.
  - f) Smart Positioner with integral I-P convertor, feedback position Transmitter (4-20 mA DC output), Input & Output pressure gauges, local keypad & display.
  - g) Solenoid Valve
  - h) Junction box with cable gland
07. Fail-safe operation : Stay put for regulating duty.
08. Repeatability : Better than 0.5% of full travel.
09. Hysteresis : Less than  $\pm 1\%$  of full travel
10. Operating Temp. limit : 80° C (min.)

1.29.00 SIGHT GLASS

01. Type : Flap-type
02. End connection : Screwed / Flanged
03. Material :
- a) Body : SS-304
  - b) Cover Plate : SS-304
  - c) Indicator : SS-316
04. Sight Glass : Toughened Borosilicate
05. Gasket : Neoprene
06. Bolts & Nuts : High tensile steel
07. Hydraulic Test
- Pressure : 1.5 times maximum working pressure
08. Accessories : As required

1.30.00 SMOKE DENSITY ANALYZER

01. Type : Insitu dry visible light (through LED)
02. Principle of



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- Measurement : Transmission & absorption (Dual beam type)
03. Sensor type : Luminiscence
04. Display : Back Lit LCD
05. Measurement range : 0-999 mg/m<sup>3</sup>, 0-999 mg/Nm<sup>3</sup>, 0-100% opacity
06. Measurement averaging : Selectable 10 sec to 60 minutes
07. Accuracy : 0.2% of F.S
08. Resolution : 0.1% of F.S / 1mg/m<sup>3</sup> whichever is better
09. Linearity : 1.0% of F.S
10. Repeatability : < 0.5% of Span
11. Response time  
(upto 90% of full scale) : 5 sec
12. Flue gas temperature : 90°C (When FGD in operation)  
135°C (When FGD not in operation)  
Max 600°C (at APH outlet)
13. Ambient temperature : 0 - 60°C
14. Operating  
temperature : Transmitter & receiver- 0-90°C, Electronic  
unit – 0-70°C
15. Mounting : Transceiver on opposite side of the duct
16. Analog output : 4-20mA DC (in 500 ohm resistance) to DCS
17. Alarm output : 2 SPCO potential free rated at 230 VAC, 5A
18. Power Supply : 240V AC, 50 Hz, 1 Phase UPS
19. Automatic misalignment  
detection : Required
20. Automatic compensation  
of lens contamination : Required
21. Purge air Failure : Purge air to be provided from Blower unit and  
to be monitored for failure.
22. Span and Zero Check : Automatic periodic with manual override



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23. Housing : Corrosion resistant painted aluminium rated at IP-65
24. Fail safe shutter : Automatic fail safe shutter against power and air failure
25. Input normalisation : Correction for temperature, pressure, oxygen and water vapour to be provided.
26. Preferred Features : "Power Supply On" LED visible from front
27. Accessories : a) Mounting pads suitable for mounting projector and receiver units on duct, flanges, etc.  
b) Blower unit (Purging System) with purge fail alarm at CCR  
c) Enclosure for electronic units & indicators
28. Application : At chimney  
At each ESP outlet
- 1.31.00 SO<sub>x</sub> & NO<sub>x</sub> ANALYZER
- As per Protocol for Real time (Emission & Effluent) Data Management from Insudtries Version-1.2 (10.06.2015); Instruments/Analysers/Equipments (each model) individually certified from Institutions like TUV, MCERTs, USEPA etc. as notified by CPCB.
01. Type : Insitu Probe/ Cross duct type analyser
02. Gases to be measured : SO<sub>x</sub>, NO<sub>x</sub>
03. Principle of measurement : Infrared absorption/ UV Spectroscopy
04. Flue gas Temperature : As per process requirement
05. Mounting/Application : Flanged/ On chimney
06. Measurement range : Fully selectable as per process requirement
07. Units of measurement : PPM, mg / Nm<sup>3</sup> and %
08. Power Supply : 240V, 50 Hz, 1 Phase UPS
09. Local Display : Back lit LCD / LED
11. Accuracy : 2% of measured value



