



PART - B (DETAILED TECHNICAL SPECIFICATION)  
SUB-SECTION-III-C (CONTROL & INSTRUMENTATION  
SYSTEM)

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**





SUB-SECTION-III-C1


BASIC DESIGN CRITERIA


**RGTPP HISAR (2X600 MW)  
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**TECHNICAL SPECIFICATION  
SECTION-VI  
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<b>BASIC DESIGN CRITERIA</b>		
	<b>1.00.00 GENERAL REQUIREMENTS</b>		
1.01.00	<p>The Contractor shall provide instruments and equipments for control and monitoring of absorber and its associated drives in all regimes of operation in safe and most efficient manner including Primary and Secondary Instruments, Process Connection and Piping, associated Instrumentation Cables etc. as identified in the specification.</p>		
1.02.00	<p>The Contractor shall provide all material, equipment and services so as to make a totally integrated Instrumentation and Control System together with all accessories, auxiliaries and associated equipments ensuring operability, maintainability and reliability. This work shall be consistent with modern power plant practices and shall be in compliance with all applicable codes, standards, guides, statutory regulations and safety requirements in force.</p>		
1.03.00	<p>Further Bidder shall also include in his proposal and shall furnish all equipment, devices and services which may not be specifically stated in the specification but are needed for completeness of the equipment/systems furnished by the Bidder and for meeting the intent and requirements of the specification.</p>		
1.04.00	<p>Bidder shall include in his bid a detailed Bill of Material (BOM) for each of the systems.</p>		
1.05.00	<p>In addition to requirements specified under this Section-VI, Part-B, all C&amp;I systems/ sub-systems/ equipment/ devices shall also meet other requirements stipulated under other Sub-sections/ parts/ sections of specification.</p>		
	<b>2.00.00 RELIABILITY AND AVAILABILITY</b>		
2.01.00	<p>Each component and system offered by the Bidder shall be of established reliability. The minimum target reliability of each piece of equipment like each electronic module/card, Power supply, Peripheral etc. shall be established by the Bidder, considering its failure rate/mean time between failures (MTBF), meantime to repair (MTTR), such that the availability of the complete C&amp;I system is assured .</p>		
2.02.00	<p>When more than one device uses the same measurement or control signal, the transmitter and other components/ module shall be fully equipped to provide all signal requirements. All the 4-20 mA output signals from transmitters/other control system shall be able to drive minimum 500 Ohms load resistance. The system shall be arranged so that the failure of any monitoring device or control components or spurious intermediate grounding in the signal path shall not open the signal loop nor cause the loss or malfunction of signal to other devices using the same signal.</p>		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
2.03.00	<p>To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level to satisfy the availability criteria mentioned above. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment.</p>		
<b>3.00.00</b>	<b>OPERABILITY &amp; MAINTAINABILITY</b>		
3.01.00	<p>The design of the control systems and related equipments shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved. 'Fail Safe' operation signifies that the loss of signal, loss of excitation or failure of any component shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips are avoided / minimized. Safety hardwired switches should be provided for emergency start/stop of equipments. The details shall be finalized during detailed engineering.</p>		
3.02.00	<p>The types of failure that shall be taken into account for ensuring operability of the plant shall include but not be limited to:</p> <ul style="list-style-type: none"> <li>— Failure of sensor or transmitter.</li> <li>— Failure of main and/or redundant controller/other modules.</li> <li>— Loss of motive power to final control element.</li> <li>— Loss of control power.</li> <li>— Loss of instrument air.</li> </ul>		
3.03.00	<p>The choice of hardware shall also take into account sound maintainability principles and techniques. The same shall include but shall not be limited to the following:</p> <ul style="list-style-type: none"> <li>— Standardization of parts.</li> <li>— Minimum use of special tools.</li> <li>— Grouping of functions.</li> <li>— Interchangeability.</li> <li>— Malfunction identification facility/self surveillance facility.</li> <li>— Easy modular replacement.</li> <li>— Fool proof design providing proper identification and other features to</li> </ul>		
<p align="center">RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p align="center">PART-B SUB-SECTION-III-C1 BASIC DESIGN CRITERIA</p>	<p align="center">PAGE 2 OF 4</p>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>										
	<p>preclude improper mounting and installation.</p> <p>— Appropriate de-rating of electronic components and parts.</p>										
3.04.00	<p>The equipment shall employ latest state of the art technology to guard against obsolescence. In any case, Bidder shall be required to ensure supply of spare parts for lifetime of the plant. In case, the Bidder feels that certain equipment/component is likely to become obsolete, the Bidder shall clearly bring out the same in his Bid and indicate steps proposed to deal with such obsolescence.</p>										
3.05.00	<p>Control &amp; Monitoring</p>										
3.05.01	<p>The control, monitoring &amp; operation of flue gas desulphurization system and other system being supplied under the contract, is envisaged from DDCMIS Based Control system being supplied by contractor under this package.</p>										
4.00.00	<p><b>ENVIRONMENTAL CONDITIONS</b></p>										
4.01.00	<p>Instruments, devices and equipments for location in outdoors/indoor/air-conditioned areas shall be designed to suit the environmental conditions indicated below and shall be suitable for continuous operation in the operating environment of a coal fired utility station and also during periods of air conditioning failure without any loss of function, or departure from the specification requirements covered under this specification.</p>										
<table border="1"> <tr> <td>Ambient Temperature (outside cabinets)</td> <td>Pressure</td> <td>Relative humidity</td> <td>Atmosphere</td> <td></td> <td>Required protection Class of panels/ cabinets/ desks to be provided by contractor.</td> </tr> </table>						Ambient Temperature (outside cabinets)	Pressure	Relative humidity	Atmosphere		Required protection Class of panels/ cabinets/ desks to be provided by contractor.
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<p style="text-align: center;"><b>Outdoor Location</b></p>											
<table border="1"> <tr> <td>55 degree C max.</td> <td>Atmosphere</td> <td>100 % Max.</td> <td>Air dirty)</td> <td></td> <td>IP 55</td> </tr> </table>						55 degree C max.	Atmosphere	100 % Max.	Air dirty)		IP 55
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<p style="text-align: center;"><b>Indoor Location</b></p>											
<table border="1"> <tr> <td>55 degree C max.</td> <td>Atmosphere</td> <td>95 % Max.</td> <td>Air</td> <td></td> <td>IP 54**</td> </tr> </table>						55 degree C max.	Atmosphere	95 % Max.	Air		IP 54**
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>				
<b>5.00.00</b>	4 degree C min.	Atmosphere	5 % min.	Air	IP 54**
	<b>Air Conditioned Areas</b>				
	24 +/- 5 degree C normal	Atmosphere	95 % Max.	Air	IP 22***
	50 degree C max. *	Atmosphere	5 %min.	Air	IP 22***
		* During air conditioning failure.			
		** For non-ventilated enclosures. For ventilated enclosures, protection class shall be IP 42.			
		*** With a suitable canopy at the top to prevent ingress of dripping water.			
	For PCs, OWS, EWS, Servers, Printers and other peripherals, maximum temperature limit shall be 35 Deg.C. For mini-UPS, the same shall be 40 Deg.C.				
<b>GROUNDING SYSTEM</b>					
All panels, desks, cabinets shall be provided with a continuous bare copper ground bus. The ground bus shall be bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels.					
The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length applicable).					
Shield on instrumentation cables shall be grounded on panel side. When shielding termination is required in cabinets furnished under this specification, suitable terminals shall be furnished on copper flat forming system ground. Refer Part-A Sub Section-II for scope of system & shield grounding cables.					
The Contractor shall submit with the offer recommended grounding scheme required for his system. The exact grounding scheme shall be finalised during detailed engineering.					
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## SUB-SECTION-III-C2


### MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)


**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**


**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<b>1.00.00</b>	<b>MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)</b>		
1.01.00	Measuring instruments/equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Refer Sub-section Basic Design Criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards and shall be subject to Employer's approval.		
1.02.00	Every panel-mounted instrument requiring power supply shall be provided with easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.		
1.03.00	All transmitters, sensors, switches and gauges for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided on as required basis with in quoted lump sum price. The Contractor shall furnish all Instrumentation / Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering.		
1.04.00	The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.		
1.05.00	All instruments envisaged for sea water applications, shall be provided with wetted parts made of Monel/ Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by contractor).  For Chlorine application: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Hastelloy C. Also, filled liquid shall be Fluorolube oil/ Inert Hydrocarbon / CTFE etc., for these applications.  For applications of FECL3 solution: Instruments shall be provided with wetted parts (e.g. diaphragm seal, etc.) made of Tantalum.		
1.06.00	For coastal areas, all instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.		
1.07.00	The instruments, for which technical specification is not attached, shall be supplied as per the standard and proven practice of the contractor. The same shall be established by the contractor during detailed engineering by providing detailed explanation/concepts, if required by the employer, of such implementation along with standard documentation.		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
2.00.00	<b>SPECIFICATION FOR ELECTRONIC TRANSMITTERS</b>		
2.01.00	<b>SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF PRESS AND DP BASED FLOW / LEVEL MEASUREMENTS</b>		
	<b>Sl.No.</b>	<b>Features</b>	<b>Essential/Minimum Requirements</b>
	1.	Type of Transmitter	Microprocessor based 2 wire type (loop powered), Hart protocol compatible.
	2	Output signal	4-20 mA DC (Analog) along with superimposed digital signal based on HART protocol
	3	Accuracy	$\pm 0.060\%$ of calibrated range (minimum) for calibrated range greater than 400 mmwc. $+0.065\%$ of calibrated range (minimum) for calibrated range greater than 250 kg/cm <sup>2</sup> . $\pm 0.10\%$ of calibrated range (minimum) for calibrated range less than 400 mmwc
	4.	Turn down (minimum)	50:1 for greater than or equal to span of 400mmwcl. 20:1 for span below 400mmwcl. 10:1 for span greater than 250 kg/cm <sup>2</sup>
	5.	Stability	0.25 % of calibrated range for 10 years for calibrated range greater than equal to 400 mmwc on standard conditions of manufacturer. 0.2 % of calibrated range for 1 years for calibrated range less than 400 mmwc on standard conditions of manufacturer. 0.15% of calibrated range for 5 years for static pressure greater than 250 kg/cm <sup>2</sup> .
	(Above mentioned (3, 4, 5) parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only).		
	6.	Zero and span drift	$\pm 0.015$ per degC at max span $\pm 0.11\%$ per degC at min. Span
		Power Supply	24V DC $\pm 10\%$ .
	7.	Load impedance	500 ohm (minimum)
	8.	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating
	9.	Over Pressure	150% of max. Operating pressure
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>			
2.02.00	10.	Electrical Connection	Plug and socket type except in hazardous area	
	11.	Process connection	1/2 inch NPT (F)	
	12.	Span and Zero	Continuous, tamper proof, Remote as well as manual adjustability from instrument with zero suppression and elevation facility.	
	13.	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition.	
		Diagnostics and Display	Self-Indicating feature and digital display	
	14.	Accessories	2 valve manifold for absolute & Gauge pressure transmitters, 3-valve manifold for Differential Pressure and 5 valve manifold for Level /Flow applications. The valve manifold shall be non integral type (except Fuel Oil area). -For hazardous area, enclosure as described in NEC article 500 -2 inch pipe for mounting with Enclosure /Rack/Canopy	
	15.	Certification	SIL 2 or Better	
	16.	Adjustment/calibration/maintenance	From hand held HART calibrator	
	Notes:			
	1) LVDT type is not acceptable.			
	2) For primary air/ secondary air/flue gas applications, DP type transmitters shall be provided for pressure measurement below range of 2000 mmwc.			
	3) 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.			
	<b>GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER</b>			
	Type		Microprocessor based 2 wire type (loop powered), HART protocol compatible Guided wave radar transmitter.	
	Principle		TDR (Time domain reflectometry)	
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	Probe Type & Material	(i) Coaxial probe of SS316/316L. If required, probe shall be suitable for overfill prevention.  (ii) Rod probe, cable probe of SS316/SS316L can be used for applications wherever coaxial probe is not suitable.	
	Output signal	4-20 mA DC along with superimposed digital signal (based on HART protocol), suitable for over fill prevention.	
	Accuracy	+/- 0.5% of calibrated span or minimum 5mm.	
	Power supply	24 VDC +/- 10%.	
	Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.	
	Adjustment/ calibration	Using hand held HART calibrator	
	Zero & span adjustment	Continuous, temper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc.	
	Display	Integral digital display.	
	Load Impedance	500 ohms (minimum).	
	Electromagnetic compatibility	Shall meet EN 61326-1 (1997) and AmdtA1, class A equipment/EN 50081-2 & EN 5008 1-2 & EN 50082-2	
	Mounting	(i) External cage shall be provided where ever side mounting is required. External cage and other mounting accessories to be provided by the contractor.  (ii) Where ever top mounting is required, all mounting accessories, stilling well (as required) etc., shall be provided by the contractor.  (iii) All weather canopy shall be provided for protection from direct	
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**TECHNICAL REQUIREMENTS**


	sunlight and direct rain for open locations.
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Note: Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.

**2.03.00 Ultrasonic Type level Transmitter**

S.No.	Features	Essential/Minimum requirement
1.	Type of Transmitter	Non-contact Microprocessor based 2 wire type (loop powered), HART protocol compatible Ultrasonic transmitter.
2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).
3.	Accuracy	+/- 0.5% of calibrated span or minimum 5mm.
4.	Power supply	24 V DC +/- 10%.
5.	Temperature compensation	To be provided within transducer.
6.	Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.
7.	Adjustment/calibration/maintenance	Using hand held HART calibrator
8.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any level in the tank/sump etc.
9.	Sensor Material	Corrosion resistant material to suit individual application requirement.

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	10.	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry.
	11.	Range	Range of transmitter shall be capable of covering the complete level span of tank taking care of blocking distance, frequency attenuation due to surface, obstructions, vapors etc.
	12.	Display	Integral digital display
	13.	Diagnostics	Loss of echo alarm etc.
	14.	Load Impedance	500 ohms (minimum).
	15.	Electrical Connection	Plug and socket
	16.	Accessories	<ul style="list-style-type: none"> <li>• All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations.</li> <li>• All mounting accessories required for erection and commissioning shall be provided.</li> <li>• For hazardous area, explosion proof enclosure as described in NEC article 500</li> </ul>
	<p><b>Note:</b></p> <p>1) Contractor can also provide Radar type transmitter as per above specification in place of ultrasonic transmitter subject to approval by Employer during detailed Engineering. Sonic frequency based transmitters can also be provided under “ultrasonic transmitters” category for fly ash silo level.</p>		
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<b>CLAUSE NO.</b>	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>2) Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.</p> <p>3) For applications where transmitter location is not accessible, the transmitter shall have separate sensor unit and electronic unit for such applications. It shall be possible to mount the electronic unit at accessible location.</p>		
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2.04.00


**SPECIFICATION FOR ULTRASONIC TYPE FLOW TRANSMITTER**


S.No	Features	Essential/Minimum requirement
1.	Type of Transmitter	Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic transmitter. Insertion type.
2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).
3.	Sensor Accuracy	+/- 2% of calibrated span.
4.	Power supply	24 V DC +/-10%.
5.	Temperature compensation	To be provided within transducer.
6.	Housing	Weather proof as per IP-55 with durable corrosion resistance coating.
7.	Adjustment/calibration/ maintenance	From hand held calibrator
8.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual to calibrate the instrument without any process flow.
9.	Sensor Material	Corrosion resistant material to suit individual application requirement.
10.	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank/sumps obstructions such as pipes, heating coils or agitator blades. Also transmitter shall have adjustable damping circuitry.
11.	Range	Should be suitable for the required process range.
12.	Display	LCD display with integral keypad to be provided.
13.	Diagnostics	Loss of echo alarm etc.
14.	Load Impedance	500 ohms minimum
15.	Electrical Connection	Plug and socket
16.	Accessories	<ul style="list-style-type: none"> <li>All weather canopy for protection from direct sunlight and direct rain.</li> <li>All mounting hardware and accessories required for erection and commissioning mounting fittings materials shall be SS 316.</li> <li>For hazardous area, explosion proof enclosure as described in NEC article 500</li> </ul>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>																																															
2.05.00	<b>SPECIFICATION FOR ELECTRO-MAGNETIC TYPE FLOW TRANSMITTER</b> <table border="1"> <thead> <tr> <th>S.No.</th> <th>Features</th> <th>Essential/Minimum requirement</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Type of Transmitter</td> <td>Microprocessor based 2 wire type, HART protocol compatible, full bore type.</td> </tr> <tr> <td>2.</td> <td>Output signal</td> <td>4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).</td> </tr> <tr> <td>3.</td> <td>Accuracy</td> <td>+/- 0.5% of calibrated span.</td> </tr> <tr> <td>4.</td> <td>Power supply</td> <td>24 V DC +/- 10%.</td> </tr> <tr> <td>5.</td> <td>Housing</td> <td>Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.</td> </tr> <tr> <td>6.</td> <td>Adjustment/calibration/maintenance</td> <td>Using hand held HART calibrator.</td> </tr> <tr> <td>7.</td> <td>Zero and Span adjustment</td> <td>Continuous, tamper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any process flow.</td> </tr> <tr> <td>8.</td> <td>Sensor Material</td> <td>Corrosion resistant material to suit individual application requirement.</td> </tr> <tr> <td>9.</td> <td>Flow tube</td> <td>SS304.</td> </tr> <tr> <td>10.</td> <td>Liner</td> <td>Hard rubber or better material to suit the actual application.</td> </tr> <tr> <td>11.</td> <td>Range</td> <td>Should be suitable for the required process range.</td> </tr> <tr> <td>12.</td> <td>Display</td> <td>Integral digital display</td> </tr> <tr> <td>13.</td> <td>Load Impedance</td> <td>500 ohms (minimum).</td> </tr> <tr> <td>14.</td> <td>Accessories</td> <td> <p>All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations.</p> <p>All mounting accessories required for erection and commissioning shall be provided.</p> <p>For hazardous area, explosion proof enclosure as described in NEC article 500</p> </td> </tr> </tbody> </table>			S.No.	Features	Essential/Minimum requirement	1.	Type of Transmitter	Microprocessor based 2 wire type, HART protocol compatible, full bore type.	2.	Output signal	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol).	3.	Accuracy	+/- 0.5% of calibrated span.	4.	Power supply	24 V DC +/- 10%.	5.	Housing	Weather proof as per IP-65, metallic housing with durable corrosion resistance coating.	6.	Adjustment/calibration/maintenance	Using hand held HART calibrator.	7.	Zero and Span adjustment	Continuous, tamper proof, remote as well as manual adjustability from instrument. It should be possible to calibrate the instrument without any process flow.	8.	Sensor Material	Corrosion resistant material to suit individual application requirement.	9.	Flow tube	SS304.	10.	Liner	Hard rubber or better material to suit the actual application.	11.	Range	Should be suitable for the required process range.	12.	Display	Integral digital display	13.	Load Impedance	500 ohms (minimum).	14.	Accessories	<p>All weather canopy shall be provided for protection from direct sunlight and direct rain for open locations.</p> <p>All mounting accessories required for erection and commissioning shall be provided.</p> <p>For hazardous area, explosion proof enclosure as described in NEC article 500</p>
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<p><b>2.06.00</b></p> <p><b>3.00.00</b></p> <p><b>3.01.00</b></p>	<p>Note:- Four wire type transmitters can also be provided for applications where 2- wire transmitter has some technical limitations, subject to employer's approval during detailed engineering stage. However, in such cases isolated 4-20 mA DC (analog) output shall be provided. Power supply required for such transmitters shall be 240V AC / 24V DC.</p> <p><b>HART Hand Held calibrator</b></p> <p>Hand held calibrator shall be provided for adjustment/calibration/maintenance of the HART compatible transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided for that specific type of transmitter.</p> <p><b>Temperature Elements and accessories</b></p> <p><b>Thermocouple</b></p> <table border="1"> <thead> <tr> <th>Sr. No.</th> <th>Features</th> <th>Essential/Minimum Requirements</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Type of Thermocouple.</td> <td>: 16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature Range (ungrounded separate junction type).</td> </tr> <tr> <td>2</td> <td>No. of element</td> <td>: Duplex</td> </tr> <tr> <td>3</td> <td>Housing/Head</td> <td>: IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well.</td> </tr> <tr> <td>4</td> <td>Insulation and Sheathing of Thermocouple</td> <td>: Swaged type mineral (magnesium oxide) insulation and SS316 sheath.</td> </tr> <tr> <td>5</td> <td>Calibration and accuracy</td> <td>: As per IEC-584/ ANSI-MC-96.1 (special limits of errors/ class1) for T/C.</td> </tr> <tr> <td>6</td> <td>Accessories</td> <td>: Thermo well and associated fittings</td> </tr> <tr> <td>7</td> <td>Standard</td> <td>: IEC-584/ ANSI MC 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well</td> </tr> </tbody> </table>	Sr. No.	Features	Essential/Minimum Requirements	1	Type of Thermocouple.	: 16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type R) depending on operating temperature Range (ungrounded separate junction type).	2	No. of element	: Duplex	3	Housing/Head	: IP-65/Diecast Aluminium. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection. TE terminal head shall be spring loaded for positive contacts with the thermo well.	4	Insulation and Sheathing of Thermocouple	: Swaged type mineral (magnesium oxide) insulation and SS316 sheath.	5	Calibration and accuracy	: As per IEC-584/ ANSI-MC-96.1 (special limits of errors/ class1) for T/C.	6	Accessories	: Thermo well and associated fittings	7	Standard	: IEC-584/ ANSI MC 96.1 for Thermocouple and ASME PTC-19.3 for Thermo-well	<p align="center">RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p align="center">PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</p>	<p align="center">PAGE 10 OF 40</p>
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3.04.00	<p>Insulation</p> <p>Thermocouple wire gauge</p> <p>Protective sheath</p> <p>Protective sheath dia</p> <p>Calibration &amp; accuracy</p> <p>Mounting accessories</p> <p>Cold end sealing</p> <p>Minimum bending radius</p> <p>Length of T/C</p> <p><b>Notes :</b></p> <p>1) The specification for thermocouples of bearings metal temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However type of thermocouples shall be K-type.</p> <p><b>Thermo well</b> (for all process temp. elements)</p> <p>(a) Shall be one piece solid bored type of 316 SS of step-less tapered design. (As per ASME PTC 19.3, 1974)</p> <p>(b) For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.</p> <p>(c) For Air &amp; Flue gas thermowell material should be Inconel 600. (However contractor shall provide better material for Flue gas service if required based on the specified boiler design parameters).</p> <p>(d) For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.</p>	<p>Mineral Insulation (Magnesium Oxide).</p> <p>16 AWG</p> <p>SS 321</p> <p>8 mm OD</p> <p>As per IEC-584/ ANSI-MC-96.1 (special limits of error) for T/C</p> <p>1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310. Adjustable gland fitting for connection at the junction box end as per manufacturer's standard.</p> <p>SS pot seal with colour coded PTFE Insulated flexible tails. Sealing compound- Epoxy resin. Length of PTFE insulated flying leads shall be minimum 750 mm.</p> <p>30 mm</p> <p>On as required basis considering location of measurement point and the JB/TTJB location.</p>		
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<b>3.05.00</b>	<p><b>TEMPERATURE TRANSMITTER (TT)</b></p> <p>Following specifications are applicable for Dual input/ Single input temperature transmitter.</p> <p>Temperature transmitter shall be 2-wire (loop powered) directly powered from 4-20mA input cards of DDCMIS. TT shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation for thermocouples shall be performed in the temperature transmitter itself.</p> <table border="1"> <thead> <tr> <th>S No.</th> <th>Features</th> <th>Essential/Minimum Requirements</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Output</td> <td>2-wire (power supply from input card of control system) with 4-20mA output with superimposed HART protocol signal</td> </tr> <tr> <td>2.</td> <td>Input</td> <td>Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K, R &amp; ,S types ( Selectable through HART terminal/calibrator)</td> </tr> <tr> <td></td> <td>Isolation</td> <td>Min 500 VAC</td> </tr> <tr> <td></td> <td>EMC compatibility</td> <td>As per EN 61326</td> </tr> <tr> <td></td> <td>Power supply</td> <td>24 V C +/- 10%</td> </tr> <tr> <td>3.</td> <td>Housing</td> <td>Weather proof as per IP-67, metallic housing with durable corrosion resistant coating</td> </tr> <tr> <td>4.</td> <td>Electrical connection</td> <td>Plug and Socket connector except hazardous area</td> </tr> <tr> <td>5.</td> <td>Diagnostics display</td> <td>&amp; Self-Indicating feature and digital display on transmitter</td> </tr> <tr> <td>6.</td> <td>Operating Ambient temperature</td> <td>85 deg C without display. 70 deg C with display.</td> </tr> <tr> <td>7.</td> <td>Mounting</td> <td>2 inch pipe mounting with Canopy.</td> </tr> <tr> <td>8.</td> <td>Accessories</td> <td>As required by service and operating condition.</td> </tr> <tr> <td>9.</td> <td>Composite Accuracy</td> <td>(Refer note 2 )  RTD                   =&lt;0.25% of 0-250 deg C span T/C-K type       =&lt;0.2% of 0-600 deg C span CJC accuracy (for thermocouples) shall be =&lt; 1 deg C</td> </tr> </tbody> </table> <p>Notes:</p> <p>1. In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output.</p>			S No.	Features	Essential/Minimum Requirements	1.	Output	2-wire (power supply from input card of control system) with 4-20mA output with superimposed HART protocol signal	2.	Input	Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K, R & ,S types ( Selectable through HART terminal/calibrator)		Isolation	Min 500 VAC		EMC compatibility	As per EN 61326		Power supply	24 V C +/- 10%	3.	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating	4.	Electrical connection	Plug and Socket connector except hazardous area	5.	Diagnostics display	& Self-Indicating feature and digital display on transmitter	6.	Operating Ambient temperature	85 deg C without display. 70 deg C with display.	7.	Mounting	2 inch pipe mounting with Canopy.	8.	Accessories	As required by service and operating condition.	9.	Composite Accuracy	(Refer note 2 )  RTD                   =<0.25% of 0-250 deg C span T/C-K type       =<0.2% of 0-600 deg C span CJC accuracy (for thermocouples) shall be =< 1 deg C
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**TECHNICAL REQUIREMENTS**


2. Dual input temperature transmitter shall have bump less changeover facility to second sensor in case first sensor fails. This changeover is to be alarmed in control system.
3. Composite accuracy is to be calculated as summation of all applicable accuracies of temperature transmitter for converting sensor input to output (e.g., A/D accuracy, basic accuracy, digital accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of temperature elements specified. All such accuracy/ temperature effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters shall be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input as specified above.
4. Above mentioned parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only.
5. Dual input temperature transmitters can also be accepted in place of single input TT.


4.00.00

**SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.**


SI. No	FEATURES	ESSENTIAL/MINIMUM REQUIREMENTS		
		Pr. Gauge/ DP Gauge/ Draught gauges	Temperature Gauge	Level Gauge
1	Sensing Element	Bourdon for high pressure, Diaphragm/ Bellow for low pr.	Inert gas actuated/ Liquid filled other than mercury	Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Material of sensing element	SS 316	SS 316	
3	Material of movement	SS 304	SS 304	
4	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon steel/304 SS
5	Dial size	150mm	150 mm	Tubular covering entire range


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>			
6	End connection	1/2 inch NPT (M)	1/2 inch or 3/4 inch NPT (M).	Process connection as per ASME PTC and drain/vent 15 NB
7	Accuracy	±1% of span	± 1% of span	± 2%
8	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
9	Range selection	Shall cover 125% of max. operating press	Shall cover 125% of max. operating temp	Shall cover max. Operating level.
10	Over range	125% of FSD	125% of FSD	-
11	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof
12	Zero/span adjustment	Provided	Provided	--
13	Identification	Engraved with service legend or laminated phenolic name plate		
14	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel/SS as per CS/Alloy process Requirement.
Notes:-				
*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.				
Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.				
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.				
In vibration prone areas glycerine filled gauges should be provided				
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>		<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>
				<b>PAGE 15 OF 40</b>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
5.00.00	<b>PROCESS ACTUATED SWITCHES</b>		
	<b>FEATURES</b>	<b>ESSENTIAL / MINIMUM REQUIREMENTS</b>	
	Pressure/ Draft Switches/ DP Switches	Temperature switches	Level switches
	Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum.	Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (5 m minimum, to suit application)
	Material	316 SS	Bulb 316 SS/ capillary 304 SS
	End connection	½ inch NPT (F)	½ inch NPT (F)
	Over range/ proof pressure	150% of maximum operating pr.	150% of maximum operating pr.
	Repeatability	+/- 0.5% of full range	
	No. of contacts	2 NO+ 2NC SPDT snap action dry contact	
	Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS)	
	Elect. Connection	Plug in socket.	
	Set point adjustment	Provided over full range.	
	Dead band adjustment	Adjustable/ fixed as per requirement of application.	
	Enclosure	Weather and dust proof as per IP-55, metallic housing.	
	Accessories	Siphon, snubber, chemical seal, pulsation dampeners as required by process	Thermo well of 316 SS and packing glands All mounting accessories
	Mounting	Suitable for enclosure/ rack mounting or direct mounting	Suitable for rack mounting or direct mounting
	Power Supply (wherever required)	As per Contractor's Standard practice.	
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 16 OF 40</b>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>																
	<p>Notes :-</p> <ol style="list-style-type: none"> <li>1) 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.</li> <li>2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low pressure applications.</li> <li>3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.</li> <li>4) The specifications of switches for air conditioning &amp; ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.</li> </ol>																
6.00.00	<p><b>SOLENOID VALVES</b></p> <p>Solenoid valves shall fulfill the following requirements: -</p> <p>Type 2/3/4 way SS 316/ forged brass (depending on the application subject to Employer's approval during detailed engg.)</p> <p>Power supply 24V DC.</p> <p>Plug in connector connection.</p> <p>Insulation : Class "H"</p>																
7.00.00	<p><b>Limit switches</b></p> <p>Limit switches shall be silver plated with high conductivity and non-corrosive type. Contact rating shall be sufficient to meet the requirement of Fire alarm Control System subject to a minimum of 60V, 6VA rating. Protection class shall be IP-55.</p>																
8.00.00	<p><b>SPECIFICATION FOR CORIOLIS FLOW TRANSMITTER</b></p> <table border="0" style="width: 100%;"> <tr> <td style="width: 60%;">Type</td> <td>Coriolis</td> </tr> <tr> <td>Material of Wetted Parts</td> <td>316 SS</td> </tr> <tr> <td>Material of Housing</td> <td>304L SS</td> </tr> <tr> <td>Accuracy</td> <td>± 0.2% of Rate</td> </tr> <tr> <td>Repeatability</td> <td>± 0.1% of Rate</td> </tr> <tr> <td>Output</td> <td>4-20 mA DC, HART Compatible</td> </tr> <tr> <td>Power Supply</td> <td>230 VAC or 24VDC operated</td> </tr> </table>			Type	Coriolis	Material of Wetted Parts	316 SS	Material of Housing	304L SS	Accuracy	± 0.2% of Rate	Repeatability	± 0.1% of Rate	Output	4-20 mA DC, HART Compatible	Power Supply	230 VAC or 24VDC operated
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<b>9.00.00</b>  <b>9.01.00</b>	Process Temperature range  Others	0-200 degree Celsius  Drain / purging arrangement shall be provided as per standard practice.	
	<p>The offered Coriolis type flow transmitter shall be suitable for intended application. Contractor shall submit flow and sizing calculation for Employer's approval. For each type of Coriolis type flow transmitter general arrangement and assembly drawing and cable wiring diagram shall be submitted for Employer's approval.</p>		
	<b>SPECIFICATION FOR FLOW ELEMENTS</b>		
	<b>Orifice Plate</b>		
	Features	Essential/Minimum Requirements	
	Type	Concentric as per ASME PTC-19.5 (Part-II), ISA RP-3.2, 1960 or BS-1042, ISO 5167	
	Material	316 SS	
	Thickness	3 mm for main pipe diameter up to 300 mm and 6 mm for main pipe dia above 300 mm.	
	Material of branch pipe	Same as main pipe	
	Root valve type	Globe	
	Root valve material	Same as pipe material	
	Root valve size	1 / 2 inch or 1 inch (as applicable)	
	Impulse pipe of same material up to root valve	Required	
	Tappings	Flanged weld neck or D & D/2 with 3 pairs of tapping (as applicable). Root valves to be provided in all the tappings. However for flow elements in CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.	
	Beta Ratio	0.34 to 0.7	
	Beta Ratio calculation to be submitted	Yes	
	Assembly drg. and flow Vs DP Curves	Yes	
	Accessories	Root valves, flanges, Vent/drain hole(As required)	
<p>Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval.</p>			
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 18 OF 40</b>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>																												
<b>9.02.00</b>	<p><b>Flow Nozzle</b></p> <table border="0"> <tr> <td>Features</td> <td>Essential/Minimum Requirements</td> </tr> <tr> <td>Type</td> <td>Long radius, welded type as per ASME PTC-19.5 (Part-III) or BS-1042</td> </tr> <tr> <td>Material</td> <td>316 SS</td> </tr> <tr> <td>Thickness</td> <td>Suitable for intended application.</td> </tr> <tr> <td>Material of branch pipe</td> <td>Same as main pipe</td> </tr> <tr> <td>Root valve type</td> <td>Globe</td> </tr> <tr> <td>Root valve material</td> <td>Same as pipe material</td> </tr> <tr> <td>Root valve size</td> <td>1 inch</td> </tr> <tr> <td>Impulse pipe of same material up to root valve</td> <td>Required</td> </tr> <tr> <td>Tapping</td> <td>Flanged weld neck or D &amp; D/2 with 3 pairs of tapping ( as applicable ). Root valves to be provided in all the tappings. However for flow elements in CPU, DM &amp; PT plant- 2 Pairs of Tappings shall be provided as minimum.</td> </tr> <tr> <td>Beta Ratio</td> <td>Around 0.7</td> </tr> <tr> <td>Beta Ratio calculation to be submitted</td> <td>Yes</td> </tr> <tr> <td>Assembly drg. and flow Vs DP Curves</td> <td>Yes</td> </tr> <tr> <td>Accessories</td> <td>Root valves, vent and drain hole.</td> </tr> </table> <p>Contractor shall submit certified flow calculation and differential pressure vs. flow curves for each element for Employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Employer's approval.</p>	Features	Essential/Minimum Requirements	Type	Long radius, welded type as per ASME PTC-19.5 (Part-III) or BS-1042	Material	316 SS	Thickness	Suitable for intended application.	Material of branch pipe	Same as main pipe	Root valve type	Globe	Root valve material	Same as pipe material	Root valve size	1 inch	Impulse pipe of same material up to root valve	Required	Tapping	Flanged weld neck or D & D/2 with 3 pairs of tapping ( as applicable ). Root valves to be provided in all the tappings. However for flow elements in CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.	Beta Ratio	Around 0.7	Beta Ratio calculation to be submitted	Yes	Assembly drg. and flow Vs DP Curves	Yes	Accessories	Root valves, vent and drain hole.
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<b>9.03.00</b>	<p><b>Venturi (For Liquid applications)</b></p> <hr/> <table border="0"> <tr> <td><b>Features</b></td> <td><b>Essential/Minimum Requirements</b></td> </tr> <tr> <td>Type</td> <td>Rough Welded (for Pipe dia between 200mm to 1200mm) or Machined (for Pipe dia 50mm to 250mm) as per ISO 5167-4:2003,</td> </tr> <tr> <td>Material</td> <td>Same as Main Pipe</td> </tr> </table>	<b>Features</b>	<b>Essential/Minimum Requirements</b>	Type	Rough Welded (for Pipe dia between 200mm to 1200mm) or Machined (for Pipe dia 50mm to 250mm) as per ISO 5167-4:2003,	Material	Same as Main Pipe																						
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<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:</b> 31/CE/PLG/RGTPP/FGD-250	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 19 OF 40</b>																										


Thickness	Same as Main Pipe.
Root valve type	Globe Type
Root valve material	Same as Pipe material
Root valve size	1 inch
Impulse pipe of same material up to root valve	Required
Tapping	3 pairs of tappings for each Venturi as per ISO 5167-4:2003, However for some areas like CPU, DM & PT plant- 2 Pairs of Tappings shall be provided as minimum.
Beta Ratio	0.4 to 0.7
Beta Ratio calculation to be Submitted	Yes
Assembly drg. and flow Vs DP Curves	Yes
Accessories	Root valves, vent and drain hole.


Contractor shall submit certified flow calculation and differential pressure vs. Flow curves for each element for employer's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for employer's approval.

**9.04.00**

**ROTAMETERS**

Sr. No.	Features	Essential / minimum requirements
1.	Type	Variable Area Metal Tube
2.	Fluid media	Water/oil
3.	Tube body	SS316
4.	Material of float	316 SS
5.	Indicator	Linear scale
6.	Accessories	Flange, orifice in case of bypass Rota meter (for line size above 100 mm)
7.	Housing protection class	IP-55
8.	Accuracy	± 2% of measured value.

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>			
10.00.00	<b>ANALYSER INSTRUMENTS (OTHER THAN CEMS)</b>			
10.01.00	<b>Common requirements:-</b>			
1	Type	Microprocessor based with self-indicating type diagnostic feature. Output signal: 4-20 mA DC galvanically isolated. Binary Signal: 2NO+2NC		
2	Display	Digital display with reading in engineering units. Display of the measurement values as well as all the information required for checking/maintenance of the analyzer.		
3	Zero & span Adjustment	To be provided for all selectable ranges.		
4	Ambient temp.	0-50°C unless defined otherwise.		
5	Analyser enclosure Type/Material	Weather protection for analyser mounted inside analyser panel shall be IP-22 or better. For all other analysers, weather protection class shall be IP-55.		
6	Calibration	Auto ( at programmable definite time intervals) & Manual (from Remote).		
7	Power Supply	To be arranged by Contractor subject to Employer's approval.		
8	Others	i) All interconnection tubing and cabling between probe and analyser / analyser panel and cabling from analyser/ analyser panel to FGD Control system are to be provided by Contractor.  ii) All the calibration gases (certified cylinder) required for one year continuous operation shall be provided. The calibration gas container material shall not contaminate the calibration gas.		
9	Compliance to standards	USEPA, TUV, MCERTS or equivalent standards		
10	Type of Technology	SO <sub>2</sub> /NO <sub>x</sub> :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Path) type  Note:- For Hot extractive sampling type and Dilution extractive sampling type system – The components involved in sample handling system shall be imported & further, Sample handling system design shall be vetted by Original Analyzer Manufacturer (OAM). Necessary documents shall be furnished during detailed engineering in order to establish the above requirement. Technical expert of OAM shall witness testing of sample handling system and validate it. Alternatively sampling handling system assembled at Original Analyzer manufacturer (OAM) works shall also be accepted.		
11	Measurement range, tapping	As per FGD system design and process parameters.		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 21 OF 40</b>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>																																
<b>10.02.00</b>	<table border="1"> <tr> <td></td> <td>point</td> <td></td> </tr> </table>				point																												
		point																															
<p>Note: Analyzers shall be placed inside Air conditioned CONTAINERISED ROOM (PORTABLE CABIN) or Air conditioned analyzer room provided by the contactor. For detailed specification of CONTAINERISED ROOM (PORTABLE CABIN), Contractor to refer Sub section IIIC-11, Part-B, Section-VI of technical specification.</p> <p><b>Specific requirements for Hot-extractive sampling type SO2 analysers</b></p>																																	
<b>10.03.00</b>	<table border="1"> <thead> <tr> <th>Specification Requirements</th> <th>SO2 Analyser</th> </tr> </thead> <tbody> <tr> <td>Type of Instrument</td> <td>Sampling type - Hot Extractive type</td> </tr> <tr> <td>Principle of Measurement</td> <td>Radiation absorption</td> </tr> <tr> <td>Accuracy</td> <td>+/- 1% of lowest measurement range or better</td> </tr> <tr> <td>Linearity</td> <td>≤ +/-1% of lowest measurement range</td> </tr> <tr> <td>Repeatability</td> <td>≤ 1% of lowest measurement range</td> </tr> <tr> <td>Minimum detection limit</td> <td>≤ 0.5% of lowest measurement range</td> </tr> <tr> <td>Temperature Drift</td> <td>≤ +/- 2%/10 Deg.C</td> </tr> <tr> <td>Zero Drift</td> <td>≤ +/-1% of lowest measurement range /week</td> </tr> <tr> <td>Span Drift</td> <td>≤ +/-1% of lowest measurement range /week</td> </tr> <tr> <td>Analyser Response time (up to 90% of full scale)</td> <td>≤ 5 secs</td> </tr> <tr> <td>Operating Temperature Range for probe</td> <td>0-300 deg.C</td> </tr> <tr> <td>Filter</td> <td>Ceramic 3.5 Micron</td> </tr> <tr> <td>Accessories for purging system</td> <td>Purging system including Auto Scavenging facility shall be provided</td> </tr> <tr> <td>Sample gas inlet temperature to analyser</td> <td>Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards.</td> </tr> </tbody> </table>			Specification Requirements	SO2 Analyser	Type of Instrument	Sampling type - Hot Extractive type	Principle of Measurement	Radiation absorption	Accuracy	+/- 1% of lowest measurement range or better	Linearity	≤ +/-1% of lowest measurement range	Repeatability	≤ 1% of lowest measurement range	Minimum detection limit	≤ 0.5% of lowest measurement range	Temperature Drift	≤ +/- 2%/10 Deg.C	Zero Drift	≤ +/-1% of lowest measurement range /week	Span Drift	≤ +/-1% of lowest measurement range /week	Analyser Response time (up to 90% of full scale)	≤ 5 secs	Operating Temperature Range for probe	0-300 deg.C	Filter	Ceramic 3.5 Micron	Accessories for purging system	Purging system including Auto Scavenging facility shall be provided	Sample gas inlet temperature to analyser	Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards.
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<p><b>Specific requirements for Dilution Extractive type SO2 Analysers</b></p> <p>The design of the Dilution Extractive type system shall be satisfying the following requirements. The sampling system shall consist of In-situ dilution probe, dilution probe controller, sample conditioning system like air drier and filters etc and other accessories</p>																																	
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 22 OF 40</b>																														





**TECHNICAL REQUIREMENTS**

meeting the following requirements as a minimum. All system components and accessories required for completion of this system shall be furnished although these may not be individually specified herein. Following are the minimum requirements:


- a) Modular Electronic Design.
- b) Heatless Air dryer with inlet filter, chemical scrubbers to remove traces of NOx/CO2/SO2 from air and accumulator.
- c) Self test facility with screen display.
- d) Protection of instrument in case ambient or surrounding temp going high beyond stipulated limit.
- e) The following are the minimum requirement for the probe:-
  - Flange and counter flange for inserting probe
  - Flange and counter flange for inserting probe
  - Coarse and Fine Filters
  - Critical orifice
  - Automatic blow back or purging facility
  - SS316L probe material
- f) Further dilution probe controller shall be provided with the ability to control dilution ratio.
- g) Unheated umbilical chord to be provided for transportation of the diluted sample, zero air, vacuum pressure, and calibration gas. This chord has to be a single bundle in FRLS PVC outer sheath. The sample line has to be of PTFE.


Specification Requirements	SO2 Analyser
Principle of measurement	Pulsed/UV Fluorescence technology.
Probe operating temp	0-300 deg C
Accuracy	+/- 1% of lowest measurement range or better
Linearity	≤ +/-1% of lowest measurement range
Repeatability	≤ 1% of lowest measurement range
Minimum detection limit	≤ 0.5% of lowest measurement range
Zero drift	≤ +/-1% of lowest measurement range/week
span drift	≤ +/-1% of lowest measurement range/week
Response time (up to 95% of full scale)	100 sec
Sample gas inlet temperature to analyser	5 deg.C - 40 deg.C


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
10.04.00	<b>Specific requirements for In-situ (Path) type SO2 analysers</b>		
	<b>Specification Requirements</b>	<b>SO2 Analyser cum monitor</b>	
	Principle of Measurement	Differential Optical Absorption Spectroscopy	
	Accuracy	+/- 1% of lowest measurement range or better	
	Linearity	≤ +/-1% of lowest measurement range	
	Repeatability	≤ 1% of lowest measurement range	
	Minimum detection limit	≤ 0.5% of lowest measurement range	
	Temperature Drift	≤ +/- 2%/10 Deg.C	
	Zero Drift	≤ +/-1% of lowest measurement range/week	
	Span Drift	≤ +/-1% of lowest measurement range/week	
	Response time(up to 90% of full scale)	≤ 5 sec	
	Probe Operating Temperature Range	0 to 300 deg C	
	Accessories for purging system	Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure.	
	Temperature compensation	Automatic temperature compensation to be provided	
10.05.00	<b>pH Analyser</b>		
	a)	<b>Type</b>	: Cell - flow through
	b)	<b>Accuracy</b>	: < ± 1% of reading
	c)	<b>Range</b>	: 0 - 14 pH freely programmable (For others)
	d)	<b>No. of steams</b>	: Single
	e)	<b>Temp. compensation</b>	: Automatic
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>					
<p><b>11.00.00</b></p>	<p><b>CONTINUOUS EMISSION MONITORING SYSTEM (CEMS):-</b></p> <ul style="list-style-type: none"> <li>(i) CEMS comprising of analysers and associated items for measurement of SO<sub>2</sub>, NO<sub>x</sub>, CO, CO<sub>2</sub>, Mercury, Particulate Matter (dust density) monitor and Stack Flue Gas Flow in Stack emission shall be provided by the Contractor.</li> <li>(ii) Direct measurement of NO and NO<sub>2</sub> shall be done. Total NO<sub>x</sub> values shall be reported as NO<sub>2</sub> i.e. NO<sub>x</sub> = NO + NO<sub>2</sub> = NO X 1.53 + NO<sub>2</sub> = NO<sub>x</sub> as NO<sub>2</sub>.</li> <li>(iii) Oxygen (O<sub>2</sub>) measurement in stack emission based on Paramagnetic/ Zirconia type instrument shall be provided by the Contractor for correction of SO<sub>2</sub>, NO<sub>x</sub> and Particulate matter value corresponding to the standard/reference O<sub>2</sub>.</li> <li>(iv) CEMS Parameters shall be normalized for temperature, pressure, moisture (applicable in case wet measurement techniques), etc. This facility shall be available in the respective analysers. Necessary measurement shall be provided by the Contractor for these parameters. All the CEMS parameters shall be reported on dry basis.</li> <li>(v) CO<sub>2</sub> Measurement at stack and at instrument end shall be provided in case dilution techniques are used.</li> <li>(vi) CEMS analysers for which dual ranges are specified shall be calibrated for range near to operating process value.</li> <li>(vii) Offered CEMS should be capable of operating unattended over the prolonged period of time.</li> <li>(viii) Analyzers shall be placed inside Air conditioned CONTAINERISED ROOM (PORTABLE CABIN) or Air conditioned analyzer room provided by the contractor. For detailed specification of CONTAINERISED ROOM (PORTABLE CABIN), Contractor to refer Sub section IIIC-11, Part-B, Section-VI of technical specification.</li> <li>(ix) Manual sampling provision for flue gas parameter monitoring shall also be provided as per latest Emission Regulation of CPCB/SPCB in each stack along with necessary provision of platform, lighting facility, safety rails and ladders etc. complete in all respect.</li> </ul> <p>The common requirements to be met for all types of analysers are as below. The specific requirements to be met by each type of analyser are detailed in the subsequent clauses.</p>					
<p><b>11.01.00</b></p>	<p><b>Common Requirements for all Analysers</b></p> <table border="1"> <tr> <td>1</td> <td>Type</td> <td>           Microprocessor based with self-indicating type diagnostic feature.            Output signal: 4-20 mA DC galvanically isolated.            Digital signal transmission: RS232/ RS485 Modbus Protocol/            Ethernet TCP/IP protocol shall be provided in CEMS analysers         </td> </tr> </table>			1	Type	Microprocessor based with self-indicating type diagnostic feature. Output signal: 4-20 mA DC galvanically isolated. Digital signal transmission: RS232/ RS485 Modbus Protocol/ Ethernet TCP/IP protocol shall be provided in CEMS analysers
1	Type	Microprocessor based with self-indicating type diagnostic feature. Output signal: 4-20 mA DC galvanically isolated. Digital signal transmission: RS232/ RS485 Modbus Protocol/ Ethernet TCP/IP protocol shall be provided in CEMS analysers				
<p><b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b></p>	<p><b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b></p>	<p><b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b></p>	<p><b>PAGE 25 OF 40</b></p>			




CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>			
			<p>for bidirectional communication of stack emission data to Employer's cloud server.</p>	
2	Display		Digital display with reading in engineering units. Display of the measurement values as well as all the information required for checking/maintenance of the analyzer. Remote display cum configuration unit shall be housed in local instrument box with protection rating of IP-65 or better.	
3	Zero & span Adjustment		To be provided for all selectable ranges.	
4	Ambient temp.		0-50°C unless defined otherwise.	
5	Analyser enclosure Type/Material		Weather protection for analyser mounted inside analyser panel shall be IP-22 or better. For all other analysers, weather protection class shall be IP-55.	
6	Calibration		Auto & Manual (from Remote). CEMS analyser should have inbuilt zero and calibration check capability.	
7	Power Supply		To be arranged by Contractor subject to Employer's approval.	
8	Others		<p>i) All interconnection tubing and cabling between probe and analyser / analyser panel and cabling from analyser/ analyser panel to DCS (in respective unit control room) are to be provided by Contractor.</p> <p>ii) All the calibration gases (certified cylinder) required for one year continuous operation shall be provided. The calibration gas container material shall not contaminate the calibration gas.</p>	
9	Location of probe	of	<p>SO<sub>2</sub>/NO<sub>x</sub>/CO/CO<sub>2</sub>-On stack at approximate elevation of 35 Mtrs.</p> <p>Particulate Matter (Dust Density) &amp; Flow measurement -On stack at approximate elevation of 88 Mtrs</p> <p>Mercury:- On stack at approximate elevation of 35 Mtrs</p> <p>Location of sample point given above is indicative. Actual sample point location shall comply with latest CPCB norms and shall be accessible for maintenance.</p>	
10	Location of the analysers (other than insitu type)/Analyser Panel.		AT 0' Mtrs near stack for CEMS analysers except particulate matter analyser. For particulate matter preferred location is '0' meter near stack. Remote display cum configuration unit for particulate matter analyser should be provided at '0' meter near stack in the analyser panel in case particulate matter analyser is kept near the sample point due to technical limitation.	
11	Compliance to standards	to	USEPA, TUV, MCERTS or equivalent standards	
12	Type of Technology	of	SO <sub>2</sub> /NO <sub>x</sub> :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Path) type	
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:</b> 31/CE/PLG/RGTPP/FGD-250	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 26 OF 40</b>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
		<p>CO :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Cross-duct) type. (can be combined with SO2/NOx)</p> <p>CO2 :- Hot-extractive sampling type/ Dilution Extractive/ In-situ (Cross-duct) type (can be combined with CO or SO2/NOx above).</p> <p>Particulate Matter (Dust Density):- Extractive type with reheating or dilution.</p> <p>Mercury (Hg) :- Extractive type</p> <p>Note:- For Hot extractive sampling type and Dilution extractive sampling type system – The components involved in sample handling system shall be imported &amp; further, Sample handling system design shall be vetted by Original Analyzer Manufacturer (OAM). Necessary documents shall be furnished during detailed engineering in order to establish the above requirement. Technical expert of OAM shall witness testing of sample handling system and validate it. Alternatively sampling handling system assembled at Original Analyzer manufacturer (OAM) works shall also be accepted.</p>	
	13	<p><b>System capability</b></p> <p>1 No. of CEMS PC station to be provided with all the requisite softwares having the following capabilities:-</p> <ul style="list-style-type: none"> <li>- Visualisation of acquired values of data from all analysers</li> <li>- Average computation of data(programmable time like 30min, 1 hour, 24 hours, 48 hours or 1 week)</li> <li>- Trend representation of raw, and averaged data (trend time period shall be freely selectable)</li> <li>- Archiving in simple formats like MS Excel etc</li> <li>- Alarm setting and annunciation</li> <li>- Calibration procedures</li> <li>- Normalisation of emission data</li> <li>- Annual cumulative mass of pollutants using flue gas flow and emission values</li> <li>- Capabilities of comparison of data w.r.t. standard/threshold values.</li> <li>- Providing remote access to calibration and configuration.</li> <li>- Channel configuration for range, unit etc.</li> <li>- Data storage capacity.</li> <li>- Auto Report generation.</li> <li>- Diagnostics.</li> <li>- Data transmission.</li> </ul> <p>All the necessary algorithms shall be provided to achieve system capability.</p> <p>Specification for PC station shall be as per Annexure-IIIC-02G to sub-section IIIC-02, Section-VI, DDCMIS, Part-B.</p>	
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:</b>	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 27 OF 40</b>
<b>31/CE/PLG/RGTPP/FGD-250</b>			

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>			
11.02.00	14	Contractual conditions for CEMS system	<p>Warranty:- As defined elsewhere in the Contract.</p> <p>Comprehensive Annual Maintenance Contract:-. Refer sub-section-IIC-C&amp; I/ Section-VI/ Part-A. This shall cover total maintenance of all hardware and software related to CEMS and shall include free repair/replacement of all components/cables/equipment etc and supply of expendable items.</p> <p>Availability of valid data:-AT least 90% of time during warranty and CAMC period. For this purpose, contractor may take necessary steps to ensure availability.</p> <p>Services to be provided during Warranty and CAMC period shall be as per clause no. 3.04.00, 3.05.00 and 3.06.00, Sub-Section-III-C, SECTION-VI, PART-A.</p>	
	<p><b>Specific requirements for Hot-extractive sampling type SO<sub>2</sub>, NO<sub>x</sub>, CO<sub>2</sub> &amp; CO analysers</b></p>			
	Specification Requirements	SO <sub>2</sub> Analyser and Nox Analyser cum monitor (combined)	CO <sub>2</sub> ANALYZER	CO Analyser
	Type of Instrument	Sampling type - Hot Extractive type	Hot-Extractive	Hot-extractive type
	Principle of Measurement	Radiation absorption	NDIR absorption	NDIR absorption
	Measurement Range	0-250 / 0-1500 mg/Nm <sup>3</sup> (selectable)	0 to 25% (selectable)	0-100/ 0-1000 mg/Nm <sup>3</sup> (selectable)
	Accuracy	+/- 1% of lowest measurement range or better	+/- 1% of Span or better	+/- 1% of lowest measurement range or better
	Linearity	≤ +/-1% of lowest measurement range	≤ +/-1% of lowest measurement range	≤ +/-1% of lowest measurement range
	Repeatability	≤ 1% of lowest measurement range	≤ 1% of lowest measurement range	≤ 1% of lowest measurement range
	Minimum detection limit	≤ 0.5% of lowest measurement range	≤ 0.5% of lowest measurement range	≤ 0.5% of lowest measurement range
Temperature Drift	≤ +/- 2%/10 Deg.C	≤ +/- 2% / 10 Deg.C	≤ +/- 2%/10 Deg.C	
Zero Drift	≤ +/-1% of lowest measurement range /week	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week	
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>			
11.03.00	Span Drift	≤ +/-1% of lowest measurement range /week	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week
	Analyser Response time (up to 90% of full scale)	≤ 5 secs	≤ 5 secs	≤ 5 secs
	Operating Temperature Range for probe	0-300 deg.C	0-300 deg.C	0-300 deg.C
	Filter	Ceramic 3.5 Micron	Ceramic 3.5 Micron	Ceramic 3.5 Micron
	Accessories for purging system	Purging system including Auto Scavenging facility shall be provided	Purging system including Auto Scavenging facility shall be provided	Purging system including Auto Scavenging facility shall be provided
	Sample gas inlet temperature to analyser	Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards.	Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards.	Temperature of the sample gas inlet to analyser shall be controlled before analyser as per manufacturer standards.
	<p><b>Specific requirements for Dilution Extractive type SO<sub>2</sub>, NO<sub>x</sub>, CO<sub>2</sub> &amp; CO Analysers</b></p> <p>The design of the Dilution Extractive type system shall be satisfying the following requirements. The sampling system shall consist of In-situ dilution probe, dilution probe controller, sample conditioning system like air drier and filters etc and other accessories meeting the following requirements as a minimum. All system components and accessories required for completion of this system shall be furnished although these may not be individually specified herein. Following are the minimum requirements:</p> <p>h) Modular Electronic Design.</p> <p>i) Heatless Air dryer with inlet filter, chemical scrubbers to remove traces of NO<sub>x</sub>/CO<sub>2</sub>/SO<sub>2</sub> from air and accumulator.</p> <p>j) Self test facility with screen display.</p> <p>k) Protection of instrument in case ambient or surrounding temp going high beyond stipulated limit.</p> <p>l) The following are the minimum requirement for the probe:-</p> <ul style="list-style-type: none"> <li>• Flange and counter flange for inserting probe</li> <li>• Flange and counter flange for inserting probe</li> <li>• Coarse and Fine Filters</li> </ul>			
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 29 OF 40</b>	


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<ul style="list-style-type: none"> <li>• Critical orifice</li> <li>• Automatic blow back or purging facility</li> <li>• SS316L probe material</li> </ul> <p>m) Further dilution probe controller shall be provided with the ability to control dilution ratio.</p> <p>n) Unheated umbilical chord to be provided for transportation of the diluted sample, zero air, vacuum pressure, and calibration gas. This chord has to be a single bundle in FRLS PVC outer sheath. The sample line has to be of PTFE.</p> <p>o) Any dilution extractive system must have CO2 measurement facility at source/stack and measuring point/instrument end to prove the correctness of the selected dilution ratio.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:</b> 31/CE/PLG/RGTPP/FGD-250	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 30 OF 40</b>


CLAUSE NO.



**TECHNICAL REQUIREMENTS**

Specification Requirements	SO2 Analyser	NOx Analyser	CO2 Analyser	CO Analyser
Principle of measurement	Pulsed/UV Fluorescence technology.	Chemiluminescence technology.	Gas Filter correlation	Gas Filter Correlation technology
Measurement Range	0-250 / 0-1500 mg/Nm3 (selectable)	0-250 / 0-1500 mg/Nm3 (selectable)	0 to 25% (selectable)	0-100/ 0-1000 mg/Nm3 (selectable)
Probe operating temp	0-300 deg C	0-300 deg C	0-300 deg C	0-300 deg.C
Accuracy	+/- 1% of lowest measurement range or better	+/- 1% of lowest measurement range or better	+/- 1% of lowest measurement range or better	+/- 1% of lowest measurement range or better
Linearity	≤ +/-1% of lowest measurement range	≤ +/-1% of lowest measurement range	≤ +/-1% of lowest measurement range	≤ +/-1% of lowest measurement range
Repeatability	≤ 1% of lowest measurement range	≤ 1% of lowest measurement range	≤ 1% of lowest measurement range	≤ 1% of lowest measurement range
Minimum detection limit	≤ 0.5% of lowest measurement range	≤ 0.5% of lowest measurement range	≤ 0.5% of lowest measurement range	≤ 0.5% of lowest measurement range
Zero drift	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week
span drift	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week
Response time (up to 95% of full scale)	100 sec	60 sec	90 sec	60 sec
Sample gas inlet temperature to analyser	5 deg.C - 40 deg.C	5 deg.C - 40 deg.C	5 deg.C - 40 deg.C	5 deg.- 40 deg.C

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>			
<b>11.04.00</b>	<b>Specific requirements for In-situ (Path) type SO<sub>2</sub>, NO<sub>x</sub>, CO<sub>2</sub> &amp; CO analysers</b>			
	Specification Requirements	SO <sub>2</sub> /NO <sub>x</sub> Analyser cum monitor	CO <sub>2</sub> Analyser cum monitor	CO Analyser cum monitor
	Principle of Measurement	Differential Optical Absorption Spectroscopy	Differential Optical Absorption Spectroscopy	IR absorption
	Measurement Range	0-250 / 0-1500 mg/Nm <sup>3</sup> (selectable)	0-25% (selectable)	0-100/ 0-1000 mg/Nm <sup>3</sup> (selectable)
	Accuracy	+/- 1% of lowest measurement range or better	+/- 1% of lowest measurement range or better	+/- 1% of lowest measurement range or better
	Linearity	≤ +/-1% of lowest measurement range	≤ +/-1% of lowest measurement range	≤ +/-1% of lowest measurement range
	Repeatability	≤ 1% of lowest measurement range	≤ 1% of lowest measurement range	≤ 1% of lowest measurement range
	Minimum detection limit	≤ 0.5% of lowest measurement range	≤ 0.5% of lowest measurement range	≤ 0.5% of lowest measurement range
	Temperature Drift	≤ +/- 2%/10 Deg.C	≤ +/- 2%/10 Deg.C	≤ +/- 2%/10 Deg.C
	Zero Drift	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week
	Span Drift	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week	≤ +/-1% of lowest measurement range/week
	Response time(up to 90% of full scale)	≤ 5 sec	≤ 5 sec	≤ 5 sec
	Probe Operating Temperature Range	0 to 300 deg C	0 to 300 deg C	0 to 300 deg C
	Accessories for purging system	Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure.	Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure.	Purging system to be provided with heavy duty blowers and shutter mechanism for automatic isolation of lens during purge air failure.
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 32 OF 40</b>	

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>			
11.05.00	Temperature compensation	Automatic temperature compensation to be provided	Automatic temperature compensation to be provided	Automatic temperature compensation to be provided
	<b>Specific requirements for Particulate Matter (Dust density) monitor</b>			
	<b>Specification Requirements</b>		<b>PARTICULATE EMISSION (Dust density Stack Opacity) monitor</b>	
	Type of Instrument		Extractive type with reheating or dilution.	
	Principle of Measurement		Scattered Light measurement	
	Measurement Range		0-50 mg/Nm <sup>3</sup> / 0 - 300 mg/Nm <sup>3</sup> (Programmable)	
	Accuracy		+/- 2% of lowest measurement range or better	
	Linearity		≤ +/- 1% of lowest measurement range	
	Repeatability		≤ 1% of lowest measurement range	
	Minimum detection limit		≤ 1% of lowest measurement range	
	a) Temperature Drift		≤ +/- 2%/10 Deg.C	
	b) Zero Drift		≤ +/-1% of lowest measurement range/week	
	e) Span Drift		≤ +/-1% of lowest measurement range/week	
	Analyser Response time(up to 90% of full scale)		≤ 5 sec	
	Operating Temperature Range for probe		0-300 deg.C	
	Filter		To be provided	
	Accessories purging system		Purging system to be provided.	
Temperature compensation/measurement		Temperature compensation to be provided, if applicable.		
		First site Calibration of the instrument should be done based on the results of an extractive IsoKinetic Test by the Contractor.		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 33 OF 40</b>	





**TECHNICAL REQUIREMENTS**

**11.06.00**


**Specific requirements for Continuous On-line Mercury Analyser**


S.NO.	PARAMETER	DETAILS
1	Measurement Principle	Atomic Absorption Spectrometry/ Atomic Fluorescence spectrometry.
2	Range	0 - 35 microgram/Nm3
3	Accuracy	+/- 1% of Span or better
4.	Minimum detection limit	1 microgram/Nm3


**11.07.00**


**ULTRASONIC FLOW METER FOR FLUE GAS FLOW IN STACK**


Type	Microprocessor based with self-indicating type diagnostic feature.  Output signal: 4-20 mA DC galvanically isolated.  Digital signal transmission: RS232/ RS485 Modbus Protocol/ Ethernet TCP/IP protocol for bidirectional communication of stack emission data to Employer's cloud server.
Mounting Style	Transducers on the duct/stack
Transducer type and material	Single pair of Corrosion resistant material to be provided
Zero and Span adjustment	To be provided
Flow measurement	Instantaneous Flow rate as well as totalized flow
Power supply Distribution	To be arranged by the Contractor from Employer's terminal point.
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.
Recording / Totalizing/Logging Facilities	To be provided
Diagnostics	False signal tolerance , power supply failure etc
Protection class	IP-65 or better
Ambient temperature	-20 deg to +60 deg C
Accuracy	+/- 2% of span or better
Electrical connection	Plug and socket
Accessories	All mounting hardware required like clamping

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
11.08.00		fixtures, mechanism to remove the transducers online, interconnecting cables to DDCMIS, cables, flexible conduits, junction boxes etc  Purging arrangement for Cleaning sensors to be provided. Material of all fittings shall be SS 316.	
	Software features	Compensation for temperature and pressure and any cross path errors.  Programming, configuration, shall be possible from front panel.	
	<p><b>NOTES:-</b></p> <p>01. Hot extractive sampling type/ Dilution extractive type SO<sub>2</sub>/NO<sub>x</sub>/CO/CO<sub>2</sub> systems shall be provided with dual sample probes along with all required accessories such as redundant heavy duty pumps with continuous rated motors, moisture detection facility, pre-fabricated heated (for sampling type only) sample lines from probes to analyser panel, solenoid valves, filters, coolers along with level switch in gas coolers for auto draining purpose and flow meter etc as applicable. Alternatively, permeation based dryer (located near the tapping point) alongwith necessary sample conditioning devices to ensure full protection, to avoid clogging &amp; long life of permeation tubes may also be provided in place of sample cooler. Also, healthiness status/alarm/indication of permeation based dryer shall be provided in analyser panel.</p> <p>02. In case IR based technique is used for SO<sub>2</sub>/NO<sub>x</sub> measurement, correction for H<sub>2</sub>O cross interference shall be available in the analyser.</p> <p>03. For O<sub>2</sub> Analyser, the construction of the sensor shall be such that joints between dissimilar materials are avoided to prevent formation of cracks.</p> <p>Connectivity with DDCMIS and provision for bidirectional communication with Employer's Cloud Server</p> <p>1. 4-20mA signals from all the above analysers, flow meters, stack gas temperature, stack pressure, stack gas moisture, stack gas O<sub>2</sub> shall be wired to DCS of respective unit.</p> <p>2. RS232/ RS485 Modbus protocol/ Ethernet TCIP/IP based bidirectional communication with Employer's Cloud Server as defined in Sub-section-IIIC-C&amp;I/ Section-VI/ Part-A.</p> <p>All necessary hardware and software required at instrument end shall be provided by the Contractor. Bidder shall connect analysers/instruments of his scope and provide single point/port for connection with Employer's cloud server. Further connection to Employer's cloud server shall be in the scope of Employer. Necessary details like scheme, register addresses of analyzer, etc. shall also be provided by the Contractor for implementation of above. The Contractor shall fully assist Employer's agency involved in implementation of above connectivity.</p> <p>All the accessories and cables required for connecting Analysers outputs to DCS and provision of bidirectional communication as defined above shall be provided by Contractor on as required basis.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.:</b> 31/CE/PLG/RGTPP/FGD-250	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 35 OF 40</b>

<b>CLAUSE NO.</b>	 <b>TECHNICAL REQUIREMENTS</b>		
<b>12.00.00</b>	<p><b>Vibration Monitoring System</b></p> <p>The Vibration Monitoring System shall be furnished on a system basis including, vibration transducers, phase marker sensor with low noise flexible cables in flexible metal conduit, terminated in local terminal boxes, necessary pre-amplifier/electronics mounted in local weather proof boxes, vibration monitors, mounting racks and cabinets etc. The vibration monitoring system shall include all power supplies, interconnecting cabling, calibration equipment, configuration software &amp; hardware like PC, indicators, integrating units, signal conditioning devices and all other accessories, erection hardware required for monitoring of Vibration at each point. The contractor shall provide the vibration pads.</p> <p>Contractor can offer up to Four Channel Vibration monitors. The allocation of channels shall be such that loss of one monitor shall not affect more than one side of the bearing of one machine. In the case of more than two channel Vibration monitors being provided by the Contractor, then one spare monitor shall be provided mounted in the panel to take care of immediate replacement of any failed monitors. Offered vibration monitors shall be modular in construction, plug in type.</p> <p>Eddy current / piezoelectric type transducers shall be used. The sensors shall be either proximity or velocity or accelerometer type. However, the finally selected sensor type shall also depend on recommendation of the equipment manufacturer &amp; suitable for application requirement which shall be finalised during detail engineering and without any extra price. Transducers shall be furnished in weatherproof housing suitable for field conditions. Cables/cabling from transducers local JB to Vibration Monitoring system in FGD Control Room/Control Equipment Room shall be provided by the Contractor.</p> <p>Vibration monitoring system shall give one no. buffered output of 4-20 mA DC and two no. of buffered raw signal for each point monitored and one no. of buffered raw signal for each phase marker sensor. The 4-20mA signal shall be suitable for use as an input to DDCMIS, linear in proportion to vibration velocity or displacement. Raw buffered signal(s) shall be suitable for archiving and analysis. Monitor shall provide vibration indication calibrated in velocity units along with provisions of changing to displacement unit (field-programmable) for each measurement point in both horizontal &amp; vertical planes. The generation of alarm and trip signals is not envisaged in vibration monitoring system, the same shall be derived in DDCMIS. However in case of vibration initiated protection of equipments, OEM standard and proven practices shall also be considered.</p> <p>The vibration monitor racks with power supplies shall be mounted in a separate self standing cabinet to be located in control room. The number of racks and power supplies shall be such that on failure of a single power supply/module, not more than four monitors shall be affected. The vibration monitoring cabinet shall be fed from redundant 24V DC feeders with auto changeover scheme.</p> <p>The power supply arrangement for monitors shall ensure that failure of one power supply shall not affect any monitoring function in the system. Also any power supply failure /earth fault in any of the monitors will be isolated without affecting other monitors/ common power supply. If 230 V AC UPS power supply is required for panel PC/ desktop PC, UPS/Mini UPS for the same shall be provided by the contractor.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 36 OF 40</b>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
13.00.00	<p>The functional requirement for vibration monitoring system shall include but not be limited to the following:</p> <ul style="list-style-type: none"> <li>- Vibration monitor front face status indications shall be available for indications of healthy conditions of pick up circuit, monitor circuit and power supply. On sensor fault/wire break in the sensor circuit, the system shall have the feature of identifying the same through suitable means like the signal forced to a value less than 4 mA. In case, such a feature is not available then suitable contact shall be provided from the monitor for sensor fault.</li> <li>- The facility shall be available for online functional checking of monitors.</li> <li>- All vibration monitoring equipment shall be functionally tested for circuit continuity and output response. All the components &amp; interconnection cables shall be tested to ensure compliance with the specification requirements &amp; all other applicable codes &amp; standards.</li> </ul> <p>In case it is the proven standard practice of a Contractor to provide vibration monitoring PC with TFT LCD monitor, instead of dedicated monitors with the signal conditioning equipment in control equipment room, the same shall also be acceptable. However, all relevant functional requirements detailed above shall be met and the system shall be subject to Employer's approval. Earthing and grounding of VMS panels, sensors, cards etc shall be as per VMS OEM practice.</p> <p>The Bidder shall provide maintenance services of complete Vibration Monitoring System under a comprehensive Annual Maintenance Contract (AMC) for an additional period of two years after the end of Comprehensive Operation &amp; Maintenance period.</p> <p>The AMC shall cover total maintenance of all hardware &amp; software coming under the scope of Vibration Monitoring System and shall include free repair/replacement of all cards/ modules/ peripherals/ cables/ components etc., correction of software problems and supply of expendable items. The Bidder shall ensure 99.7% availability of the system with the AMC. For that purpose, contractor may maintain adequate no. of staff at site as per his own assessment if considered necessary to ensure availability.</p> <p>Further, Bidder may note that during the AMC he will be allowed to use Employer's mandatory spares and has to replenish the same within three months time or before completion of AMC period whichever is earlier. However, if in the opinion of the Bidder, more spares than those included in the mandatory spare list are required to meet the availability requirement, then Bidder shall stock the same.</p> <p>The Bidder shall prepare detailed list of faults corrected and parts, expendables utilised during AMC period and shall furnish the same to Employer, properly documented at the end of AMC period. Further, during AMC period the details as required by Employer/ Project Manager shall be made available by Bidder's personnel.</p> <p><b>FIELD INSTRUMENTS BASED ON FIELDBUS</b></p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 37 OF 40</b>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>					
13.01.00	<p>The following instruments shall be connected to DDCMIS through fieldbus i.e. FOUNDATION Fieldbus/PROFIBUS PA protocol complying to IEC 61158 directly from transmitter.</p> <p><b>Electronic Transmitter for Pressure, Differential Pressure and DP based Flow / Level measurements.</b></p>					
	<table border="1"> <thead> <tr> <th>S No.</th> <th>Features</th> <th>Essential/Minimum Requirements</th> </tr> </thead> </table>			S No.	Features	Essential/Minimum Requirements
	S No.	Features	Essential/Minimum Requirements			
	1.	Type of Transmitter	FOUNDATION Fieldbus/PROFIBUS PA based output			
	2.	Accuracy	$\pm 0.060$ % of calibrated range (minimum) for calibrated range greater than 400 mmwc. $+0.065$ % of calibrated range (minimum) for calibrated range greater than 250 kg/cm <sup>2</sup> . $\pm 0.10$ % of calibrated range (minimum) for calibrated range less than 400 mmwc.			
	3.	Stability	0.25 % of calibrated range for 10 years for calibrated range greater than equal to 400 mmwc on standard conditions of manufacturer. 0.2 % of calibrated range for 1 years for calibrated range less than 400 mmwc on standard conditions of manufacturer. 0.15% of calibrated range for 5 years for DPT with static pressure greater than 250 kg/cm <sup>2</sup> .			
	4	Turn down	50:1 for greater than or equal to span of 400mmwcl. 20:1 for span below 400mmwcl. 10:1 for span greater than 250 kg/cm <sup>2</sup>			
	(Above mentioned (2,3,4) parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only).					
	5	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating			
	6.	Electrical connection	½" NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible			
7.	Process connection	½" NPT (F)				
8.	Operating Ambient temperature	85 deg C without display. 70 deg C with display.				
	Overpressure	150% of max operating pressure				
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 38 OF 40</b>			

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	9.	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. -2 valve manifold for absolute & gauge pressure transmitters, -3-valve for DP and 5 valve manifold for level/flow applications. -The valve manifold shall be non-integral type. -For hazardous area, enclosure as described in NEC article 5.
	10.	Mounting	2 inch pipe mounting with Enclosure/Rack/Canopy.
	11.	Diagnostics & display	Self-Indicating feature and digital display on transmitter
	Notes		
	<ul style="list-style-type: none"> <li>- For primary air/ secondary air/flue gas/ furnace pressure applications, DP type transmitters shall be provided for pressure measurement below 2000 mmwc.</li> </ul>		
	<ul style="list-style-type: none"> <li>- LVDT type is not acceptable.</li> </ul>		
	<ul style="list-style-type: none"> <li>- 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.</li> </ul>		
<b>13.02.00</b>	<b>Temperature Transmitter</b>		
<b>13.02.01</b>	<b>Single Input /Dual Input Temperature transmitter</b>		
	<p>Temperature transmitter shall be provided which shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation for thermocouples shall be performed in the temperature transmitter itself. Transmitters shall be capable of withstanding ambient temperature up to 85 deg C.</p> <p>Following specifications are applicable for dual input/single input temperature transmitter.</p>		
	<b>S No.</b>	<b>Features</b>	<b>Essential/Minimum Requirements</b>
	1.	Output	FOUNDATION fieldbus /PROFIBUS PA
	2.	Input	Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K, R & ,S types
	3.	Housing	Weather proof as per IP-67, metallic housing with durable
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C2 MEASURING INSTRUMENTS</b>	<b>PAGE 39 OF 40</b>



**TECHNICAL REQUIREMENTS**

		corrosion resistant coating
4.	Electrical connection	½” NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible
5.	Diagnostics & display	Self-Indicating feature and digital display on transmitter
6.	Operating Ambient temperature	85 deg C without display. 70 deg C with display.
7.	Mounting	2 inch pipe mounting with Canopy.
8.	Accessories	As required by service and operating condition.
9.	Composite Accuracy	(Refer note 2 )
		RTD                      =<0.25% of 0-250 deg C span
		T/C-K type              =<0.2% of 0-600 deg C span
		CJC accuracy (for thermocouples) shall be =< 1 deg C

Notes:

1. In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output.
2. Dual input temperature transmitter shall have bump less changeover facility to second sensor in case first sensor fails. This changeover is to be alarmed.
3. Composite accuracy is to be calculated as summation of all applicable accuracies of temperature transmitter for converting sensor input to output (e.g., basic accuracy, digital accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of temperature elements specified. All such accuracy/ temperature effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters shall be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input as specified above.
4. Above mentioned parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only.
5. Dual input temperature transmitters can also be accepted in place of single input TT.