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12. Repeatability : 1% of full scale
13. zero & Span drift : 2% per month
14. Calibration : Zero and Span calibration in manual and automatic mode. Automatic calibration interval shall be fully selectable. Remote Calibration and configuration facility from the remote location shall be possible. (i.e, the hardware and software required for Remote Calibration and configuration from Remote location to be provided). 15. Analog output : 4-20 mA DC (in 500 ohm resistor) to DCS for each channel
16. Alarm output : (1NO + 1NC) for each measured parameter and self diagnostic failure. All contacts rated at 230V AC, 5A
17. Input normalisation : Required—online with pressure and temperature sensor and also provision for key pad entry of inputs
18. Probe material : Stainless Steel 316L
19. Enclosure : Corrosion resistant epoxy painted aluminium housing & enclosure rated to IP-65.
20. Accessories : a) Compressor/Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR  
b) Calibration gas cylinders for SO<sub>2</sub>, Nox & N<sub>2</sub> (for Zero Calibration) filled in 10 Ltrs. of WC carbon cylinder with necessary SS regulators with pressure & flow gauges, solenoid valve & SS tubings and SS fittings etc. as required.  
c) Mounting flanges, gasket etc.  
d) control unit for interface with PC based data logger to be provided.

1.32.00 OXYGEN ANALYZER

01. Type : In-situ, Zirconium sensor, micro-processor-based transmitter,
02. Range : 0.1-10% / 0.25-25% by volume
03. Output : 4-20 mA DC linear



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04. Probe Length /  
Material : 1800 mm (approximate depending on duct size) / SS 316
05. Process Temperature : As per Process Requirement.
06. Measurement  
Reference : Instrument Air
07. Accuracy :  $\pm 1\%$  of F.S.
08. Response Time : Less than 5 (five) sec for 90% of full scale
09. Amplifier Housing : IP-65
10. Calibration : Manual or Automatic periodic-operator selectable
11. Power Supply : 240V, 50 Hz, 1 Phase UPS
12. Material for Gas Carrying Components : Stainless Steel
13. Read Out : Backlit LED/LCD
14. Protection : Automatic cell protection against reducing atmosphere
15. Alarm Facility : 1 HI and 1 LO independently adjustable over span. Contact rating 500 mA at 220 V DC (minimum).
16. Preferred Features : a) HI and LO alarm LED visible from front.  
b) Power Supply On/Failure LED visible from front
17. Accessories : a) Mounting flanges, adaptor plate and protection shield (protection/abrasive shield shall be SS 316)  
b) Gasket, nuts and bolts  
c) Cable with conduit from cell to amplifier (as required) and other special cables (if any)  
d) Automatic calibration kit (complete with all accessories and standard Gas Cylinders)



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- e) Solenoid valve, Pressure regulator with Filter and Flow indicator
18. Application : a) At economizer outlet  
b) At each air preheater inlet and outlet
- 1.33.00 H<sub>2</sub> + CO<sub>2</sub> + AIR ANALYZER
01. Type : Thermal Conductivity
02. Range Selection : 3 ranges.
03. Range : As required
04. Output : 4-20mA DC (Isolated)
05. Operating ambient temp. : 10° C to 50° C
06. Power Supply : 240V AC, 50Hz UPS
07. Sample gas flow control : Required
08. Reference gas flow : Required
09. Reference gas pressure regulator : Required
10. Cell response : 95% of change in 30 Sec.(Approx.)
11. Accuracy : 2% of full scale
12. Repeatability : 1% of full scale
13. Local Indicator : Indicating meter of 1% accuracy Backlit LCD/LED display
14. Alarm facility : Dual (High & Low) independently adjustable.
15. Contact rating : 0.5A at 220 V AC
16. Enclosure : Flame Proof
17. Accessories : Calibration gas, mounting accessories and others as required to be provided
18. Application : Generator Gas Purity.
- 1.34.00 CO ANALYZER
01. Operating Principle : NDIR