## SUB-SECTION-III-C3


# PROCESS CONNECTION AND PIPING


**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<b>PROCESS CONNECTION AND PIPING</b>		
1.00.00	<b>PROCESS CONNECTION PIPING</b>		
1.01.00	The Contractor shall provide, install and test all required material for completeness of Impulse Piping System and Air Piping System as per the requirements of this Sub-Section on as required basis for the connection of all instruments and control equipments of entire plant.		
1.01.01	<b>IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS</b>		
1.01.02	All impulse pipes shall be of seamless type conforming to ANSI B36.10 for schedule numbers. The size of impulse pipe shall be ½” for Steam & Water Application and ¾” for Air & Flue Gas applications. The rating of material of impulse pipes, tubes, fittings, valves and their installation thereof shall conform to the latest edition of standards as per following table:		
	Impulse Pipes, Tubes (Material, Rating)	ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70	
	Valves (Material, Pr. Class, Size)	ASTM A182/ASTM A105 as per ASME 16.34	
	Fittings (Size, Rating, Material)	ANSI B31.1, ANSI B31.1a, ASME B16.11-2009	
	Installation Schemes	BS 6739-2009, ANSI/ISA 77.70	
	Stainless steel tube shall be provided inside enclosures & racks from tee connection to valve manifold and then to instrument. The source shut-off (primary process root valve) and blow down valve shall be of 1/2 inch size globe valve type for all applications except for air and flue gas service wherein no source shut-off valves are to be provided. Two root valves are to be used wherever pressure is more than 40 Kg/cm <sup>2</sup> or Temp>280 °C. The end connections of valves shall be of socket welded type. Typical installation scheme of DP Transmitter (inside LIE/LIR) mounted below instrument source point is indicated in Drg. No. 0000-999-POI-A-036. Same scheme with necessary changes shall be applied for other instruments.		
1.01.03	The valve manifolds of 316 SS with pressure rating suitable for intended application shall be provided as given below:		
	<b>Manifold</b>	<b>Application/Measurement</b>	
	2 Valve	Pressure measurements using pressure transmitters/pressure switches	
	3 Valve	Pressure measurements using differential pressure transmitter/ switches	
	5 Valve	Differential Pressure, Flow and Level Measurements	
	For Pr./D.P gauges, two-way globe/gate valve shall be provided on each impulse line to the instrument in Fluid/Air & Flue Gas applications respectively .		
2.00.00	<b>AIR SUPPLY PIPING</b>		
2.01.01	All pneumatic piping, fittings, valves, air filter cum regulator, purge rotameter and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided. This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements etc.		
2.02.00	Instrument air and Service air supply shall be provided for continuous and intermittent purging respectively for all transmitters of mill, dirty air and flue gas applications. Purging Scheme shall be as per Drg. No. 0000-999-POI-A-036.		
2.03.00	The Contractor shall also provide SS Tubing and associated fittings (screwed type) of suitable sizes for all pneumatic equipments/actuators (including supply air, signal air and output to actuators) conforming to ANSI 31.1 and 31.3 standard. All other air supply lines		
RGTPP HISAR(2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250	PART-B SUB-SECTION-III-C3 PCP	PAGE 1 OF 4

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty with threaded ends. Fittings for air supply line shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs. Air supply piping shall be adequately sloped to prevent accumulation of condensed water within the pipe. The air supply headers, sub-headers and branch pipes shall be supported properly by clamps or supports.</p>		
2.04.00	<p>The instrument/service air supply to each equipment/devices requiring air supply shall be provided by a well designed air distribution scheme comprising of 2" GI Pipe Header feeding 1" GI Pipe sub-header feeding ½" pipe at each equipment/device. Instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply except for Ash Handling System wherein it shall be provided on instrument air header at each location.</p>		
2.05.00	<p>All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type &amp; trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch.</p>		
2.06.00	<p>Instrument air filters cum regulator set with mounting accessories shall be provided for pneumatic device requiring air supply. The filter regulators shall be suitable for 10-kg/ sq.cm max. Inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2-inch size pressure gauge and built in filter housing blowdown valve. The end connection shall be as per the requirement to be finalized during detailed engineering.</p>		
3.00.00	<p><b>INSTALLATION AND ROUTING</b></p>		
3.01.01	<p>All instrument piping, tubing and its accessories shall be supported in a safe manner to prevent excessive vibrations and anchored sufficiently to prevent undue strain on connected equipment. Impulse piping shall be supported at an interval not exceeding 1.5 meters. The slope of the impulse pipe from the process connection to the instrument shall be as per ANSI/ISA 77.70 latest edition and BS 6739-2009. All impulse piping shall be installed to permit free movement due to thermal expansion. Wherever required expansion loops shall be provided.</p> <p>Condensate pots shall be provided for all level measurements in steam and water services, all flow measurement in steam services and for flow measurements in water services above 120 Deg. C. Colour coding of all impulse pipes shall be done by the Contractor in line with the colour coding being followed for the parent pipes.</p>		
4.00.00	<p><b>SHOP AND SITE TESTS</b></p>		
4.01.01	<p>The equipment and work performed as per this Sub-section shall be subject to shop and site test as per requirements of Sub-section-III-E-04 (Quality Assurance &amp; Inspection) other applicable clauses of this Sub-section and Employer approved quality assurance plan.</p>		
4.01.02	<p>Hydrostatic and Pneumatic leakage tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.</p>		
5.00.00	<p><b>LOCAL INSTRUMENT ENCLOSURE AND RACKS</b></p> <p>All transmitters, switches etc. for FGD system and other system being provided under the contract shall be suitably grouped together and mounted inside (i) local instruments enclosures in case of open areas of the plant and (ii) In local instrument racks in case of</p>		
<p>RGTPP HISAR(2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C3 PCP</p>	<p>PAGE 2 OF 4</p>

<b>CLAUSE NO.</b>	 <b>TECHNICAL REQUIREMENTS</b>		
<b>5.01.00</b>	<p>covered areas. The GA of LIE with purging indicated in the Drg. No. 0000-999-POI-A-036 is to be followed by contractor. The GA of LIR shall be similar to LIE except for front/rear doors and side panels.</p> <p>The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of LIE and JB of LIE/LIR shall be IP-55.</p> <p>The enclosures shall be constructed of 3 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Double inter locking doors shall be provided. The doors shall be the three-point locking type constructed of not less than 1.6 mm thick steel. Doors shall have concealed quick removal type pinned hinges and locking handles. Door locks shall accept the same key.</p> <p>The instrument racks shall be free standing type constructed of suitable 5 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack.</p> <p>Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided.</p> <p>Contractor shall provide not more than three variants for LIE/LIR with respect to max. no. transmitters mounted in each LIE/LIR.</p> <p><b>ENCLOSURE / RACKS FOR DUAL I/P TEMPERATURE TRANSMITTERS</b></p> <p>All Dual Input temperature transmitters for FGD system and other system being provided under the contract shall be suitably grouped together and mounted inside (i) Enclosures in case of open areas of the plant and (ii) Racks in case of covered areas. Integral JB shall be provided with each Enclosure and Rack.</p> <p>The internal layout shall be such that the transmitters are accessible from both front and back side of the enclosure / rack for easy maintenance.</p> <p>Enclosure/ Racks shall be of robust and rugged design. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of Enclosure and JB shall be IP-55.</p> <p>Enclosure and Racks shall be free standing type.</p> <p>Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein.</p> <p>Contractor shall provide not more than five variants for Enclosure/ Rack with respect to max. no. transmitters mounted in each Enclosure/ Rack. However, the maximum number of Transmitters that can be grouped in one Enclosure/ Rack shall be decided during detail Engineering.</p>		
<b>RGTPP HISAR(2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C3 PCP</b>	<b>PAGE 3 OF 4</b>

**6.00.00**

**INSTALLATION OF OTHER INSTRUMENTS:**

For installation and routing of other field mounted instruments which are not covered in Cl. No. 5.00.00, please refer Cl. No 52.04.00(J) of Section-VI, Part-D, Erection Conditions of Contract (ECC) of Technical Specifications.

**7.00.00**

**For Sea Water Applications following to be provided**

System/Line Description	Sea Water Applications
Piping Class	S
Impulse Pipe Material	ASTM-A 213 TP 316L
Schedule (Size)	80(1/2 inch)
Materials for Fitting/Valve Body	ASTM-A 182 316L
Valve Stem Material	-do-
Rating of Piping/ Fittings	3000lb
Pr. Class of Valve	800





SUB-SECTION-III-C4


INSTRUMENTATION CABLES

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**


**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>														
1.00.00	<b>INSTRUMENTATION CABLE, CONTROL &amp; POWER SUPPLY CABLE, INTERNAL WIRING AND ELECTRICAL FIELD CONSTRUCTION MATERIAL (CABLE SUB-TRAYS ETC)</b>														
1.01.00	<b>General requirements</b>														
1.01.01	All cables including special cables, internal wiring and electrical field construction material shall conform to this specification, Employer approved detail engineering drawings & documents and the latest edition of the relevant standards & guidelines. The Bidder shall furnish all material and services required for the completeness of the work identified in his scope as per this specification.														
1.01.02	The Contractor shall supply, erect, terminate and test all instrumentation cables for control and instrumentation equipment/devices/systems included under Contractor's scope and ensuring completeness of the control system.														
1.01.03	Any other application where it is felt that instrumentation cables are required due to system/operating condition requirements, are also to be provided by Contractor.														
1.01.04	Other type of cables like fiber optic/co-axial cables for system bus, cables for connection of peripherals etc. (under Contractor's scope) are also to be furnished by the Contractor.														
1.01.05	Contractor shall supply all cable erection and laying hardware from the main trunk routes like branch cable trays/sub-trays, supports, flexible conduits, cable glands, lugs, pull boxes etc. on as required basis for all the systems covered under this specification.														
1.01.06	Wherever the quantity has been defined as on as required basis, the same are to be furnished by contractor on as required basis within his quoted lump sum price without any further cost implication to the Employer.														
2.00.00	<b>SPECIFICATION OF INSTRUMENTATION CABLE</b>														
2.01.00	<b>Common Requirements</b>														
	<table border="1"> <thead> <tr> <th>S. No.</th> <th>Property</th> <th>Requirement</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Operating Voltage</td> <td>225 V (peak value)</td> </tr> <tr> <td>2.</td> <td>Codes and standard</td> <td>All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.</td> </tr> <tr> <td>3.</td> <td>Continuous operation suitability</td> <td>At 205 Deg C for Type-C cables &amp; heat resistant cables, at 70 Deg C for all other type of cables.</td> </tr> </tbody> </table>			S. No.	Property	Requirement	1	Operating Voltage	225 V (peak value)	2.	Codes and standard	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.	3.	Continuous operation suitability	At 205 Deg C for Type-C cables & heat resistant cables, at 70 Deg C for all other type of cables.
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2.	Codes and standard	All instrumentation cables shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and their amendments read along with this specification.													
3.	Continuous operation suitability	At 205 Deg C for Type-C cables & heat resistant cables, at 70 Deg C for all other type of cables.													
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C4 INSTRUMENTATION CABLES</b>	<b>PAGE 1 OF 13</b>												


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>								
2.02.00	<table border="1"> <thead> <tr> <th>S. No.</th> <th>Property</th> <th>Requirement</th> </tr> </thead> </table>	S. No.	Property	Requirement					
	S. No.	Property	Requirement						
	4.	Marking :- a. <i>Progressive automatic on-line sequential marking of length in meters to be provided at every one meter on outer sheath.</i>  b. Marking to read 'FRLS' to be provided at every 5 meters on outer sheath except for Type-C cable  c. Durable marking at intervals not exceeding 625 mm shall include manufacturer's name, insulation material, conductor's size, number of pairs, voltage rating, type of cable, year of manufacturer to be provided on outer sheath.							
	5.	Allowable Tolerance on overall diameter	+/- 2 mm (maximum) over the declared value in data sheet						
	6.	Variation in diameter	Not more than 1.0 mm throughout the length of cable.						
	7.	Ovality at any cross-section	Not more than 1.0 mm						
	8.	CAGE-CLAMP suitability	To be provided						
	9.	Color	The outer sheath shall be of blue color.						
	10.	Others	Repaired cables shall not be acceptable.						
	2.02.00	<b>Specific Requirements</b>							
<table border="1"> <thead> <tr> <th>Specification Requirements</th> <th>Type-A cable</th> <th>Type-B cable</th> <th>Type F &amp; G cable</th> <th>Type-C cable</th> </tr> </thead> </table>		Specification Requirements	Type-A cable	Type-B cable	Type F & G cable	Type-C cable			
Specification Requirements		Type-A cable	Type-B cable	Type F & G cable	Type-C cable				
<b>A. CONDUCTORS</b>									
Cross section area		0.5 sq. mm							
Conductor material		ANSI type KX	ANSI type SX	Annealed bare copper	ANSI type KX				
Colour code		Yellow-Red	Black-Red	As per VDE-815	Yellow-Red				
Conductor Grade		As per ANSI MC 96.1		Electrolytic	As per ANSI MC 96.1				
No & dia of strands		7x0.3 mm (nom)							
No. of Pairs	2	2	2/4/8/12/16/24 / 48	2					
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>		<b>PART-B SUB-SECTION-III-C4 INSTRUMENTATION CABLES</b>	<b>PAGE 2 OF 13</b>					


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	<b>Specification Requirements</b>	<b>Type-A cable</b>	<b>Type-B cable</b>	<b>Type F &amp; G cable</b>	<b>Type-C cable</b>
	Max. conductor loop resistance per Km (in ohm) at 20 deg. C	As per ANSI MC 96.1	73.4		As per ANSI MC 96.1
	Reference Standard	As per ANSI MC 96.1	VDE : 0815		As per ANSI MC 96.1
	<b>B. INSULATION</b>				
	Material	Extruded PVC type YI 3			Teflon (i.e. extruded FEP)
	Thickness in mm (Min/Max)	0.25/0.35			0.4 / 0.50 (nominal)
	Volume Resistivity (Min) in ohm-cm	1 x 10 <sup>14</sup> at 20 deg. C & 1x10 <sup>11</sup> at 70 deg. C.			2.8x 10 <sup>14</sup> at 20 deg. C & 2x10 <sup>11</sup> at 205 deg. C.
	<b>C. PAIRING &amp; TWISTING</b>				
	Max. lay of pairs (mm)	50			
	Single layer of binder tape on each pair provided	Each core printed with number or Numbered binder tape to be provided on each pair	Yes	Each core printed with number or Numbered binder tape to be provided on each pair	
	Bunch ( Unit Formation) for more than 4P	N.A	To be provided	N.A	
	Conductor /pair identification as per VDE0815	N.A.	To be provided	N.A.	
	<b>D. SHIELDING</b>				
	Type of shielding	Al-Mylar tape			
	Individual pair shielding	No	To be provided for F-type cable	No	
	Minimum thickness of Individual pair shielding	No	0.028mm (28 micron)	No	
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>		<b>PART-B SUB-SECTION-III-C4 INSTRUMENTATION CABLES</b>	<b>PAGE 3 OF 13</b>	





CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>				
	<b>Specification Requirements</b>	<b>Type-A cable</b>	<b>Type-B cable</b>	<b>Type F &amp; G cable</b>	<b>Type-C cable</b>
	Overall cable assembly shielding	To be provided			
	Minimum thickness of Overall cable assembly shielding	0.055 mm (55 micron)			
	Coverage / Overlapping	100% / 20%			
	Drain wire provided for individual shield	N.A.	Yes (for F-type) Size- 0.5 sqmm No of strands-7 Dia of strands- 0.3mm Annealed Tin coated copper	N.A.	
	Drain wire provided for overall shield	Yes, Size- 0.5 sqmm, No of strands-7, Dia of strands- 0.3mm, Annealed Tin coated copper			
	<b>E. FILLERS</b> (if applicable)				
	Non-hygroscopic, flame retardant	To be provided			
	<b>F. OUTER SHEATH</b>				
	Material	Extruded PVC compound YM1 with FRLS properties			Teflon (i.e. extruded FRP)
	Minimum Thickness at any point	1.8 mm			0.4 mm
	Nominal Thickness at any point	>1.8 mm			0.5 mm
	Resistant to water, fungus, termite & rodent attack	Required			
	Minimum Oxygen index as per ASTM-D-2863	29 %			N.A.
	Minimum Temperature index as per ASTM-D-	250 deg.C			N.A.
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	<b>Specification Requirements</b>	<b>Type-A cable</b>	<b>Type-B cable</b>	<b>Type F &amp; G cable</b>	<b>Type-C cable</b>
	2863				
	Maximum Acid gas generation by weight as per IEC-60754-1		20%		N.A.
	Maximum Smoke Density Rating as per ASTM-D-2843		60%	(defined as the average area under the curve when the results of smoke density test plotted on a curve indicating light absorption vs. time as per ASTM-D-2843)	N.A.
	Reference standard		VDE207 Part 5,VDE-816		VDE207 Part 6 ASTM D2116
	<b>G. Electrical Parameters</b>				
	Mutual Capacitance Between Conductors At 0.8 KHz (Max.)	200 nF/km		120 nF/km for F type 100 nF/km for G-type	200 nF/km
	Insulation Resistance (Min.)			100 M Ohm/Km	
	Cross Talk Figure (Min.) At 0.8 KHz	60 dB		60 dB	60dB
	Characteristic Impedance (Max) At 1 KHz	N.A.		320 OHM FOR F-TYPE 340 OHM FOR G-TYPE	N.A.
	Attenuation Figure At 1 KHz (Max)	N.A.		1.2 db/km	N.A.
	<b>H. COMPLETE CABLE</b>				
	Complete Cable assembly			Shall pass Swedish Chimney test as per SEN-SS 4241475 class F3.	N.A.
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	<b>Specification Requirements</b>	<b>Type-A cable</b>	<b>Type-B cable</b>	<b>Type F &amp; G cable</b>	<b>Type-C cable</b>
	Flammability	Shall pass flammability as per IEEE-383 read in conjunction to this specification			As per manufacturer's standard subject to employer's approval
	<b>I. CABLE DRUM</b>				
	Type	Non-returnable wooden drum (wooden drum to be constructed from seasoned wood free from defects with wood preservative applied to entire drum) or steel drum.			
	Length	1000 m $\pm$ 5% for up to & including 12 pairs 500 m $\pm$ 5% for above 12 pairs			
	Note: Heat resistant instrumentation cable shall have same specification as of G/F type instrumentation cable as specified above, except that insulation and outer sheath material shall be Teflon and cable shall be suitable for continuous operation at 205 Deg. C				
<b>3.00.00</b>  3.01.00  3.02.00  3.03.00  3.04.00  3.05.00	<b>SPECIFICATION OF OPTICAL FIBER CABLES (OFC)</b>  Optic Fiber cable shall be 4/8/12 core, Electrolytically chrome plated corrugated steel taped (ECCST), fully water blocked with dielectric central member for outdoor/indoor application so as to prevent any physical damage. The cable shall have multiple single-mode or multi mode fibers on as required basis so as to avoid the usage of any repeaters. The outer sheath shall have Flame Retardant, UV resistant properties and are to be identified with the manufacturer's name, year of manufacturer, progressive automatic sequential on-line marking of length in meters at every meter.  The cable core shall have suitable characteristics and strengthening for prevention of damage during pulling viz. Dielectric central member, Loose buffer tube design, 4 fibers per buffer tube (minimum), Interstices and buffer tubes duly filled with Thixotropic jelly etc. The cable shall be suitable for a maximum tensile force of 2000 N during installation, and once installed, a tensile force of 1000 N minimum. The compressive strength of cable shall be 3000 N minimum & crush resistance 4000 N minimum. The operating temperature shall be – 20 deg. C to 70 deg.C  All testing of the fiber optic cable being supplied shall be as per the relevant IEC, EIA and other international standards.  Bidder to ensure that minimum 100% cores are kept as spares in all types of optical fibre cables.  Cables shall be suitable for laying in conduits, ducts, trenches, racks and under ground buried installation.				
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3.06.00	Spliced / Repaired cables are not acceptable.																																															
3.07.00	Penetration of water resistance and impact resistance shall be as per IEC standard.																																															
4.00.00	<b>SPECIFICATION OF CONTROL &amp; POWER SUPPLY CABLES</b> Refer Electrical sub-sections																																															
5.00.00	<b>INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY</b> <p>The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group Junction Boxes (JBs) at strategic locations (where large concentration of signals are available, e.g. valves limit &amp; torque switches, switchgear) is done and consequently cable with higher number of pairs are extensively used. The details of termination to be followed are mentioned in the given Table A.</p> <p>TABLE A: CABLE TERMINATION TO BE FOLLOWED</p> <table border="1"> <thead> <tr> <th colspan="2">Application</th> <th colspan="2">Type Of Termination</th> <th rowspan="2">Type Of Cable</th> </tr> <tr> <th>FROM (A)</th> <th>TO (B)</th> <th>END A</th> <th>END B</th> </tr> </thead> <tbody> <tr> <td>Valves/dampers drives (Integral Junction box)</td> <td>Marshalling / Marshalling – cum Termination Cubicle / local group JB</td> <td>Plug in connector</td> <td>Post mount cage clamp type.</td> <td>G</td> </tr> <tr> <td>Transmitters, Process Actuated switches mounted in LIE/LIR</td> <td>Integral Junction box of LIE/LIR</td> <td>Plug in connector</td> <td>Cage clamp (Rail mount) type.</td> <td>F,G</td> </tr> <tr> <td>RTD heads</td> <td>Local junction box</td> <td>Plug in connector</td> <td>Cage clamp (Rail mount) type.</td> <td>F</td> </tr> <tr> <td>Thermocouple</td> <td>Local junction box / CJC box (if applicable)</td> <td>Plug in connector</td> <td>Cage clamp (Rail mount) type.</td> <td>A, B, C*</td> </tr> <tr> <td>Other Field mounted Instrument</td> <td>Local JB / Group JB</td> <td>Plug in connector</td> <td>Cage clamp (Rail mount) type.</td> <td>F,G</td> </tr> <tr> <td>RTD</td> <td>Temperature transmitter</td> <td>Plug in connector</td> <td>Screwed, Cage clamp type</td> <td>F</td> </tr> <tr> <td>Thermocouple</td> <td>Temperature transmitter</td> <td>Plug in connector</td> <td>Screwed, Cage clamp type</td> <td>A, B, C*</td> </tr> </tbody> </table>				Application		Type Of Termination		Type Of Cable	FROM (A)	TO (B)	END A	END B	Valves/dampers drives (Integral Junction box)	Marshalling / Marshalling – cum Termination Cubicle / local group JB	Plug in connector	Post mount cage clamp type.	G	Transmitters, Process Actuated switches mounted in LIE/LIR	Integral Junction box of LIE/LIR	Plug in connector	Cage clamp (Rail mount) type.	F,G	RTD heads	Local junction box	Plug in connector	Cage clamp (Rail mount) type.	F	Thermocouple	Local junction box / CJC box (if applicable)	Plug in connector	Cage clamp (Rail mount) type.	A, B, C*	Other Field mounted Instrument	Local JB / Group JB	Plug in connector	Cage clamp (Rail mount) type.	F,G	RTD	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	F	Thermocouple	Temperature transmitter	Plug in connector	Screwed, Cage clamp type	A, B, C*
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<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C4 INSTRUMENTATION CABLES</b>	<b>PAGE 8 OF 13</b>																																				


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<b>6.00.00</b> 6.01.00 6.02.00 6.03.00 6.04.00 6.05.00 <b>7.00.00</b> 7.01.00 7.02.00 7.03.00 7.04.00 7.05.00 7.06.00	<b>TERMINAL BLOCKS</b> All terminal blocks shall be rail mounted/post mounted, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg. C. The terminal blocks in field mounted junction boxes, temperature transmitters, instrument enclosures/racks, etc., shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room logic/termination/marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by the Bidder and the technical details of the same including width etc. shall be subject to Employer's approval. All the terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, transparent covers, support brackets, distance sleeves, warning label, marking, etc. The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc. All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks. For terminating each process actuated switches, drive actuators, control valves, Thermocouple, RTD, etc. in Local Junction Boxes, etc, refer Drg no. 0000-999-POI-A-065. The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls. <b>INTERNAL PANELS/ SYSTEM CABINETS WIRING</b> Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815. All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferrules at both ends. All wires directly connected to trip devices shall be distinguished by one additional red colour ferrule. All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points. All floor slots of desk/panels/cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables. All the special tools as may be required for solder less connections shall be provided by Bidder. Wire sizes to be utilised for internal wiring. (i) Current (4-20 mA), low voltage signals (48V); 0.5 Sq.mm. Ammeter/Voltmeter circuit, control switches etc. for electrical system.	<b>TECHNICAL SPECIFICATION</b> SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250	<b>PART-B</b> SUB-SECTION-III-C4 INSTRUMENTATION CABLES	<b>PAGE</b> 9 OF 13
<b>RGTPP HISAR (2X600 MW)</b> <b>FLUE GAS DESULPHURISATION (FGD)</b> <b>SYSTEM PACKAGE</b>				

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	(ii) Power supply and internal illumination. <span style="float: right;">2.5Sq.mm. minimum (shall be as per load requirement.)</span>		
<b>8.00.00</b>	<b>INSTRUMENTATION CABLE INSTALLATION AND ROUTING</b>		
8.01.00	All cables assigned to a particular duct/conduit shall be grouped and pulled in simultaneously using cable grips and suitable lubricants. Cables removed from one duct/conduit shall not be reused without approval of Employer.		
8.02.00	Cables shall be segregated as per IEEE Std.-422. In vertically stacked trays, the higher voltage cable shall be in higher position and instrumentation cable shall be in bottom tier of the tray stack. The distance between instrumentation cables and those of other system shall be as follows:		
	From 11 kV/6.6 kV/3.3 kV tray system	-	914 mm
	From 415V tray system	-	610 mm
	From control cable tray system	-	305 mm
8.03.00	Cables shall terminate in the enclosure through cable glands. All cable glands shall be properly gasketed. Sealing (to prevent ingress of dust entry and propagation of fire) shall be provided for all floor slots used for cable entrance. Compression cable glands (double for armoured and single for other cables) shall be provided.		
8.04.00	Not in use		
8.05.00	The cables emanating from redundant equipment/devices shall be routed through different paths. The above segregation of cables & wiring for redundant equipments/devices shall be in accordance with IEEE-Std-422.		
<b>9.00.00</b>	<b>CABLE LAYING AND ACCESSORIES</b>		
9.01.00	<b>CABLE LAYING</b> <ol style="list-style-type: none"> <li>1 Cables shall be laid strictly in line with cable schedule.</li> <li>2 Identification tags for cables.  Indelible tags to be provided at all terminations, on both sides of wall or floor crossing, on each conduit/duct/pipe entry/exit, and at every 20 m in cable trench/tray.</li> <li>3 Cable tray numbering and marking.  To be provided at every 10m and at each end of cable way &amp; branch connection.</li> <li>4 No jointing is permissible for Instrumentation cables. For other cables Jointing for more than 250 Meters run of cable shall be permitted.</li> <li>5 Buried cable protection</li> </ol>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C4 INSTRUMENTATION CABLES</b>	<b>PAGE 10 OF 13</b>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
9.02.00	<p>With concrete slabs; Route markers at every 20 Meters along the route &amp; at every bend.</p> <p>6 Road Crossings</p> <p>Cables to pass through buried high density PE pipes encased in PCC. At least 300 mm clearance shall be provided between</p> <ul style="list-style-type: none"> <li>- HT power &amp; LT power cables,</li> <li>- LT power &amp; LT control/instrumentation cables,</li> </ul> <p>Spacing between cables of same voltage grade shall be in accordance with the derating criteria adopted for cable sizing.</p> <p>7 Segregation (physical isolation to prevent fire jumping)</p> <ul style="list-style-type: none"> <li>a All cable associated with the unit shall be segregated from cables of other Units.</li> <li>b Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire.</li> </ul> <p>8 Cable clamping</p> <p>All cables laid on trays shall be neatly dressed up &amp; suitably clamped/tied to the tray. For cables in trefoil formation, trefoil clamps shall be provided.</p> <p>9 Optical fiber cables ( OFCs) :</p> <p>Outside Building Area - to be laid necessarily inside GI conduit with support from cable tray/Trestle structure</p> <p><b>Inside Building Area – to be laid on separate cable sub-trays</b></p> <p>While buried- in separate burried trench approx.1.0 meter depth, to be laid in 2” rodent proof HDPE conduits covered with sand, brick, laid breadth-wise and soil along the pipe line route by contractor;</p> <p>While crossing roads - to be laid in GI/ rodent proof HDPE conduits with sand filling at bottom and sand, soil filling at top with cement concrete;</p> <p>While crossing canals/river- to be laid in rodent proof HDPE conduits within hume pipe.</p> <p>10 <b>Laying of Network Cable (UTP/STP) :</b></p> <p><b>Out side Building Area- to be laid necessarily inside GI conduits with support from cable tray / Trestle structure.</b></p> <p><b>Inside Building Area- to be laid necessarily inside GI conduits on separate cable sub-trays.</b></p>	<p>Bidder shall supply and install all cable accessories and fittings like Light Interface Units, Surge suppressors, Opto isolators, Interface Converters, Fibre Optic Card Cage, Fibre Optic</p>	
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C4 INSTRUMENTATION CABLES</p>	<p>PAGE 11 OF 13</p>



CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>Line Driver, Repeater / Modem (for Optical Fibre Cables), cable glands, grommets, lugs, termination kits etc. on as required basis.</p>		
9.03.00	<p>Cables, which terminate in cabinets of draw out sections shall have sufficient cable coiled in the bottom of the cabinet to permit full withdrawal of draw out sections without disconnecting the cables. When prefabricated cables with factory connectors on both ends are longer than required, the excess cable shall be coiled in the bottom of one or both termination cabinets.</p>		
9.04.00	<p>The Bidder shall be responsible for proper grounding of all equipment under this package. Further, proper termination of cable shields shall be verified and the grounding of the same shall be coordinated so as to achieve grounding of all instrumentation cable shields at same potential. This shall be completed prior to system tests.</p>		
9.05.00	<p>The Contractor shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Contractor.</p>		
<b>10.00.00</b>	<p><b>FIELD MOUNTED LOCAL JUNCTION BOXES</b></p> <p>(i) No. of ways            12/24/36/48/64/72/96/128 with 20% spares terminals.</p> <p>(ii) Material            and    4mm thick Fiberglass Reinforced Polyester (FRP). Thickness</p> <p>(iii) Type                    Screwed at all four corners for door. Door gasket shall be of synthetic rubber.</p> <p>(iv) Mounting clamps    Suitable for mounting on walls, columns, structures etc. The and accessories        brackets, bolts, nuts, screws, glands required for erection shall be of SS, included in Bidders scope of supply.</p> <p>(v) Type of terminal      Rail mounted cage-clamp type suitable for conductor size upto blocks                      2.5 mm<sup>2</sup>. A M6 earthing stud shall be provided.</p> <p>(vi) Protection Class    IP: 55 minimum for indoor &amp; IP-65 minimum for outdoor applications.</p> <p>(vii) Grounding            To be provided.</p> <p>(viii) Color                 RAL 7035</p>		
<b>11.00.00</b>	<p><b>CONDUITS</b></p>		
11.01.00	<p>Conduits shall be generally used for interconnecting cables from field instruments to Local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanised rigid mild steel in accordance with IS: 9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant <b>terne coated steel</b> with , water leak, fire and rust proof protected <i>for the areas of Mills,Drum, Main Steam, RH steam Air Heaters and Furnace, BFPDT's</i> .</p>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C4 INSTRUMENTATION CABLES</p>	<p>PAGE 12 OF 13</p>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p><i>And for remaining applications, water leak, fire and rust proof flexible GI conduits shall be provided. The temperature rating of flexible conduit shall be suitable for actual application.</i></p> <p>11.02.00 All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied.</p> <p>11.03.00 Conduit sealing, explosion proof, dust proof and other types of special fittings shall be provided as required by these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors and in damp locations shall be sealed and gasketed. Hazardous area fittings and conduits sealing shall conform with NEC requirements for the area classification.</p> <p>11.04.00 Contractor shall provide double locknuts on all conduit terminations not provided with threaded hubs and couplings. Water tight conduit unions and rain tight conduit hubs shall be utilised for all the application which shall be exposed to weather. Moisture pockets shall be eliminated from conduits.</p> <p>11.05.00 Conduits shall be securely fastened to all boxes and cabinets.</p> <p><b>12.00.00 CABLE SUB-TRAY &amp; SUPPORT</b></p> <p>12.01.00 The cable sub-trays and the supporting system, to be generally used between Local/Group JB's and the main cable trays and the same shall be furnished and installed by the Contractor. It is the assembly of sections and associated fittings forming a rigid structural system used to support the cable from the equipment or instrument enclosure upto the main cable trays (trunk route).</p> <p>12.02.00 The covers on the cable sub-trays shall be used for protection of cables in areas where damage may occur from falling objects, welding spark, corrosive environment, etc. &amp; shall be electrically continuous and solidly grounded.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C4 INSTRUMENTATION CABLES</b>	<b>PAGE 13 OF 13</b>





SUB-SECTION-III-C5


DDCMIS


**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**


**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
1.00.00	<b>DISTRIBUTED DIGITAL CONTROL, MONITORING AND INFORMATION SYSTEM (DDCMIS)</b>		
1.01.00	<b>General Requirements</b>		
1.01.01	The requirements for Distributed Digital Control Monitoring and Information System (DDCMIS) are indicated on functional basis in this specification. Contractor shall be responsible for engineering, selection and connection of all components and sub-systems to form a complete system whose performance is in accordance with functional, hardware, parametric and other requirements of this specifications. It is not the intent or purpose of this specification to specify all individual system components since the Contractor has full responsibility for engineering and furnishing of a complete system.		
1.02.00	<b>System Configuration</b> DDCMIS shall basically consist of the following:		
1.02.01	Control System (including its Measurement system).		
1.02.02	Human-Machine Interface and Plant Information System (HMIPIS)		
1.02.03	System Programming & Documentation Facility		
1.02.04	Data Communication System		
1.02.05	Integrated OWS based Annunciation functions		
1.02.06	Time synchronization with Master clock		
	The basic configuration of DDCMIS shall be as indicated in the DDCMIS configuration drawing No. 0000-151-POI-A-013. Contract Quantities of the C&I System shall be as per Appendix-I to Part-A.		
1.03.00	<b>System Expandability</b>		
1.03.01	Modular System design shall be adopted to facilitate easy system expansion. The system shall have the capability and facility for expansion through the addition of controller modules, I/O cards, peripherals like operator workstations (OWS), printers etc. The system shall have the capability to add any new control loops, groups/subgroups logics in control system.		
1.04.00	<b>On-Line Maintenance</b>		
1.04.01	It shall be possible to remove/replace various modules online (like I/O module, interface module etc.) from its slot for maintenance purpose without switching off power supply to the corresponding rack. System design shall ensure that while doing so, undefined signaling and releases do not occur and controller operation in any way is not affected. Further, it shall also be possible to remove/replace any of the redundant controller module without switching off the power to the corresponding rack and this will not result in system disturbance or loss of any controller functions for the other controller. The on-line removal/insertion of controller, I/O modules etc. shall in no way jeopardize safety of plant and personnel.		
<b>RGTPP HISAR (2X600 MW)  FLUE GAS DESULPHURISATION (FGD)  SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION  SECTION – VI  BID DOC. NO.:  31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B  SUB-SECTION-III-C5  DDCMIS</b>	<b>PAGE  1 OF 23</b>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
1.05.00	<b>Fault Diagnostics</b>		
1.05.01	<p>The DDCMIS shall include on-line self-surveillance, monitoring and diagnostic facility so that a failure/malfunction can be diagnosed automatically and reported/indicated remotely on OWS/Programmer station. The failure/ malfunctions to be reported shall include:</p> <ul style="list-style-type: none"> <li>(a) Module level faults of control system.</li> <li>(b) Failure of HMIPIS bus/unit LAN, system bus, Local/Remote comm. Bus.</li> <li>(c) Power supply faults (Over voltage, under voltage, loss of input) for each feeder of power supply for system / marshalling/ relay and HMIPIS cabinets.</li> <li>(d) Software faults.</li> </ul> <p>These faults shall typically be reported as color change on system status display and messages on programmer station/ OWS as well as through local indication. The diagnostic system shall ensure that the faults are detected before any significant change in any controller output has taken place. Failure of any I/O modules, Controller etc. shall be annunciated to OWS. For I/O modules, these alarms shall be grouped, while for controller, comm. controller, power supply, these shall be individual. In case the faults are not acknowledged / rectified within certain interval, then the same shall be reported to predefined users through messaging system described subsequently in this subsection. The exact strategy of the messaging system shall be elaborated and finalised during detailed engineering.</p> <p>HMIPIS shall include on-line self surveillance, monitoring and diagnostic facility so that a failure/malfunction in any of the nodes, networking device as well as communication medium can be diagnosed on the programmer/engg. Work station/OWS.</p>		
1.06.00	<b>Fault Tolerance &amp; Controllability</b>		
1.06.01	<p>The DDCMIS shall provide safe operation under all plant disturbances and on component failure so that under no condition the safety of plant, personnel or equipment is jeopardised. Control System shall be designed to prevent abnormal swings due to loss of Control System power supply, failure of any Control System component, open circuits/short circuits, instrument air supply failure etc. On any of these failures the control system output shall either remain in last position before failure or shall come to fully open/close or on/off state as required for the safety of plant/personnel/equipment and as finalised during detailed engineering. System shall be designed such that there will be no upset when Power is restored.</p>		
1.06.02	<p>I/O modules shall have protection so that any fault in sensor &amp; its wiring upto I/O module like open/short circuit, earth fault affects only that channel of I/O module. Other channels of that I/O module or other modules or other parts of system shall not be affected in any way.</p>		
1.06.03	<p>No single failure either of equipment or power source shall be capable of rendering any part/system/sub-system of DDCMIS inoperative to any degree. No single failure in HMIPIS shall lead to non-availability of more than one OWS. In such an event i.e., single failure leading to non-availability of any OWS, it shall be possible to operate the entire plant in all regimes of operation including emergency conditions from each of the other available OWS.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C5 DDCMIS</b>	<b>PAGE 2 OF 23</b>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
1.06.04	<p>In order to achieve above, following shall be redundant with automatic change-over (including the associated software), as a minimum:</p> <ul style="list-style-type: none"> <li>• Controller, Comm. Controllers, HMIPIS bus/Unit LAN, System bus, Local/Remote communication bus.</li> <li>• Power supply arrangement (feeders/modules)</li> <li>• Output modules.</li> <li>• Servers/information work stations</li> </ul> <p>However, following need not be redundant:</p> <ul style="list-style-type: none"> <li>• I/O bus, (if it is a backplane bus &amp; extension/joining of such backplane buses cabinet/adjacent cabinet) and input modules.</li> </ul>		
1.06.05	<p>The system design shall ensure that no single failure, whatsoever in any part of DDCMIS result in loss of communication except communication between HMI and control system, for which loss of communication upto a maximum of five seconds is acceptable. However, during this period, the control system shall remain fully functional and this event shall not create any disturbance/malfunction whatsoever (e.g., accumulation of control commands, issue of spurious commands/signals etc.).</p>		
1.07.00	<p><b>Signal Exchange</b></p> <p>All the signal exchange between various functional groups of each control systems shall be implemented through redundant system bus.</p>		
1.08.00	<p><b>System Spare Capacity</b></p>		
1.08.01	<p>For Control system spare capacity, refer Control System Spare Capacity as mentioned in Part A, Section VI of technical specification.</p> <p>For HMIPIS spare capacity, refer Appendix-I to Part A, Section VI of technical specification.</p>		
2.00.00	<p><b>SYSTEM DESCRIPTION</b></p>		
2.01.00	<p>The DDCMIS shall include following main constituents. (Also refer DDCMIS configuration drg.no. 0000-151-POI-A-013). The DDCMIS shall work in full integration and conjunction with field equipment/drives like pumps, motors, valves, actuators, dampers, hydraulic control systems and field instruments.</p>		
2.02.00	<p><b>Control System</b></p>		
2.02.01	<p>The Control system along with its measurement system shall perform functions of closed loop control, sequence control, interlock &amp; protection of the Plant and auxiliaries in all regimes of its operation.</p>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C5 DDCMIS</p>	<p>PAGE 3 OF 23</p>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
2.02.02	<p>The measurement system of control system shall perform the functions of signal acquisition, conditioning and signal distribution of various types of inputs/outputs like analog, (4-20 mA DC- either from pressure / DP/ flow / level transmitters, analysers etc. as well as from temperature transmitters for all temperature) measurements from thermocouple, RTD to be connected to this system), binary, pulse, digital transmission through serial port, bus connection etc. (from remote I/O etc., Through various industry standard protect including MODBUS/FIELDBUS/PROFIBUS, prefabs freed and Ethernet etc. The inputs, which are required for only information &amp; monitoring purposes, shall be distributed suitably in various groups plant area-wise.</p>		
2.02.03	<p>The control system shall also perform logic &amp; computation for annunciation functions.</p>		
2.02.04	<p>The control system hardware (controllers, modules/cards etc.) shall be housed in cabinets located in FGD common control room and offsite except for the remote I/O cubicles (as specified in Part-A) which shall be located in respective areas.</p>		
2.03.00	<p><b>Human-Machine Interface and Plant Information System (HMIPIS)</b></p>		
2.03.01	<p>Functionality/features mentioned for HMIPIS in this specification are also applicable for unified HMIPIS. The HMIPIS shall perform control, monitoring and operation of the Plant and auxiliaries in all regimes of its operation, interacting with the Control System. For this, HMIPIS shall primarily perform following functions:</p>		
2.03.02	<p>Operator interface for Control System</p>		
2.03.03	<p>Plant Supervisory functions like displays, alarm monitoring &amp; reporting, reports &amp; logs, calculations, trend recording, historical and long term data storage &amp; retrieval, etc.</p>		
2.04.00	<p><b>System Programming &amp; Documentation Facility</b></p>		
2.04.01	<p>The programmer stations shall be provided for On-line configuration &amp; tuning of Control System and On-line program development/modifications in HMIPIS.</p>		
2.04.02	<p>A work-station based system documentation facility shall be provided to generate retrieve store &amp; all system documentation, logic, control loops, cable interconnection, etc. to achieve paperless documentation for the complete plant.</p>		
2.05.00	<p><b>Data Communication System (DCS)</b></p>		
2.05.01	<p>The Data Communication System shall be provided for communication between Control System and HMIPIS, communication &amp; signal exchange between various functional groups as well as communication between various units &amp; off site / off line systems.</p>		
2.06.00	<p><b>Annunciation System</b></p> <p>The annunciation logic will be implemented as a part of DDCMIS and annunciation shall be made available on all OWS.</p>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C5 DDCMIS</p>	<p>PAGE 4 OF 23</p>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
2.07.00	<b>Power supply:</b>		
2.07.01	<p>Power supply of control system shall be based on 24V DC. The Power supply along with its associated circuitry is intended to provide the following functionalities</p> <p>(a) Isolation between input &amp; output side and distribution.</p> <p>(b) Multiple voltages as required by various modules as well as integration/supply voltage to field devices.</p> <p>(c) Auctioneering of dual voltages.</p> <p>(d) Providing stabilized/regulated power to Control System, taking care of input power supply variations.</p>		
2.07.02	<p>The Control System shall be fed from 24V DC power supply system (please refer power supply section of specification). The complete Control System, including power supply for various modules &amp; field interrogation, shall be through regulated power supply using power supply modules/packs. Further, the monitoring of individual feeders of input power supply shall be done as specified at clause 1.05.01 (c) of III-C5.</p>		
3.00.00	<b>MEASUREMENT FUNCTIONS OF CONTROL SYSTEM</b>		
3.01.00	<p>The input / output modules employed in the Control System shall be separate from controller hardware.</p>		
3.01.01	<p>The functions listed below shall generally be performed in I/O modules. However, some of the functions can be implemented in the controllers.</p>		
3.01.02	<p><b>FIELD BUS ((Foundation Fieldbus/ Profibus) Interface</b></p> <p>For interfacing fieldbus compatible field devices/ actuators, Foundation Fieldbus/Profibus interface modules, power supply, field cables (armoured) and other accessories shall be provided. The design of fieldbus interfacing scheme, from field to Controller shall comply with all requirements of latest version of standards for Foundation Fieldbus/Profibus viz. IEC 61158. All required libraries to execute various tasks like data acquisition, control/protection etc shall be provided. Redundant host/ master card and redundant power supply along with diagnostic module shall be provided. For detailed fieldbus design guidelines, refer Annexure-III-C-05K, Part-B, Section-VI.</p> <p>The Contractor shall present complete implementation scheme, including wiring scheme during detailed engineering stage for review &amp; approval by Employer.</p>		
3.02.00	<b>Analog signal conditioning &amp; processing</b>		
3.02.01	<p>The conditioning and processing functions to be performed as a minimum for the analog inputs coming for control and information purposes are:</p> <p>1. : Galvanic isolation of input and output signals for which power supply source is other than the measurement system of the control system.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C5 DDCMIS</b>	<b>PAGE 5 OF 23</b>





CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
3.02.02	<p>2. : Transmitter power supply with per point fuse protection or current limiting and power supply monitoring.</p> <p>3. : Monitor sensor wire break/open circuit/short circuit and take suitable actions in logic/loop. (This will include blocking of trip signals in case of RTD failure).</p> <p>All analog signals for control purpose shall be acquired, validated, processed and their respective Controller data base updated at a maximum interval of 250 milli seconds except for some fast-acting control loops for which the above-referred time shall be as per process requirement. For signals required for information only, the above functions shall be performed at an interval of 1 seconds. The HMI database updation shall not take more than one (1) second. The validated analog inputs shall be converted into engineering units on a per point basis. Analog input processing (scanning to alarm checking) shall be performed once every scan cycle. It shall be possible to manually disable any analog input either through deleting from scan or substitution from HMI.</p>		
3.02.03	<p>For Unit DDCMIS, the analog 4-20 mA input cards shall have input resistance <math>\geq</math> 250 ohm inside the card/FTA (as applicable) for interfacing transmitters/analysers/temp. signals (through temp transmitters) giving 4-20mA analog signal along with superimposed HART interface signals. 4-20 mA DC signal will only be used for control purpose and superimposed HART signal will be used for configuration, maintenance, diagnostic and record keeping facility for electronic transmitters and Analysers etc.</p>		
3.03.00	<p><b>Binary signal conditioning &amp; processing</b></p>		
3.03.01	<p>The binary inputs shall be wired either in form of changeover type contacts (i.e. 'NC' + 'NO' together) or non-changeover type Contact ('NC' or 'NO') depending on the process requirement.</p>		
3.03.02	<p>The conditioning and processing functions to be performed as a minimum for the binary inputs coming for control and information purposes are:</p> <ol style="list-style-type: none"> <li>1. : 24 VDC power supply for contact interrogation for all potential free contacts with per point fuse protection or suitable current limit feature/ isolation through opto-coupler.</li> <li>2. : Contact bounce filtering. (The field contact which is changing state must remain in the new state for the filter delay time to be reported as one event). The filter delay time should be suitable for the field input &amp; its scan rate.</li> <li>3. : Facility for automatic pegging the binary signal to logic one/zero or last correct value in case of failure of binary input module.</li> <li>4. : All binary signals shall be acquired validated, processed, alarm checked and their data base updated within one second.</li> <li>5. : It shall be possible to manually disable any binary input either through deleting from scan or substitution from HMI.</li> <li>6. : The non-coincidence monitoring shall be provided for binary inputs for all changeover signals.</li> </ol>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C5 DDCMIS</p>	<p>PAGE 6 OF 23</p>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
3.04.00	<b>Multiple Measurement Scheme</b>		
3.04.01	Triple / Dual measurement schemes shall be provided for triple / dual redundant sensors used in closed loop and open loop controls.		
3.04.02	The triple / dual measurement schemes for closed loop control shall provide median / average outputs. The operator shall be able to select any of the transmitters or the median/average value from the OWS.		
3.04.03	The sensors for multiple measurement schemes for open loop controls shall always be in service (except when gone Bad) and operator shall not be able to select / deselect any of the sensors. Further, measurement scheme shall be implemented considering safety / availability aspects.		
3.04.04	Individual transmitter signals, their status and selected value for control/ measurement and shall be available on OWS in the CLCS displays and the popups		
3.05.00	<b>Wiring Scheme for inputs to control system</b>		
3.05.01	<p>Each of the triple redundant binary &amp; analog inputs shall be wired to separate input modules. Similarly each of the dual redundant binary &amp; analog inputs shall be wired to separate input modules. Implementation of multiple measurement schemes of these inputs will be performed in the redundant hardware. Loss of one input module shall not affect the signal to other modules. Other channels of these modules can be used by other inputs of the same functional group.</p> <p>No single failure in any component of the control system shall lead to unavailability of more than one of dual/triple redundant input signals to control system. Similarly, no single failure in any component of the control system shall lead to unavailability of more than one of dual/triple redundant Output signals from the control system.</p>		
3.05.02	<p>The single (i.e. non-redundant) binary &amp; analog signal required for control purposes shall be wired as follows:</p> <ol style="list-style-type: none"> <li>1. The on-off status of HT drives and synch type breakers shall be wired to two input modules in parallel.</li> <li>2. Triple/dual analog sensors are required both in CLCS and OLCS for control purpose, then all of these triple/dual sensors shall be wired to the controller where CLCS loop is configured. If based on the same set of sensors, any protection action is required in OLCS (e.g., protection stop of drive) in another controller(s), then CLCS Controller shall provide three digital outputs for each such controller from three separate output modules (at defined LVM-Limit Value Monitor blocks inside Controller). The three such digital outputs of CLCS controller shall be acquired in each of the OLCS controllers in three separate digital input modules. Similar philosophy will be used when triple/dual analog sensors are required in OLCS in multiple controllers for protection function.</li> </ol>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C5 DDCMIS</b>	<b>PAGE 7 OF 23</b>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>																										
3.06.00	<p>3. If triple/dual/single binary sensors are required in OLCS in multiple controllers for protection function in these controllers, each of these sensors shall be shared among these controllers. Each of these sensors shall be directly shared from marshalling TBs without any 'active' multiplying hardware ('active' defined as hardware which requires a separate power supply for its functioning). Further, removal/insertion of any of such multiple modules shall not affect availability of such signal(s) to other modules.</p> <p>4. The input sharing scheme shall be subject to Employer's approval during detailed engineering.</p> <p><b>Remote Input output modules and cubicles</b></p> <p>It is envisaged to use remote I/O modules in various plant areas. The remote I/O signals shall be connected to the respective functional groups through redundant extended I/O bus as indicated in the Contract quantities for DDCMIS. The hardware independence of functional groups mentioned elsewhere in specification shall be applicable for remote I/O as well.</p> <p>The remote input/output modules shall be located in cubicles in respective areas. Remote input/output modules may be located in harsh environment, the modules shall be designed in such a way to work continuously under the harsh environment expected to be encountered in these areas (high temp, dust level, humidity etc.). It shall be ensured that extending of I/O bus of functional group in field does not result in false signaling /noise pickups. Further, it shall in no way deteriorate the performance of that functional group and Control System.</p>																										
3.06.01	Power supply arrangement for these cubicles shall be similar to DDCMIS system cabinets.																										
3.07.00	<p>The maximum number of inputs/outputs to be connected to each type of module shall be as follows:</p> <table border="0"> <tr> <td>1</td> <td>:</td> <td>Analog input module</td> <td>16</td> </tr> <tr> <td>2</td> <td>:</td> <td>Analog output module</td> <td>16</td> </tr> <tr> <td>3</td> <td>:</td> <td>Binary input module</td> <td>32</td> </tr> <tr> <td>4</td> <td>:</td> <td>Binary output module</td> <td>32</td> </tr> <tr> <td>5</td> <td>:</td> <td>Analog input &amp; output (combined) module</td> <td>16</td> </tr> <tr> <td>6</td> <td>:</td> <td>Binary input and output (combined) module</td> <td>32</td> </tr> </table> <p>Note: For binary inputs, one changeover contact is counted as 2 inputs (refer clause 3.03.01, PART-B Sub section III-C5).</p>	1	:	Analog input module	16	2	:	Analog output module	16	3	:	Binary input module	32	4	:	Binary output module	32	5	:	Analog input & output (combined) module	16	6	:	Binary input and output (combined) module	32		
1	:	Analog input module	16																								
2	:	Analog output module	16																								
3	:	Binary input module	32																								
4	:	Binary output module	32																								
5	:	Analog input & output (combined) module	16																								
6	:	Binary input and output (combined) module	32																								
3.08.00	The following requirements shall be met for analog/binary input/output modules as applicable.																										
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
3.08.01	Input filters to attenuate noise shall be provided.		
3.08.02	All analog outputs shall be short circuit proof.		
3.09.00	The Control Desk mounted hardwired devices & stations shall be interfaced through the I/O modules. No signal multiplication shall be done at marshalling end input termination end.		
<b>4.00.00</b>	<b>CONTROL SYSTEM REQUIREMENTS</b>		
4.01.00	The control system shall be broadly divided into the followings:-		
4.01.01	<ul style="list-style-type: none"> <li>(i) Close Loop Control System (CLCS) - Modulating control functions for various applications including individual control and operation of modulating drives.</li> <li>(ii) Open Loop Control System (OLCS) - Binary control functions pertaining to sequence / interlock / protection of plant auxiliaries for various applications including individual control and operation of binary drives.</li> <li>(iii) Performing logic &amp; computation for annunciation functions &amp; other miscellaneous Controls, signal processing etc.</li> </ul>		
4.01.02	The number of Functional Groups (FGs) which are derived from the above mentioned guideline are the minimum required. For each of the FGs, separate sets of controllers, I/O modules, communication controllers, power packs/ modules etc. shall be provided. Mixing of hardware of two or more FGs shall not be acceptable. However, splitting of any functional group in more than one FGs due to any limitation in Contractor's system (e.g. limitation in handling number of inputs/outputs including spare capacity, limitation in implementation of number of functional blocks including spare blocks etc.) shall be acceptable, subject to Employer's approval. It may be noted that after splitting of the functional groups, each FG must have its own set of controllers, I/O modules, etc. It shall be ensured that failure of any set(s) of hardware of any FG does not affect other FG(s) and data communication between other FG(s) and HMIPIS. Each FG can have one or more set of controllers, if supported by standard design of the offered system.		
4.01.03	The Contractor shall provide all hardware/software, whether or not specifically indicated in this specification to fully meet operational/maintenance/ safety requirement as well as statutory/international standard and proven practices.		
4.01.04	The Control System shall function reliably under the environmental conditions as specified in Sub-Section:- Basic Design Criteria of this specification. It shall be immune from the interference resulting from disturbances in power supply feeders, signals lines, inputs, outputs etc. as experienced in a coal fired power station. It shall be able to withstand power line disturbances.		
4.01.05	The Control System shall have on-line simulation & testing facility.		
4.01.06	The system shall have the flexibility to easily reconfigure any controller at any time without requiring additional hardware or system wiring changes and without disabling other devices from their normal operation mode. Modifications shall not require switching off power to any part of the system.		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
4.01.07	Power supply to individual functional group shall be from redundant 24V feeders with diode auctioneering and further sub-distribution.		
4.01.08	The assignment of I/O channels for Inputs/Outputs, arrangement of modules within cabinet etc. shall be identical for all units except those inputs/outputs which are common for all units. Further uniformity should be maintained for redundant stream of process equipment within a unit.		
4.01.09	The application programs for the functional controllers shall be software based which shall be maintained even through power supply failure.		
4.01.10	Independent and dedicated controllers (main and its 100% standby) shall be provided for each of the functional group (FG) of Control System except for the cases where triple redundant controllers are to be used as per this specifications. All the 100% hot redundant backup controllers shall be identical in hardware and software implementation to their corresponding main controllers and shall be able to perform all its tasks. The backup controller shall track its corresponding main controller. There shall be an automatic and bumpless switchover from the main controller to its corresponding backup controller in case of main controller failure and vice versa without resulting in any change in control status. In case of switchover from main controller to the 100% hot backup controller, the back-up controller shall work as the main controller. Further, when only one controller is working and other controller is inserted on line (for example after repair/replacement), there should not be any degradation in the function of the working controller & control operation.		
4.01.11	The loop/logic reaction time (from change of input to input module to the corresponding control command output) shall be suitable to match actual process requirements, subject to minimum requirement wherever specified.		
4.02.00	<b>Binary Controls/Open Loop Control System (OLCS) Functions</b>		
4.02.01	These clauses are applicable for all the Binary controls of DDCMIS included in Contractor's Scope.		
4.02.02	The OLCS shall include sequence control, interlock & protection for various plant auxiliaries/valves/dampers/drives etc. The sequence control shall provide safe and automatic startup and shutdown of plant and of plant items associated with a plant group. The interlock and protection system shall ensure safe operation of plant/plant items at all times and shall automatically shut down plant/plant items when unsafe conditions arise.		
4.02.03	The OLCS shall be arranged in the hierarchical control structure consisting of unit level, group level, subgroup level & drive level (as applicable).		
4.02.04	The group level shall control a set of functional sub-groups of drives. Appropriate start-up and shut down commands shall be issued to the sub-group control and various check-backs shall be received from sub-groups or drives. Each sub-group shall execute the sequential start-up and shut down programs of a set of inter-related drives along with system interlocks and protections associated with that sub-group as well as basic interlocks and protections related to individual drive falling under that sub-group. The drive level shall accept commands from the sub-groups, push buttons (wherever provided), etc., and transmit them		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
4.02.05	<p>to the respective drive, after taking into account various per missives and protections of that particular drive. For HT and other critical drives, first-up logic shall be incorporated to indicate the cause of protection/trip.</p> <p><b>Sequence Control</b></p> <p>(a.) A sequence shall be used to move a set of groups, sub-groups from an initial steady state (for instance 'OFF') to a final steady state (for instance 'ON'). The sequence initiating command for the unit &amp; group level shall be issued from OWS.</p> <p>(b.) A sequence shall be made of steps. The steps shall be executed in predetermined order according to logic criteria and monitoring time consisting of the interlock &amp; protection requirements and check back of previous step which shall act as preconditions before the sequence control can execute the command for that step.</p> <p>(c.) Each step shall have a "waiting time" implying that the subsequent step would not be executed unless the specified time elapses. A monitoring time shall also be defined as the maximum time required in executing the commands of any step and the time required for appearance of check back signals. In case, this is not completed within the specified time, a message shall be displayed and program will not proceed further.</p> <p>(d.) Manual intervention shall be possible at any stage of operation and the sequence control shall be able to continue at the correct point in the program on return to automatic control. Protection commands shall have priority over manual commands, and manual commands shall prevail over auto commands.</p> <p>(e.) Open or close priority shall be selectable for each drive.</p> <p>(f.) The sequence startup mode shall be of the following types.</p> <ul style="list-style-type: none"> <li>i) Automatic Mode</li> <li>ii) Semi-Automatic Mode</li> <li>iii) Operator Guide Mode/Test Mode</li> </ul>		
4.02.06	<p>For the drives, the command shall be provided through O/P module to the coupling relays in MCC/SWGR/Actuator/Relay Cabinets as applicable and inputs (status, SWGR &amp; process) shall be acquired through input modules. Redundancy in drive outputs shall be provided for drives, as quantified in Part-A). The failure of one of the redundant, output module shall in no way affect the function of the other output module, wherever redundancy is provided.</p>		
4.02.07	<p>The output modules shall have the feature that ensures that in case of failure, all the outputs are driven to zero. The 24V DC command outputs to drives for ON/OPEN, OFF/CLOSE shall be separate and independent and inverted outputs shall not be employed. Live +24V DC outputs shall be provided to MCC/SWGR/ actuator as applicable when command is to be issued. Keeping +24V DC extended to the relays for these outputs continuously &amp; extending ground/negative when command is to be issued, is not acceptable except some of the auxiliary plants as to be decided during detailed Engineering.</p>		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
4.02.08	For inching type of drives, position transmitter power supply and monitoring of position transmitter signal shall be provided.		
4.02.09	The sequence interlock & protection requirements shall be finalised during detailed engineering and the same shall be subject to Employer's approval.		
4.02.10	The drive function i.e. basic interlock & protection logic of the drive shall be implemented in redundant controllers. The drive function shall ensure that protection signals for the safety of the drive shall be effective under all conditions and under all modes of operation. The different commands shall be performed according to the priority of protection 'Off', Protection 'On', manual and automatic. The standard functions like running time monitoring, status signaling, alarm/drive annunciation, etc. shall be performed in drive function. The drive function shall prevent hunting of the actuator in the presence of both open & close commands for actuators of the valves & dampers. The drive function shall be implemented in dedicated standard software functional block (drive macros).		
4.02.11	It shall be possible to control all common system drives (i.e. common for more than one units), from all or some of the units.		
4.03.00	<b>Modulating Controls/Closed Loop Control System (CLCS) Functions</b>		
4.03.01	This Clause is applicable for all analog controls of DDCMIS.		
4.03.02	The CLCS shall continuously act on valves, dampers or other mechanical modulating devices such as hydraulic couplings etc., which alter the plant operation conditions. The system shall be designed to give stable control action in steady state condition and for load changes in step/ramp over the load range of 60% to 100% MCR. The system shall have the following minimum features :		
4.03.03	The controller capability shall, as a minimum, include (i) P, PI, PD and PID control functions and their variations (ii) cascade control (iii) feed forward control (iv) On-Off control, (v) Ratio and bias control, (vi) Logical operation. Other advanced control strategy like adaptive & predictive control etc. can be considered for important loops like Furnace Draft, combustion control, FW flow control etc. in addition to SH/RH temperature control.		
4.03.04	The control loop shall have enough flexibility and various features to perform feed forward, balancing of controller, increasing the response to achieve the desired process parameter within prescribed time frame.		
4.03.05	The control system shall be bumplessly transferred to manual on the conditions of Control power supply failure, Failure of redundant controllers, Field input signal not available, Analog input and / or deviation exceeding preset value, etc. as a minimum and as finalised during detailed engineering.		
4.03.06	Any switch over from auto to manual, manual to auto and switchover from OWS operation to H/A station operation and vice versa shall be bumpless and without resulting in any change in the plant regulations and the same shall be reported to the operator and recorded automatically.		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
4.03.07	<p>Analog output (positioning signal) of 4-20mADC shall be provided from CLCS to the respective microprocessor based positioner E/P converters / electrical actuators as applicable. Redundancy in drive outputs shall be provided for drives as quantified in Part-A. The failure of one of the redundant, output module shall in no way affect the function of the other output module, wherever redundancy is provided. CLCS shall also provide all the necessary outputs for indicators and other devices with output loop resistance of 500 ohms for each channel of the output module.</p>		
4.03.08	<p>The System being supplied shall be such that when permissible limits are exceeded, an automatic switchover from an operation governed by maximum efficiency, to an operation governed by safety and availability is affected.</p>		
4.03.09	<p>For safety reasons, switchover logics associated with the modulating control loops shall be performed within the same controller. Modulating control loops shall be provided with standard features to interface overriding commands from OLCS/SG/TG Protection System like open, protection open etc.</p>		
4.03.10	<p>All controllers shall be freely configurable with respect to requisite control algorithms.</p>		
<b>5.00.00</b>	<p><b>HUMAN-MACHINE INTERFACE AND PLANT INFORMATION SYSTEM (HMIPIS) REQUIREMENTS</b></p>		
5.01.00	<p><b>Operator interface to the Control System</b></p>		
5.01.01	<p>The following functions shall be provided as a minimum:</p> <p>All OWS of the HMIPIS shall be fully interchangeable i.e. all operator functions including control, monitoring and operation of any plant area or drive shall be possible from any of the OWS at any point of time without the necessity of any action like downloading of additional files.</p>		
5.01.02	<p>Further, simultaneous operation (availability of popup window/faceplate) of multiple drives of control system shall be possible from a single display.</p>		
5.01.03	<p>The system shall have built-in safety features that will allow/disallow certain functions and entry fields within a function to be under password control to protect against inadvertent and unauthorised use of these functions. Assignment of allowable functions and entry fields shall be on the basis of user profile. The system security shall contain various user levels with specific rights which shall be as finalized by the Employer during detailed engineering. However, no. of user levels, no. of users in a level and rights for each level shall be changeable by the programmer (Administrator). The users created for a particular user level shall be specific to a DDCMIS. Hence, a user of one DDCMIS shall not be able to exercise the same privileges in other DDCMIS(s). The rights of each user shall contain two types of privileges as follows :-</p> <ul style="list-style-type: none"> <li>a) Privileges for the DDCMIS</li> <li>b) Privileges for the Operating System features.</li> </ul>		
5.01.04	<p>Typically following user levels shall be available:</p> <ul style="list-style-type: none"> <li>a) Operator</li> </ul>		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<p>5.01.05</p>	<p>b) Supervisor</p> <p>c) Maintenance Engineer</p> <p>d) Programmer</p> <p>e) Shift Incharge/Station Incharge/other Monitoring Users.</p> <p>The system shall have functionality to configure view only privilege of any sub-system from HMI of any other sub-system. In case Cross HMI operation is applicable as per Part-A, it shall be possible to enable/disable operation of any valve or drive or area belonging to any sub-system from the HMI of any other sub-systems by a supervisory command through station LAN. Such control shall be based on a pre-engineered list and as per pre-predefined priority hierarchy. In case, cross HMI operation privilege is not available for a particular drive/area and still an operation is attempted for the drive/area then a suitable regret message should be displayed in HMI to the operator. It shall be possible to modify the list at site under Maintenance Engineers/ Administrator's right.</p> <p>The Contractor shall implement all necessary logics &amp; selection facility in Control System/HMIPIS for the same with safeguard to prevent multiple operations simultaneously. Status &amp; other signals related to the drive and the selection by any other user shall be made available to other users.</p>		
<p>5.02.00</p>	<p>The following functions shall be provided:</p> <p>a) Calculations: Basic calculations like time of max./min., number of transgression of a point in a band etc. shall be provided. Same can be implemented in control system also. These calculated points shall be capable of being assigned to any functions like any other scanned point.</p> <p>b) Displays such as mimics, bar chart displays, X-t plots with various update rates using the data from historian, X-Y plots (with superimposed operating curves).</p> <p>c) Control related displays like faceplates for different types of drives, sequence displays, drive level displays (pop-ups giving details of auto/ protection/ permissive condition/ faults), control type display (giving details of A/M selection, tagout / maintenance mode, process value, set point, deviation, command output, position feedback etc). Further, CLCS displays giving the single line diagram of the control loop shall be provided.</p> <p>d) System status displays: This will provide an indication of the faults in a graphical form.</p>		
<p>5.02.01</p>	<p><b>OWS Annunciation Display</b></p> <p>The OWS annunciation will replicate in software the salient features of conventional hardware annunciations facia (for permanent viewing i.e., not operator changeable) while presenting more flexibility. This annunciation shall include both the process alarms as well as system alarms. The top area of the OWS (around 20-25%), shall be reserved for these display.</p> <p>The annunciation system shall be implemented as an in-built function of DDCMIS. The field contacts shall be acquired through DDCMIS only. The annunciation points will be presented on topmost area of mimics display. The annunciation area will be divided in three (3) "alarm bands". The annunciation sequence shall be as discussed and finalized during detailed engineering.</p>		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
5.02.02	<p>Bidder shall implement the annunciation functionality as described below as a minimum.</p> <p>There will be one alarm for each alarm window. Grouped alarms shall be provided only for pre-defined system / field faults like non-coincidence, monitoring etc. The alarm text is to be displayed only when that alarm is present. A “tool-tip” will be associated with each alarm window, which will show tag no. of alarm point when cursor is brought over alarm window.</p> <p>Hooters/Speakers of different audio types shall be available for reporting new alarms and resetting of alarms (corresponding to slow flash) etc shall be available. All flashing windows shall flash together (synchronized) in any screen. Suitable means shall be provided to distinguish new alarms and return to normal messages.</p> <p>Annunciation points shall be distributed on various stations based on process area. That is, each annunciation point will be assigned screen no.(s) and an alarm band no. A particular point can be assigned more than one station also.</p> <p>No fixed space will be reserved for any alarm on any of the band. Once a particular alarm band is full, the new alarm in that band will be reported by automatic shifting of the older alarm(s) on left side of band one by one in FIFO fashion. Scroll buttons shall be provided on both the sides to view the alarms in a particular band after the particular band is full.</p> <p>The scroll button will fast flash when scrolled alarms are fast flashing, will slow flash when alarms are slow flashing and will be steady when alarms are steady. When scrolled alarms are of mixed type, the scroll bar will flash with highest flashing rate of scrolled alarms.</p> <p>When operator right clicks on alarm area, he will get a menu with following options (i) acknowledge all- to acknowledge all new alarm(s) (ii) reset all- to reset all alarm(s) returning to normal (iii) acknowledge point- to acknowledge the particular point in alarm (iv) reset- to reset the particular point in alarm (v) Root Cause – To link to Alarm Analysis result for that particular tag (vi) “configuration utility”- to view and edit alarm list, tag nos., etc of all points in all stations (vii) closing the annunciation display. This menu can be dragged &amp; placed anywhere on station screen. The actions (i), (ii), (iii), (iv) and (v) can be done by operator but action (vi) &amp; (vii) will be permitted only to Programmer. The hooter sounds will be different for each of the Unit of power plant, when there is common control room for multiple Units.</p> <p>Bidder shall provide suitable “configuration utility” for viewing and modifying list of all alarms (process and system) to be displayed on all annunciation area, band color, text color, flashing color and frequency, font, etc.</p>		
5.03.00	<p>Facility of separate individual pop-up window for 30 critical alarms (to be decided during detail engineering) over the active mimic display, in OWS is to be provided. The pop-up window should require operator intervention to close. Pop-up window of one critical alarm should not overlap with any other critical alarm pop-up. The size of the pop-up window, colour of description and size of font shall be decided during detail engineering.</p>		