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02. Type : In-situ, microprocessor based probe type at economiser. In-situ, microprocessor based Cross duct/Probe type at chimney
03. Range : As per process requirement
04. Accuracy : 1% Full Scale
05. Linearity :  $\pm 1\%$  of Full Scale
06. Repeatability :  $< 1\%$  of span
07. Calibration : Automatic & Manual (Zero & Span)
08. Power Supply : 240V AC
09. Output Signal : 4~20 mA DC
10. Alarm annunciation : Four relay contacts, dual alarm set points (240V AC, 5A)
11. Enclosure : Cast Aluminium (IP-65)
15. Indication : LCD Display
16. Op. Temperature Range : At Economiser (350 Deg C) and at Chimney (100 Deg C)
17. Accessories : Interconnection cable (as required) in flexible conduits  
Tube / fittings, mounting brackets/ pads as required  
Purge system for cleaning  
Surge Arrester
18. Location : At Economizer and Chimney
19. Additional Feature : Remote Calibration and configuration facility from the remote location shall be possible. (i.e, the hardware and software required for Remote Calibration and configuration from Remote location to be provided).

1.35.00

**MERCURY ANALYZER**

01. Operating Principle : Atomic absorption spectroscopy
02. Range : 0-100  $\mu\text{g}/\text{Nm}^3$
03. Measuring Parameters : Total gaseous mercury
04. Output : 4~20 mA DC



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05. Alarm/ Annunciation : Four Relay contacts, dual alarm set points (240V AC, 5A)
06. Indication : LCD Display
07. Sampling System : Extractive
08. Enclosure : IP-65
09. Power Supply : 240V AC (UPS)
10. Location : On Chimney
10. Accessories : a) Inbuilt calibration facility through calibrator. Inbuilt cell for Zero & Span calibration to be provided. Handling of Liquid Mercury to be avoided.  
b) Remote calibration facility to be provided.  
c) The Mercury analyser cabinet to be placed inside an enclosed AC environment.

1.36.00 DEW POINT METER

01. Type : Direct mounting capacitance type with change in output proportional to moisture present
02. Sensing Element : Ceramic/ Aluminium Oxide sensor
03. Service : Dry Air
04. Range : -90 Deg.C to 10 Deg.C Dew point temperature
05. Sensor Accuracy :  $\pm 2$  Deg.C Dew point
06. Repeatability : 0.5 Deg.C Dew point
07. Op.Ambient Temperature : -40 Deg.C to 50 Deg.C
08. Op. Pressure : 0-10 Kg/cm<sup>2</sup>
09. Display : Combined enclosure with 5 digit seven segments LED display
10. Element Filter : 80 micron sintered stainless steel
11. Output : 4~20 mA DC loop powered
12. Power Supply : 24V DC nominal



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- 13. Enclosure Class : IP-65
- 14. Interchangeability : Fully Interchangeable Transmitters
- 15. Accessories : Sampling System, cables, sensor holder, dessicant chambers, souble compression fittings, 3/4" cable gland, mounting fixture etc.

**1.37.00 DENSITY METER**

- 01. Operating Principle : Vibration Density measurement
- 02. Wetted Part Material : SS-316L
- 03. Case Material : Cast Aluminium
- 04. Output : 4~20 mA DC
- 05. Electrical connection : 1/2" NPT
- 06. Enclosure Class : IP-65
- 07. Local Display : Digital 5 digit, density display with temp. compensation
- 08. Accuracy : ±1.0 %
- 09. Power Supply : 240V AC (UPS)
- 10. Location : At the discharge of Gypsum bleed pump in FGD system.