5.04.00	<p>Facility of time activated logs (Daily &amp; Shift logs), event activated logs (Post trip log) shall be provided. At any point of time, log/ report can be demanded by operator. Maintenance data log shall be provided for total running timer &amp; other maintenance related statistics. This shall also include standby running hours.</p> <p><b>Historical storage and retrieval system (HSRS)</b></p> <p>Complete HSRS functionality shall be implemented in server/information work station (Please refer Part-A for redundancy requirements). The data shall be saved online on hard disk and transferred to the portable storage device like DVD periodically for long term storage.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C5 DDCMIS</b>	<b>PAGE 15 OF 23</b>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>Provision shall be made to notify the operator when the portable disk is required to be replaced with a fresh disk. The Hard disk capacity shall be sufficient to store at least One (1) year data Suitable facility for retrieval of data shall also be provided.</p> <p>The data to be stored in the above system shall include alarm and event list, periodic plant data (tags computed in control system as well as computed in HMIPIS) including data required for Residual life assessment, logs/reports etc. The data/information to be stored &amp; frequency of storage and retrieval shall be as finalized during detailed engineering.</p> <p><b>6.00.00 PROGRAMMER'S STATION (PROGRAM DEVELOPMENT/ MODIFICATION, SYSTEM MAINTENANCE AND DOCUMENTATION FACILITY)</b></p> <p>6.01.01 The structuring/configuration/modification of Control loops/logics in Control system and program development/modification in HMIPIS shall be possible from fully graphic displays using familiar &amp; conventional functional blocks.</p> <p>6.01.02 Any modification done in Control System and HMIPIS shall be suitably logged so that it can be traced to the user log-in ID and time of change.</p> <p><b>6.02.00 Control system structuring/configuration/tuning facilities</b></p> <p>6.02.01 Structuring/configuring and tuning facilities shall be provided for structuring/ modification, storing/loading, testing, tuning, monitoring, etc. of all the microprocessor-based controllers of the control system.</p> <p>6.02.02 It shall be possible to configure the system with ease without any special knowledge of programming or high level languages.</p> <p>6.02.03 On-line tuning of the control loops shall be possible without causing any disturbance in the execution of the control loops. Provision to store and retrieve on immediate and long term basis the system configuration, data base etc. on some device such as floppy disk shall be included. Facility shall be provided to reload/down-load the system or controller module from the already stored data, on-line.</p> <p>6.02.04 Facility for modification shall be user-friendly. For example, modification of logics/loops etc., zooming for better display, stretching etc. should be possible. It shall be possible to add/modify, delete blocks in logics/loops on-line</p> <p><b>6.03.00 System Documentation Facility</b></p> <p>6.03.01 The system shall have the facility to generate the associated documentation for both the Control System &amp; HMIPIS with all required software and hardware tools for viewing and printing drawings and documents.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C5 DDCMIS</b>	<b>PAGE 16 OF 23</b>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<b>7.00.00</b>  7.01.00  7.01.01  7.01.02  7.01.03  7.01.04	<b>DATA COMMUNICATION SYSTEM (DCS)</b>  The Data Communication System shall include a redundant System Bus for major subsystems with hot back-up. Other applicable bus systems like cubicle bus, local bus, I/O bus etc shall be redundant except for backplane buses which can be non-redundant. The system shall have the following minimum features:  Redundant communication controllers shall be provided to handle the communication between each functional group of controllers of Control System and the System Bus.  Failure of one bus and changeover to the standby system bus shall be automatic and completely bumpless.  The following buses shall be fiber-optic only.  (a) System bus from locally mounted control system cabinets/OWS to central location.  (b) I/O Bus from remote I/Os to centrally located system cabinets.  The redundant buses shall be physically separate and shall be routed separately.		
<b>8.00.00</b>  8.01.01  8.01.02  8.01.03  8.02.00  8.03.00  8.03.01	<b>POWER SUPPLY, GROUNDING, CABINET/PANELS, ETC.</b>  <b>Power Supply</b>  Contractor shall provide totally reliable & quality power supply for DDCMIS.  Wherever hot backup or redundant equipment likes controllers, processors, I/O modules, etc. have been specified and provided, the same shall be powered through separate power supply feeders.  <b>Grounding</b>  All panels, desks, cabinets shall be provided with a continuous bare copper ground bus, bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels.  Further, for connection of shields of the field instrumentation cables, a separate shield bus independent of the ground bus shall be provided, which shall be connected to the earth risers by means of independent cables.  <b>System Cabinets/Panels</b>  All DDCMIS system modules, power supply components, other control devices (except field mounted sensors/transmitters) which are required for completeness of the system shall be housed in cabinets furnished by the Contractor. All equipment and dedicated cabinets required for termination, marshalling and proper interface within Contractor's system and also with other systems shall also be provided by the Contractor.		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
8.03.02	<p>The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Employer approved drawings in the manufacturing works of a qualified manufacturer prior to shipment to the project site. The Contractor shall ensure that the cabinets are complete and ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets should only involve connections through multi pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to Control Desk/UCP.</p>		
8.03.03	<p>The DDCMIS cabinets shall be grouped into physically separate cabinets as follows:</p> <ul style="list-style-type: none"> <li>(a.) Control System Cabinets</li> <li>(b.) Marshalling cabinets</li> <li>(c.) Relay cabinets</li> <li>(d.) HMIPIS cabinets</li> </ul> <p>However, in case Bidder's system design requires the termination cabinet independent from system cabinet, the marshalling cabinets can be combined with the termination cabinet. In case, the termination arrangement is part of the system cabinet, independent marshalling cabinets shall be provided. The HMIPIS cabinets can be clubbed with Control System Cabinets for small areas where only 24V dc power supply is used.</p> <p>Contractor may make a special note that termination of field cables directly to control system cabinet is not acceptable.</p>		
8.03.04	<p>Hardware like network components, power supply distribution etc. shall be suitably housed in cabinets/enclosures. In network cabinets suitable arrangements shall be provided to ensure that the network components are visible in door closed condition (e.g. Glass doors etc), as approved by Employer</p>		
8.03.05	<p>Relay cabinets (or marshalling / termination cabinet cum relay cabinets, as the case may be) shall house all the interfacing relays in the system.</p>		
8.03.06	<p><b>Marshalling</b></p> <p>All the incoming / outgoing signals shall be grouped as per their origin / destination and will be terminated in the marshalling cabinets (or marshalling cum termination cabinet as the case may be). The grouping of these signals shall be subject to Employer's approval. The Contractor may make a special note that termination of field cables directly to the system cabinet (whether on TBs or on the pins on I/O modules) is not at all acceptable.</p> <p>System cabinet(s) and corresponding marshalling and termination cabinet(s) shall be a single shipping section, so that the internal wiring from field terminal to the module is done completely at the factory itself.</p> <p>The system cabinets shall be furnished with side panels even within a shipping section.</p>		
<p align="center">RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p align="center">PART-B SUB-SECTION-III-C5 DDCMIS</p>	<p align="center">PAGE 18 OF 23</p>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
8.03.07	<p>Contractor shall design the cabinet internal arrangement, floor cutout and cable gland plate such that all the cables entering or leaving the cabinet can be properly glanded in the gland plate. In case, glanding is not possible Contractor shall indicate in his proposal his suggested procedure for cable entry and securing the cable at place.</p>		
8.03.08	<p>The type of termination and terminal blocks to be used in the relay cum termination/ Field Termination cabinets shall be as per requirements specified under Sub-Section-Inst. Cable. The terminals used for terminating the spare cores/ pairs of field cables shall not be employed for terminating the spare channels of I/O modules/ FTMs. The following are the guidelines for termination:</p> <ol style="list-style-type: none"> <li>a. 8 level cage clamp type of termination block shall be used in marshalling/ termination panel</li> <li>b. Minimum 4 pair Instrumentation Cables shall be used for connection between field/JB and DDCMIS marshalling cabinet and all the cores of 4 pairs or its multiples to be terminated in the marshalling panel (including spare cores) sequentially as per color coding philosophy finalized during detailed engineering. When more than 4 pair cable is used, the same is to be terminated in consecutive marshalling posts. No core/ bundle shall be left un-terminated in the marshalling panel.</li> </ol>		
8.03.09	<p>The protection class of cabinets and environmental rating shall be as defined in Basic Design Criteria. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. Temperature rise inside cabinet shall not be more than 10 deg C with respect to ambient temperature in any condition. Dual blowers/fan with blower/fan failure alarm shall be provided in each cabinet with proper enclosure. Suitable louvers with wire mesh shall be provided on the cabinet. Contractor shall furnish detailed calculation of heat dissipation of various components housed in the cabinet like power supply, controller, I/O cards etc., cooling fans/ blower capacity and component density in cabinets, during detailed engineering to ensure that temperature rise is limited as specified above. Further, temperature sensor (RTD) shall be provided in each system cabinet to monitor temperature inside cabinet and suitable alarms shall be configured to indicate high temperature inside the cabinet.</p>		
8.03.10	<p>The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering.</p>		
8.03.11	<p>Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is 600 mm or above, double doors shall be provided.</p>		
8.03.12	<p>Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish color shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet</p>		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. As an alternative, single coat of anodic dip coat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.</p> <p>The Bidder shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory applied painted surface of each item of equipment.</p> <p>The finish colors for exterior and interior surfaces shall conform to following shades:</p> <p>Front &amp; Rear-RAL 9002; End panel side- RAL 5012. Internal color shall be same as external color.</p> <p>Paint films which show sags, checks or other imperfections shall not be acceptable.</p> <p>8.03.13 Cabinets shall be designed for a grounded installation on the building structure. Any isolation from the building ground which is required by equipment design shall be provided internal to the cabinet.</p> <p>8.03.14 All alarm contacts located within cabinets as well as inputs/outputs from other related system shall be suitably terminated in the cabinets.</p> <p>8.03.15 The Contractor may submit details of his standard wiring practice for similar application for consideration and approval of Employer.</p> <p>8.04.00 <b>Relays</b></p> <p>8.04.01 All the relays provided by Contractor shall be suitable for control supply of 24V DC. Each relay shall have 2 changeover type contacts &amp; the rating of contacts shall be 5 Amp at 240V AC &amp; 0.2A at 220V DC. The VA burden of relays shall be suitable to match the capacity of output modules (however, it shall not be more than 2.5 VA). Each relay shall be provided with a freewheeling diode. The relays shall be mounted in relay cabinets except for cases where number of relays is very less. In the cases where the number of relays is very less, the same can be mounted in termination / marshalling cabinets. All the contacts of relays shall be wired upto the cabinet terminal blocks.</p> <p><b>9.00.00 SYSTEM SOFTWARE REQUIREMENTS</b></p> <p>9.01.00 The Contractor shall provide all licensed software packages required by the system for meeting the intent, functional and parametric and performance requirements of the specification.</p> <p>9.02.00 All licenses shall be valid for the continuous service life of the plant. The software licenses shall be provided for the project (e.g. organisation or site license) and shall not be hardware/machine-specific, except the operating system licenses, in the event of non-machine specific license not being supported by the operating system supplier. Necessary documentary evidence to establish the same shall be submitted by the DDCMIS supplier</p> <p>9.03.00 As a customer support, the Contractor shall periodically inform and upgrade the Anti-Virus / IPS/IDS software of the workstations/servers/switches/firewall till completion of the warranty period.</p>		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
9.04.00	DDCMIS supplier to qualify operating system patches/ service packs and software patches of other third party software (like Office, Adobe etc as applicable, except antivirus and IPS/IDS) for use on its system during the continuous service life of the plant, subject to availability of the same by the manufacturer of the software.		
9.05.00	DDCMIS supplier should periodically inform and provide software patches for all DDCMIS software till continuous service life of the plant.		
<b>10.00.00</b>	<b>SYSTEM DOCUMENTATION</b>  The Contractor shall furnish detailed system and equipment documentation. It shall include detailed system and components description covering the installation, operation, care and maintenance of all system components. All final system documentation for DDCMIS hardware and related software shall be furnished. The same shall be complete, accurate and fully representative of the supplied system and its elements. All documentation/catalogues etc., shall be furnished in English language. In addition to the hard copies, CD ROM based documentation system shall also be provided. The same should be compatible to the On-line document generation facility indicated above.		
10.01.00	<b>Hardware documentation</b>		
10.01.01	Detailed technical literature, reference manuals, user's guide/manuals for the complete hardware like control system hardware, HMIPIS hardware, I/O hardware, bulk memory units, peripherals and their controllers, communication hardware including controllers, man-machine interfaces programmers unit, power supply modules etc., shall be furnished by the Bidder.		
10.01.02	<b>Operation and Maintenance manuals</b>  The operation and maintenance manuals shall include all information required for trouble shooting, repair and maintenance information regarding all equipments furnished for the completeness of the system. For details refer Part-C, General Technical Requirements.		
10.02.00	<b>Software Documentation And Software Listings</b>		
10.02.01	All technical manuals, reference manuals, user's guide etc., in English required for modification/editing/addition/deletion of features in the software of the DDCMIS shall be furnished. The Bidder shall furnish a comprehensive list of all system/application software documentation after system finalisation for Employer's review and approval.		
10.02.02	The software listings shall be submitted by the Bidder for source code of project specific application software and all special-to-project data files		
11.00.00	<b>NOT USED</b>		
12.00.00	<b>WARRANTY</b>		
12.01.00	The Bidder shall provide an unlimited warranty on all equipment and software during the Defect liability period. This warranty shall include repair, replacement or correction of identified software or hardware discrepancies at no cost to Employer.		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
12.02.00	NOT USED.		
12.03.00	<p>The Bidder shall provide warranty spares and an exhaustive list of warranty spares including components for system hardware and instrumentation and peripherals based on (and keeping adequate margin over) normally experienced failure rate shall be submitted by the Bidder for Employer's review regarding adequacy of the same. The warranty spares as per the list mentioned above will be dispatched by the Bidder along with the main equipment consignment. The Bidder shall also provide expandable items for the warranty period. This shall include printer ribbon, ink/tonner cartridge print head etc. Excluding floppy disk, M.O. Disk, tape cartridge and paper. Unused spare/consumable shall be contractor's property and taken back.</p>		
12.04.00	<p>In case of any hardware failure which hampers normal operation, the Bidder during the warranty period must provide on-site technical expertise to repair/rectify the problem within a week and if any component is not available at site, the Bidder must arrange to supply these components at site within additional 48 hours. If a software problem is identified, this problem shall be corrected within two weeks.</p>		
12.05.00	<p>After six months of DDCMIS operation the Bidder shall provide the list of parts and expendables utilized for the period. The same information will be provided at the conclusion of the warranty.</p>		
12.06.00	<p>In order to discharge the warranty responsibility, the bidder shall include in his proposal lumpsum price for the provisions of a team of service personnel at Site who will be fully qualified to perform the required duties throughout the warranty period of one year. The Bidder shall deploy at least one engineer, one supervisor and two technicians in the team. The Employer shall approve the exact nos. &amp; composition of team members. In case, the team is unable to rectify hardware or software problems, the Bidder shall depute and/or station additional specialist to rectify the problem to ensure 99.7% availability of system. The availability calculation and test procedure shall be subject to employer's approval during detailed engineering.</p>		
<b>13.00.00</b>	<b>ANNUAL MAINTENANCE CONTRACT (AMC)</b>		
13.01.00	<p>The Bidder shall provide maintenance services of complete DDCMIS System under a comprehensive Annual Maintenance Contract (AMC) for an additional period of two years after the end of Comprehensive Operation &amp; Maintenance period.</p>		
13.02.00	<p>The AMC shall cover total maintenance of all hardware &amp; software coming under the scope of DDCMIS and shall include free repair/replacement of all cards/ modules/ peripherals/ cables/ components etc., correction of software problems and supply of expendable items. The Bidder shall ensure 99.7% availability of the system with the AMC. For that purpose, contractor may maintain adequate no. of staff at site as per his own assessment if considered necessary to ensure availability.</p>		
13.03.00	<p>Further, Bidder may note that during the AMC he will be allowed to use Employer's mandatory spares and has to replenish the same within three months time or before completion of AMC period whichever is earlier. However, if in the opinion of the Bidder, more</p>		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>			
<p>13.04.00</p> <p>14.00.00</p> <p>15.00.00</p>	<p>spares than those included in the mandatory spare list are required to meet the availability requirement, then Bidder shall stock the same.</p> <p>The Bidder shall prepare detailed list of faults corrected and parts, expendables utilised during AMC period and shall furnish the same to Employer, properly documented at the end of AMC period. Further, during AMC period the details as required by Employer/ Project Manager shall be made available by Bidder's personnel.</p> <p><b>REMOTE SERVICE CENTRE</b></p> <p>Bidder shall provide the necessary hardware &amp; software required for connecting the DDCMIS system to Bidder's remote service centre, through which the diagnostics &amp; fault analysis of the DDCMIS system can be carried out. This shall include the control system and HMI, however the diagnostic of bought out items like LAN switches, etc are excluded. The method of connection shall be as per Bidder's standard practice. However, it is preferred to have the connection through a single point in the FGD DDCMIS system. The fixed charges &amp; running cost till warranty period shall be included in the Quoted Price. The running cost thereafter shall be included in the AMC price. Connection for Remote access to the DDCMIS for diagnostics shall be through firewall. Virtual Private Networks (VPN) technology shall be used for data integrity and confidentiality. The type of VPN (SSL, IP Sec, SSL), no. of bits for encryption etc shall be decided during detailed engineering. Further, this access shall be strictly under request control &amp; record of such access shall be made available to the Employer's designated personnel. Also, it should be ensured that the hardware at the other end of the Remote access connection (i.e. at the contractor's works) shall be standalone/isolated (i.e. not connected to any network).</p> <p><b>TESTING AND COMMISSIONING TOOL</b></p> <p>The testing and commissioning tool is intended to be used for test operation of any drive in absence of DDCMIS during initial commissioning (e.g. fan trial run, etc.) While the tool shall be used for all type of drives envisaged in the specification, it is designed to be operated for one drive at a time. Portable trolley mounted system completed with necessary hardware for operating the drives and monitoring its parameter shall be supplied.</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C5 DDCMIS</p>	<p>PAGE 23 OF 23</p>
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CLAUSE NO.	TECHNICAL REQUIREMENTS	Annexure IIIC-05G	
1.00.00	<p><b>Requirements for HMI Hardware (Refer sub section- scope of supply &amp; services for applicability of this annexure)</b></p> <p>1.01.00 HMIPIS Hardware</p> <p>1.01.01 All the peripherals shall conform to the following minimum requirement but the exact make &amp; model shall be as approved by Employer during detailed engineering.</p> <p>1.01.02 The Servers/Worstations/PCs/Laptop to be provided by the Contractor should be latest available in the market at the time of supply to prevent early obsolescence and shall be subject to Employer's approval. The software packages to be included with the PCs shall also be the latest version available at the time of supply.</p> <p>1.01.03 The actual size of the Main and Bulk Memory shall be sufficient to meet the functional and parametric requirements as specified with 25% additional working memory and 50% additional bulk memory over and above the memory capacity required for system implementation.</p> <p>1.01.04 Power Fail Auto Restart (PFAR) facility with automatic time update shall be provided.</p> <p>1.01.05 For Servers and Historians / Station LAN Server/ Programming station/NMS Server the hardware shall conform to the following minimum requirements:</p> <p><b>HARDWARE REQUIREMENTS</b></p> <ol style="list-style-type: none"> <li>1. Min three no. redundant; hot swappable; Hard Disk with RAID 5 implementation. Usable Hard disk capacity shall be sufficient for the application and to store at least one (1) year historical data, wherever required.</li> <li>2. Redundant Hot swappable Power supply</li> <li>3. Quantity of Monitor, Keyboard and Mouse (as indicated in Part-A, appendix) has to be supplied in total for the stations placed in Programmer room of Unit Area. For all other stations Monitor Keyboard and mouse are provided as per Bidder's standard Practice.</li> <li>4. One intelligent SNMP manageable mini-UPS (online) for 30 minutes backup shall be provided, with all accessories and software for remote monitoring facility, with each station.</li> <li>5. Additional external graphics card with dual output ports (apart from onboard graphics card) suitable to display full HD resolution in Programmer room.</li> </ol> <p><b>SOFTWARE REQUIREMENTS</b></p> <ol style="list-style-type: none"> <li>1. Application software as per the functional requirement.</li> <li>2. Anti-Virus Software with IPS#</li> </ol> <p># if anti-virus software cannot be provided as per standard practice of the DCS OEM suitable mitigating controls like whitelisting to be provided.</p>		
<p>RGTPP, HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C5 DDCMIS ANNEXURE IIIC-05G</p>	<p>PAGE 1 OF 6</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS Annexure IIIC-05G		
1.01.06	<p>For Operator workstations/ Other workstations/ Documentation station (in case not part of prog. Stn.)</p> <p><b>HARDWARE REQUIREMENTS</b></p> <ol style="list-style-type: none"> <li>1. Standard Hardware as recommended by the Bidder shall be acceptable.</li> <li>2. Individual Monitors shall be supplied for all stations (except LVS OWS)</li> <li>3. Additional external graphics card with dual output ports (apart from onboard graphics card) suitable to display full HD resolution in control room.</li> </ol> <p><b>SOFTWARE REQUIREMENTS</b></p> <ol style="list-style-type: none"> <li>1. Application software as per the functional requirement.</li> <li>2. Anti-Virus Software with IPS#</li> </ol> <p># if anti-virus software cannot be provided as per standard practice of the DCS OEM suitable mitigating controls like whitelisting to be provided.</p>		
1.01.07	<p>For PC Station</p> <p><b>HARDWARE REQUIREMENTS</b></p> <ol style="list-style-type: none"> <li>1. Standard Hardware as recommended by the Contractor shall be acceptable.</li> <li>2. One intelligent SNMP manageable mini-UPS (online) for 30 minutes backup shall be provided, with all accessories and software for remote monitoring facility, with each PC Station.</li> </ol> <p><b>SOFTWARE REQUIREMENTS</b></p> <ol style="list-style-type: none"> <li>1. Application software as per functional requirement</li> <li>2. Latest MS OFFICE (Word, Excel, PowerPoint, Outlook)</li> <li>3. Microsoft Visual Studio (only for Programmer PC)</li> <li>4. Adobe Acrobat</li> <li>5. Anti-Virus Software with IPS#</li> </ol> <p># if anti-virus software cannot be provided as per standard practice of the DCS OEM suitable mitigating controls like whitelisting to be provided.</p>		
1.01.08	<p>Specification for Lap-Top (Note-Book) PC</p> <p>The screen size of the laptops should be 15 – 17 inches.</p>		
<p>RGTPP, HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C5 DDCMIS ANNEXURE IIIC-05G</p>	<p>PAGE 2 OF 6</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS				Annexure IIIC-05G																																												
<p>1.01.09</p> <p>1.01.10</p> <p>1.01.11</p>	<p>All the Laptop will also be used as pluggable temporary programmer's station and operator station functionalities of the programming stations mentioned in the specifications shall be provided (including requisite license).</p> <p><b>Not used</b></p> <p><b>Not used</b></p> <p><b>Printers</b></p> <table border="1"> <thead> <tr> <th>Sr. No</th> <th>Features</th> <th>Colour Laser Printer</th> <th>Colour Laser Printer</th> <th>Line Impact Dot Matrix Printer</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Paper Size</td> <td>A3</td> <td>A4</td> <td>132 column continuous fan fold type</td> </tr> <tr> <td>2</td> <td>Printing Speed (min.)- in normal mode for A4 size paper</td> <td>6 ppm (Color) 24 ppm (B&amp;W)</td> <td>4 ppm (color) 16 ppm (B&amp;W)</td> <td>1000 LPM</td> </tr> <tr> <td>3</td> <td>Type</td> <td>Heavy duty, at least 50000 pages/month</td> <td>Heavy duty, at least 30000 pages/month</td> <td>Heavy duty, at least 50000 pages/month</td> </tr> <tr> <td>4</td> <td>Resolution (black) (min.)</td> <td>600 dpi</td> <td>600 dpi</td> <td>-</td> </tr> <tr> <td>5</td> <td>First page out time (with full graphic display)</td> <td>=&lt;1 min for color, &lt;45 sec for BW</td> <td>=&lt;1 min for color, &lt;45 sec for BW</td> <td></td> </tr> <tr> <td>6</td> <td>Paper input capacity (min.)</td> <td>500 sheets</td> <td>500 sheets</td> <td>Continuous paper feed</td> </tr> <tr> <td>7</td> <td>Additional features</td> <td>Automatic Duplex Printing</td> <td></td> <td>With printer Stand &amp; sound proof enclosure (&lt;60 dB)</td> </tr> <tr> <td>8</td> <td>Additional Cartridge/toner/ ribbon of each type as used in printer with each printer</td> <td>1</td> <td>1</td> <td>100</td> </tr> </tbody> </table>				Sr. No	Features	Colour Laser Printer	Colour Laser Printer	Line Impact Dot Matrix Printer	1	Paper Size	A3	A4	132 column continuous fan fold type	2	Printing Speed (min.)- in normal mode for A4 size paper	6 ppm (Color) 24 ppm (B&W)	4 ppm (color) 16 ppm (B&W)	1000 LPM	3	Type	Heavy duty, at least 50000 pages/month	Heavy duty, at least 30000 pages/month	Heavy duty, at least 50000 pages/month	4	Resolution (black) (min.)	600 dpi	600 dpi	-	5	First page out time (with full graphic display)	=<1 min for color, <45 sec for BW	=<1 min for color, <45 sec for BW		6	Paper input capacity (min.)	500 sheets	500 sheets	Continuous paper feed	7	Additional features	Automatic Duplex Printing		With printer Stand & sound proof enclosure (<60 dB)	8	Additional Cartridge/toner/ ribbon of each type as used in printer with each printer	1	1	100
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CLAUSE NO.	TECHNICAL REQUIREMENTS	Annexure IIIC-05G	
1.01.12	<p>Switches :</p> <p>Layer-3 switches shall have the following features:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Minimum 15 nos. Fiber Gigabit Ethernet Port. 20% spare ports are to be provided over and above the total ports used</li> <li><input type="checkbox"/> 10/100/1000 Base TX ports (STP) as per requirement with 20% spare</li> <li><input type="checkbox"/> SNMP v1, v2, v3, RMON, VLAN, Multi link Trunk support (IEEE 802.3ad – Link Aggregation)</li> <li><input type="checkbox"/> Broadcast/multicast storm control</li> <li><input type="checkbox"/> Non-Blocking wire speed</li> <li><input type="checkbox"/> Hot swappable dual redundant Power Supply</li> <li><input type="checkbox"/> RIP, OSPF, BGP</li> <li><input type="checkbox"/> VRRP</li> <li><input type="checkbox"/> PIM and DVMRP Multicast Routing</li> <li><input type="checkbox"/> IPV4and IPV6 ready</li> <li><input type="checkbox"/> Support MACsec in hardware (IEEE 802.1AE)</li> <li><input type="checkbox"/> 10 GB module support for future upgradeability</li> </ul> <p>Expandability/stackability through a dedicated high speed expansion port. Routable, remotely manageable, configurable.</p> <p>One intelligent SNMP manageable mini-UPS for 30 minutes backup shall be provided with all accessories and software.</p> <p>Secondary switches shall have the following features:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> 10/100/1000 Base TX ports (STP) as per requirement with 20% spare</li> <li><input type="checkbox"/> Gigabit Ethernet Port as per requirement with 20% spare</li> <li><input type="checkbox"/> SNMP, RMON, VLAN, Multi link Trunk support.</li> <li><input type="checkbox"/> Support for stacking with high throughput</li> <li><input type="checkbox"/> Broadcast/multicast storm control</li> </ul>		
1.01.13	<p>Firewall :</p> <p>Firewall appliance should facilitate multi-vendor, multi-application environment and should support third-party products on open alliance. It should support Active-Active configuration.</p>		
<p>RGTPP, HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C5 DDCMIS ANNEXURE IIIC-05G</p>	<p>PAGE 4 OF 6</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS	Annexure IIIC-05G	
<p>1.01.14</p> <p>1.01.15</p>	<p><input type="checkbox"/> The firewall should contain following features:</p> <p>(a) Stateful inspection of packets.</p> <p>(b) NAT functionality, including dynamic and static NAT translations</p> <p>(c) Latest version of SNMP</p> <p><input type="checkbox"/> The firewall must send log information to a separate log server via an encrypted connection. Firewall logging must not impact firewall performance.</p> <p><input type="checkbox"/> Remote network access to the firewall should only be possible through the administration interface.</p> <p>Firewall should also meet the following requirements.</p> <p><input type="checkbox"/> The firewall must not support any unencrypted means of access to the firewall.</p> <p><input type="checkbox"/> It should Monitors ALL network traffic-traffic at Firewalls (Internet and external networks), in the DMZ and detect known threat through deep packet inspection.</p> <p><input type="checkbox"/> Detects unknown threats via anomaly scanning.</p> <p><input type="checkbox"/> Detect unknown threats via behavior pattern to protect from zero day attacks.</p> <p><input type="checkbox"/> Keeps up-to-date on new threats and vulnerabilities.</p> <p>IPS/ IDS Features :</p> <p>In order to inspect all inbound and outbound network activity and identify suspicious patterns that may indicate a network or system attack from someone attempting to break into or compromise a system on the Employer Station LAN Network, the IDS/IPS will be provided as per the Station LAN configuration.</p> <p>Network Management Software (NMS) :</p> <p>The network management software should contain the below mentioned features.</p> <p><input type="checkbox"/> Graphical user interface (GUI) management.</p> <p><input type="checkbox"/> Automated discovery and display of Ethernet topology and devices.</p> <p><input type="checkbox"/> Monitor traffic flow through the device</p> <p><input type="checkbox"/> View a device image indicating which ports are active and which modules are installed. If a particular network device is down, it should give the tools like ping/telnet options in the same screen to further diagnose the problem.</p> <p><input type="checkbox"/> Real-time activity and utilization statistics and graphical trends.</p> <p><input type="checkbox"/> Facility of providing pre-defined actions like e-mail, SMS etc. upon any event generated in the network.</p>		
<p>RGTPP, HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C5 DDCMIS ANNEXURE IIIC-05G</p>	<p>PAGE 5 OF 6</p>