**1.38.00 RADAR TYPE LEVEL MEASUREMENT**

- 01. Type : Radar based on Time Domain Reflectometry
- 02. Antena : Co axial / single rod type guided wave or Horn type as required for the application
- 03. Communication : Two wire 4-20mA DC, HART protocol
- 04. Environmental temperature : 0 – 50°C
- 05. Enclosure : Explosion proof /IP 65 as per application
- 06. Cable Entry : 1/2" NPT
- 07. Calibration : a) Self calibration with internal reference  
b) Zero & Span calibration
- 08. Programming : Handheld programmer & Local key pad
- 09. Process Connection : Flanged /screwed



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- 10 Transmitter Beam  
Angle : 10 degree or less
- 11 Blocking distance : less than 300 mm
12. Electronic Housing : Epoxy painted Die-Cast aluminium alloy
13. Antenna / Flange  
assembly : 316 SS or Hestallooy (as required)
14. Output Indicator : Digital Integral Display (Backlit LCD/LED)
15. Accuracy : 5 mm or 0.1% of probe length
16. Accessories : a) Programming tool kit  
b) Gasket

**1.39.00 CHLORINE LEAK DETECTOR**

01. Type : Electrochemical
02. Resolution : 0.1 ppm
03. Display Type : Digital Indicating Meter
04. Operating Temperature : 0~45°C
05. Alarm Contacts : Dual Alarm setpoints (240V AC, 5A)
06. Enclosure Class : IP-65
07. Mounting : Wall mounting
08. Power Supply : 240V AC
09. Output : 4~20 mA DC (600 Ω load)

**1.40.00 RESIDUAL CHLORINE ANALYZER**

01. Type : Amperometric
02. Electrode : Platinum/ Gold and copper electrode shall be provided with cell cleaning system
03. Display Type : LCD in Analyzer Panel
04. Range : 0 to 20.0 mg/L (ppm)
05. Accuracy : 2% or better . The measurement accuracy shall not be affected by presence of treatment chemicals as chromates,



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phosphates, de-former highly polluted water,  
change in temperature etc.

- 06. Sensitivity : 0.01 mg/L
- 07. Alarm Contacts : Dual Alarm setpoints (240V AC, 5A)
- 08. Enclosure Class : IP-65
- 09. Power Supply : 240V AC
- 10. Output : 4-20 mA DC (600  $\Omega$  load)
- 11. Calibration : Zero & Span adjustment. Final calibration adjustments of the analyzer to be done at site and duly verified by titration. Temperature compensation range 0-50°C.
- 12. Mounting : Field mounting conform to IP-65
- 13. Accessories : Chemical reagents, sample drain, pumping system (if required) etc.

**1.41.00 ELECTRIC TO PNEUMATIC (E/P) CONVERTERS**

- 01. Air Supply : 1.5 kg/cm<sup>2</sup>
- 02. Max. supply Pressure : 7 kg/cm<sup>2</sup>
- 03. Input Signal : 4-20 mA DC (as required by the design of control system).
- 04. Output Signal : 0.2 to 1.0 kg/cm<sup>2</sup>
- 05. Control Action : Air to Close, Air to Open and Fail freeze-field selectable
- 06. Response Time : 5 seconds for 0 to 90% output pressure
- 07. Repeatability : +/- 0.1% span typical
- 08. Accuracy : +/- 0.25% span typical
- 09. Linearity : 0.5% of span or better
- 10. Hysteresis : 0.1% of span or better
- 11. Ambient Temp. effect : Less than 0.02% of span per °C between



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-20 °C to +60 °C

12. Supply pressure effect: less than 1%
13. Span and zero adjustment : screw
14. Mounting : Close to Actuator (but not on the actuator)
15. Output Capacity : To suit the actuator
16. Protection Class : IP 65
17. Allowable Drift Rate :  $\pm 2\%$  of set point / hour maximum

On loss of control signal, the last set point pressure shall be maintained so that the associated control valve remains in stay put condition.

1.42.00

**SMART POSITIONER**

01. Type : Universal design (linear or rotary application)
02. Input Signal : 4-20mA DC , 2 wire loop with 24V DC.
03. Output Signal (position F/B) :
  - i) 4-20mA
  - ii) Configurable end position switch
04. Supply Pressure : Single acting 1.2 to 7.0 bar  
Double acting 1.2 to 10.5 bar
05. Air Delivery : Single acting 10.0 SCFM at 2.1 bar supply  
Double acting 7.2 SCFM at 2.1 bar supply
06. Housing : IP 65
07. Repeatability :  $\pm 0.3\%$  of span or better
08. Accuracy :  $\pm 0.1\%$  of span or better
09. Communication : Hart protocol
10. Power-up with position :  $< 150$  ms or better control
11. Power interruption without reset :  $< 100$ ms or better
12. Body Material : Aluminium
13. Response Time : Less than 10 sec



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14. Features :
- i) Noncontact position feedback sensor
  - ii) Integral Electro-Pneumatic convertor
  - ii) Self calibration with tunable response time
  - iii) Online diagnostics
  - iv) Pressure gauges to be provided on positioner (I/P & O/P pressure)

**1.43.00 MAGNETIC LEVEL INDICATOR**

01. TYPE : Magnetically coupled level indicator
02. Display : Coloured flags
03. Chamber material : Stainless steel
04. Wetted part material : Stainless steel
05. Process connection : Side Side Flanged
06. Drain & Vent : Flanged
07. Scale : Standard, Stainless steel
08. Accessories : Counter flange, gaskets

**1.44.00 FLOW SWITCH**

01. Type : Paddle /Piston/Disk
02. Wetted part material : Stainless steel or Hastelloy for acidic application
03. End connection Tee : i) Threaded upto 1" line size with integral Tee  
ii) Flanged for line size > 1 1/2"
04. Enclosure material : Die cast aluminium
05. Enclosure class : IP 65
06. Switch configuration : 2 SPDT
07. Contact rating : 240V AC 15A
08. Repeatability : 2%
09. Cable connection : 1/2"NPTF



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10. Accessories : Tee, counter flange

1.45.00 ULTRA SONIC TYPE FLOW METER

- a) Ultrasonic Flow meter shall be dual path transit time clamp-on type.
- b) The flow meters shall be of proven reliability, accuracy and repeatability requiring a minimum of maintenance. They shall comply with relevant international standards and shall be subject to approval.
- c) CW flow shall be measured by redundant Ultrasonic Flow meter.
- d) All accessories required for mounting/erection of these instruments shall be furnished, erected and installed as necessary for completeness of the system though not specifically asked for. Also the equipment shall include necessary cables, flexible conduits, junction boxes required for the purpose.
- e) Flow meters shall be provided with suitable environment protection devices / structures such that they shall be suitable for continuous operation in the operating environment of a coal fired utility station without any loss of function or departure from the specification requirements.
- f) Technical Requirements
  01. Type : Transit time Clamp On Ultrasonic meter
  02. Mounting Style : Dual path with two sets of transducers on the same pipe
  03. Flow measurement : Instantaneous Flow rate as well as totalized flow
  04. Power supply : 240V AC, 50Hz with built-in battery back up.
  05. Analog Outputs : Isolated 4-20mA linear outputs for each path
  06. Binary Output : Contact relay outputs, 2 NO + 2 NC for alarm
  07. Communication ports : RS 232 C digital  
Hand held terminal port
  08. Display/Indication : Flow meter with LCD screen backlight based local display and keypad. If required, transmitter shall be suitably located away from the sensor for better access and visibility.
  09. Recording / Totalizing /



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- Logging Facilities : Yes. Should be able to compute cumulative flow over intervals selectable by Owner i.e., daily, weekly, monthly etc. The data shall be stored in the memory of flow computer for access in future.
10. Software features : Compensation for any cross path errors Programming, configuration, shall be possible from front panel.
11. Diagnostics : False signal tolerance , power supply failure etc.
12. Protection Class : IP-65 or better, Weather protection against direct sunlight, rain etc for Flow meter and suitable for Cooling water for Transducer.
13. Accuracy :  $\pm 1\%$
14. Electrical connection : Plug and socket
15. Accessories : All mounting hardware required like clamping fixtures, mechanism to remove the transducers online, interconnecting cables etc.  
All weather canopy for protection from direct sunlight and direct rain. Material of all fittings shall be SS 316
- g) Bidder shall submit certified flow calculation and differential pressure Vs. flow curves for each element for Owner's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Owner's approval.

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