CLAUSE NO.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b></p> <p style="text-align: right;"><b>Annexure IIIC-05G</b></p>		
	<ul style="list-style-type: none"> <li><input type="checkbox"/> Facility of viewing logical graphs of devices like routers, web servers, according to the needs.</li> <li><input type="checkbox"/> The following parameters should be monitored. <ul style="list-style-type: none"> <li><input type="checkbox"/> Device status</li> <li><input type="checkbox"/> Port Status</li> <li><input type="checkbox"/> CPU utilization</li> <li><input type="checkbox"/> Memory Utilization</li> <li><input type="checkbox"/> All port utilization including uplink ports.</li> </ul> </li> </ul> <p>For monitoring the parameters mentioned above, the NMS workstation should be connected to all HMIPIS switches/firewalls through management LAN which is a separate LAN from the redundant Station LAN.</p>		
<p style="text-align: center;">RGTPP, HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p style="text-align: center;">PART-B SUB-SECTION-III-C5 DDCMIS ANNEXURE IIIC-05G</p>	<p style="text-align: center;">PAGE 6 OF 6</p>



CLAUSE NO.	<p style="text-align: center;"><b>TECHNICAL REQUIREMENTS</b> <span style="float: right;"><b>Annexure IIIC-05J</b></span></p>		
	<p><b>Security Policies/Procedures and Security Audits:</b></p> <p>In order to enforce network security in the Station LAN &amp; the HMI of all DDCMIS, security policies and procedures are to be followed by the Contractor during the tenure of the Contract &amp; by Employer's site personnel thereafter.</p> <p>For checking compliance to the above security policies &amp; procedures ,periodic security audit by a certified auditor (as per CERT-IN panel or CERT of country of origin of DDCMIS supplier)) is to be arranged by the Contractor during ATST, at the time of trial operation/PG test of C&amp;I package and every year during AMC period. This shall include vulnerability assessment of the workstations/ servers and penetration testing of the Station LAN through the firewall from a node outside the network. Suitable actions based on the findings of the security audit shall be carried out by the Contractor.</p> <p>These security policies/procedures envisages formation of an Information Security team which shall comprise of vendor's personnel deputed at site during tenure of the contract and HPGCL/Consultant personnel thereafter. All the responsibilities of information security team have to be discharged by vendor's team during tenure of the contract and HPGCL/ Consultant team thereafter. Even though different roles have been identified for the individual members of the information security team more than one role can be performed by the same person. It may be noted that following policies/procedures are only the operation guidelines and advisory steps to ensure maximum data security.</p> <p>The following security policies shall be followed. Details of the same shall be provided during detailed engg.</p> <ol style="list-style-type: none"> <li>1. Information Security Policy <ol style="list-style-type: none"> <li>a) Information Security Team Policy</li> <li>b) Firewall Policy</li> <li>c) Information Identification and Classification Policy</li> <li>d) Security Policy Review Policy</li> <li>e) Information Labeling and Handling Policy</li> <li>f) System Planning and Acceptance Policy</li> <li>g) Capacity Management Policy</li> <li>h) Media Handling Policy</li> <li>i) Information Security Awareness Policy</li> <li>j) Third Party Access Policy</li> <li>k) Change Control Policy</li> <li>l) Anti Virus Policy</li> <li>m) System Access Policy</li> <li>n) Monitoring Policy</li> <li>o) Incident Handling Policy</li> <li>p) Information Backup and Restoration Policy</li> <li>q) Network Access Policy</li> <li>r) User Access Management Policy</li> </ol> </li> </ol>		
<p style="text-align: center;">RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION(FGD) SYSTEM PACKAGE</p>	<p style="text-align: center;">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p style="text-align: center;">PART-B SUB-SECTION-III-C5 DDCMIS ANNEXURE IIIC-05J</p>	<p style="text-align: center;">PAGE 1 OF 1</p>

CLAUSE NO.	<b>TECHNICAL REQUIREMENTS</b> <span style="float: right;"><b>Annexure IIIC-05K</b></span>		
<p>1.00.00</p> <p>1.01.00</p> <p>1.02.00</p> <p>1.03.00</p> <p>1.04.01</p>	<p><b>GENEREAL REQUIREMENTS FOR FIELDBUS INSTRUMENTS AND ACTUATORS</b></p> <p>This section provides the basic guidelines for the design and implementation of Fieldbus (Foundation Field Bus/ Profibus) based control system.</p> <p>The requirements given herein are minimum requirements to be considered by Contractor to ensure uniformity in basic design and shall not be considered as final requirements. The Fieldbus design shall be further validated by contractor and approved by Employer during detailed engineering and any variation/ changes required based on DDCMIS system requirements and actual field installation, operational philosophy etc. shall be considered by contractor without any implications.</p> <p>The fieldbus segment design shall be finalized and validated based on functional requirements as per:</p> <ul style="list-style-type: none"> <li>• Process requirements (P&amp;IDs/ operational requirements).</li> <li>• Loop response time of different loops device communication time i.e. cycle time for fast and slow loops with scheduled and unscheduled organization as per project.</li> <li>• Area classification requirements (e.g. hazardous or safe).</li> <li>• Fieldbus devices specifications (maximum current drawn from bus, block execution speeds, power conditioner suitable for field barrier, etc.)</li> <li>• Length of segments.</li> <li>• Instrument location plans with elevation details.</li> <li>• Host-system documentation showing configuration rules or restrictions.</li> <li>• For Foundation Fieldbus &amp; Profibus PA chicken foot/ branch/ or combination of both topology shall be provided. For Profibus DP, Bus/ Line topology in Redundant mode shall be provided. That is, for Profibus DP redundant cables connected to redundant ports of devices shall be provided.</li> </ul> <p>Suitable field bus segment design shall be considered keeping the safety &amp; integrity of the system intact so that the cabling, marshalling, junction boxes and system performance shall be optimized.</p> <p>However, all such segment device allocation, topology shall be decided during detailed engineering. Any modification shall be carried out by contractor without price implication.</p> <p>Contractor to provide all standard functional blocks for all Foundation Fieldbus/ Profibus devices as per latest FF/ Profibus version and standard guidelines. Fieldbus components including power supply, terminators, isolators, etc. provided by Contractor shall comply to IEC 61158 and other standard Fieldbus guidelines.</p> <p>Redundant host/ master card and redundant power supply along with advance diagnostic module shall be provided. All required libraries to execute various tasks like data acquisition, control/protection etc. shall be provided.</p>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION(FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C5 DDCMIS ANNEXURE IIIC-05K</p>	<p>PAGE 1 OF 3</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS		Annexure IIIC-05K																		
1.04.02	<p>In fieldbus system following spare capacity in each FG shall be provided :</p> <table border="1"> <thead> <tr> <th>Item</th> <th>Sub Item</th> <th>Spare capacity</th> </tr> </thead> <tbody> <tr> <td>Controller</td> <td>Software Blocks</td> <td>30%</td> </tr> <tr> <td></td> <td>Host</td> <td>30%</td> </tr> <tr> <td>Host/ Power supply</td> <td>Installed spare capacity</td> <td>10%</td> </tr> <tr> <td>Host/ Power supply space</td> <td>Only spare space</td> <td>20%</td> </tr> <tr> <td>Segment spare capacity</td> <td></td> <td>40%</td> </tr> </tbody> </table> <p>If in a FG, conventional and fieldbus system both are implemented then above spare capacity shall be in proportion to fieldbus/ conventional system implementation.</p>			Item	Sub Item	Spare capacity	Controller	Software Blocks	30%		Host	30%	Host/ Power supply	Installed spare capacity	10%	Host/ Power supply space	Only spare space	20%	Segment spare capacity		40%
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1.04.03	<p>The contractor shall present complete implementation scheme, including wiring scheme during detailed engineering stage for review and approval by Employer.</p>																				
1.05.00	<p>Fieldbus cable (specifically used for Foundation Fieldbus/ Profibus PA and Profibus DP) shall be Individually shielded twisted pair, with round steel wired armour (SWA) complying to IEC 61158, Type A. The cable construction shall meet EN 50288-7 standard for physical properties and the outer sheath shall be of PVC-TM53 as per EN 50290-2-22. Continuous operating temperature of Fieldbus cable shall be minimum 90 Deg C. For laying of fieldbus cables, cable trays envisaged for instrumentation cable with all the accessories shall be used by the contractor. Minimum 300 mm spacing to be kept between the fieldbus trays and other high voltage cables to avoid any interference.</p> <p>SS Junction boxes specially designed for fieldbus application shall be provided on as required basis. These SS JB's shall house field mounted fieldbus components like distributors, tee, etc. These SS JB's shall have suitable cover and gasket and shall have protection class of IP-66 or better. SS Cable glands and blind plugs shall be provided by the Contractor.</p>																				
1.06.00	<p>Comprehensive Fieldbus Maintenance and Diagnostic software shall be provided. This software shall be capable of collecting complete diagnostic information from fieldbus network and all fieldbus devices and presenting in user friendly interface for detailed diagnostic and troubleshooting of the system. It shall be possible to completely configure parameters of fieldbus network and fieldbus devices from centralized system through this software. This software shall have feature of providing data related to maintenance of fieldbus devices as available through fieldbus system. This system/ software shall have provision to get updated to latest version/ release of various fieldbus devices.</p>																				
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION(FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C5 DDCMIS ANNEXURE IIIC-05K</p>	<p>PAGE 2 OF 3</p>																		

CLAUSE NO.	<b>TECHNICAL REQUIREMENTS</b> <span style="float: right;"><b>Annexure IIIC-05K</b></span>		
1.07.00	During FAT suitable arrangement shall be made by Contractor to test Fieldbus modules including field devices as per approved FAT procedure.		
1.08.00	The contractor shall use fieldbus segment design tool / software to design complete network verifying various design parameters like device voltage, total cable length, spur length, system power requirements etc. the contractor shall provide device voltage calculations for all segments, based on calculation in software package. All these calculations shall be handed over during detailed engineering in electronic format in a way that Employer can thoroughly verify design basis/ calculations carried out by Contractor.		
1.09.00	Suitable short circuit protection, surge protection, grounding requirements shall be provided for all devices, so that fault in one device shall not impact the availability of other devices in the segment.		
1.10.00	All required diagnostic and configuration tools/ hand held devices shall be provided for configuration and troubleshooting of devices and network.		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION(FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C5 DDCMIS ANNEXURE IIIC-05K</b>	<b>PAGE 3 OF 3</b>





## SUB-SECTION-III-C6


# TYPE TEST REQUIREMENTS

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<b>TYPE TEST REQUIREMENTS</b>		
<b>1.00.00</b>	<b>TYPE TEST REQUIREMENTS</b>		
1.01.00	General Requirements		
1.01.01	<p>The Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. A list of such tests are given for various equipment in table titled 'TYPE TEST REQUIREMENT FOR C&amp;I SYSTEMS' at the end of this chapter and under the item Special Requirement for Solid State Equipments/Systems. For the balance equipment instrument, type tests may be conducted as per manufactures standard or if required by relevant standard.</p> <p>(a) Out of the tests listed, the Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests.</p> <p>(b) For the rest, submission of type test results and certificate shall be acceptable provided.</p> <p style="padding-left: 40px;">i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment.</p> <p style="padding-left: 40px;">ii. There has been no change in the components from the offered equipment &amp; tested equipment.</p> <p style="padding-left: 40px;">iii. The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening but not more than five (5) year back.</p> <p>(c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account.</p>		
1.01.02	As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main Bidder or his authorized representative and the balance have to be approved by the Employer.		
RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250	PART-B SUB-SECTION-III-C6 TYPE TEST REQUIREMENTS	PAGE 1 OF 7

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
1.01.03	The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.		
1.01.04	For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.		
1.01.05	The Bidder shall indicate in the relevant BPS schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only be payable after conduction of the respective test in presence of authorize representative of Employer. If a test is waived off, then the cost shall not be payable.		
<b>2.00.00</b>	<b>SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS</b>		
2.01.00	<p>The minimum type test reports, over and above the requirements of above clause, which are to be submitted for each of the major C&amp;I systems Analyzer instruments, various PLCs etc. shall be as indicated below:</p> <p>i) Surge Protections for Solid State Equipments/ Systems</p> <p>All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. Hence, all front end cards which receive external signals like Analog input &amp; output modules, Binary input &amp; output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted alongwith the proposal. As an alternative to above, suitable class of IEC-60255-4 which is equivalent to ANSI 37.90a/ IEEE-472 may also be adopted for SWC test.</p> <p>ii) Dry Heat test as per IEC-68-2-2 or equivalent.</p> <p>iii) Damp Heat test as per IEC-68-2-3 or equivalent.</p> <p>iv) Vibration test as per IEC-68-2-6 or equivalent.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C6 TYPE TEST REQUIREMENTS</b>	<b>PAGE 2 OF 7</b>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>v) Electrostatic discharge tests as per IEC 61000-4-2 or equivalent.</p> <p>vi) Radio frequency immunity test as per EN 50082-2 or equivalent.</p> <p>vii) Electromagnetic immunity as per EN 61131-2 or equivalent.</p> <p>Test listed at item no. v, vi, vii, above are applicable for front end cards only as defined under item (i) above.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C6 TYPE TEST REQUIREMENTS</b>	<b>PAGE 3 OF 7</b>



## 3.00.00

## TYPE TEST REQUIREMENT FOR C&amp;I SYSTEMS

SI No	Item	Test requirement	Standard	Test to be specifically conducted	Employer's approval req. On test certificate	Remarks
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
1	Elect. Metering instruments	As per standard (col 4)	IS-1248	No	Yes	
2	Electronic transmitter	As per standard (col 4)	BS-6447 / IEC-60770	No	Yes	
3	INSTRUMENTATION CABLES TWISTED & SHIELDED			No	Yes	
4	Pressure gauge	Degree of protection test	IS-2147	No	No	
		Temp interference test	IS -3624	No	No	
5	Temperature gauge	Degree of protection test	IS-2147	No	No	
6	Pressure & DP switch	Degree of protection test	IS-2147	No	No	
		As per standard (col 4)	BS 6134	No	No	
7	Level switch	Degree of protection test	IS-2147	No	No	
8	Control valves	CV Test	ISA 75.02	No	Yes	
9	Flow Nozzles & Orifice plate	Calibration	ASME PTC , BS 1042	No	Yes	
10	PLCs	All tests as per IEC-1131	IEC-601131	No	Yes	

SI No	Item	Test requirement	Standard	Test to be specifically conducted	Employer's approval req. On test certificate	Remarks
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
11	Junction Box	Degree of protection test	IS-13947	No	Yes	
12	Battery charger (Not required for inbuilt chargers)	Degree of protection test	IS-13947	No	No	
		Short circuit current capability	IEC-60146-2	No	Yes	
		Temp rise test without redundant fans	Approved procedure, IEC 60146-2	No	Yes	
		SWC test	Approved procedure	No	Yes	
		Burn-in-test	Approved procedure	No	Yes	
		Efficiency	IEC-60146-2,	No	Yes	
		Audible Noise Test	IEC 60146-2	No	Yes	
		Fuse Clearing Capability	Approved procedure	No	Yes	
		Relative harmonic content	Approved procedure	No	Yes	

SI No	Item	Test requirement	Standard	Test to be specifically conducted	Employer's approval req. On test certificate	Remarks
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
		ESD immunity test	IEC-61000-4-2-9(1)	No	Yes	
		Radio interference	IEC 60146-2	No	Yes	
		Over Load Test on Inverter & charger	Approved procedure	No	Yes	
		Restart Test	IEC 60146-2	No	Yes	
		Output voltage tolerance	Approved	No	Yes	
		Output voltage Harmonic content	Approved procedure	No	Yes	
		Insulation test	IEC 60146	No	Yes	
		Load Tests	Approved procedure	No	Yes	
		Preliminary light load test	IEC 60146	No	Yes	
		Current division / Voltage division	IEC 60146-2	No	Yes	
13	Battery	As per standard (col 4)	IEC –623 / IS 10918 for Ni-Cd IS-1652 for Plante Lead Acid	No	Yes	
14	Voltage stabilizers	Over Load Test	Approved procedure	No	Yes	

<b>Sl No</b>	<b>Item</b>	<b>Test requirement</b>	<b>Standard</b>	<b>Test to be specifically conducted</b>	<b>Employer's approval req. On test certificate</b>	<b>Remarks</b>
<b>Col 1</b>	<b>Col 2</b>	<b>Col 3</b>	<b>Col 4</b>	<b>Col 5</b>	<b>Col 6</b>	<b>Col 7</b>
		Temp rise test without redundant fans	Approved procedure	No	Yes	





SUB-SECTION-III-C7

CONTROL VALVES, ACTUATORS & ACCESSORIES

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<b>CONTROL VALVES, ACTUATORS &amp; ACCESSORIES</b>		
1.00.00	<b>CONTROL VALVES &amp; ACCESSORIES</b>		
1.01.00	General Requirements		
1.01.01	<p>The control valves and accessories equipment furnished by the Bidder shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler &amp; pressure vessel code, Indian Boiler Regulation (IBR), ISA, and other standards specified elsewhere as well as in accordance with all applicable requirements of the “Federal Occupational Safety and Health Standards, USA” or acceptable equal standards. All the Control Valves, their actuators and accessories to be furnished under this Sub-section will be fully suitable and compatible with the modulating loops covered under the Specification.</p>		
1.01.02	<p>All the control valves and accessories offered by the Bidder, shall be from reputed, experienced manufacturers of specified type and range of valves.</p>		
1.02.00	<b>CONTROL VALVE SIZING &amp; CONSTRUCTION</b>		
1.02.01	<p>The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.</p>		
1.02.02	<p>The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve stem travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA handbook on control valves. While deciding the size of valves, Bidder shall ensure that valves trim exit outlet velocity as defined in ISA handbook does not exceed 8 m/sec for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Bidder shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which will be subject to Employer’s approval during detailed engineering.</p>		
1.02.03	<p>Control valves for steam and water applications shall be designed to prevent cavitation, wire drawing, flashing on the downstream side of valve and down stream piping. Thus for cavitation/flashing service, only valve with anti cavitation trim shall be provided. Detailed calculations to establish whether cavitation will occur or not for any given application shall be furnished.</p>		
RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250	PART-B SUB-SECTION-III-C7 CONTROL VALVES, ACTUATORS & ACCESSORIES	PAGE 1 OF 5

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
1.02.04	Control valves shall have leakage rate as per leakage Class-IV.		
1.02.05	The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers.		
<b>2.00.00</b>	<b>VALVE CONSTRUCTION</b>		
2.01.00	All valves shall be of globe /Butterfly body design & straightaway pattern with single or double port, unless other wise specified or recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure and pressure drops permit.		
2.02.00	Valves with high lift cage guided plugs & quick-change trims shall be supplied.		
2.03.00	Cast Iron valves are not acceptable.		
2.04.00	Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Employer. Bonnet joints of the internal threaded or union type will not be acceptable.		
2.05.00	Plug shall be of one-piece construction cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.		
2.06.00	All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing)		
2.07.00	Valve characteristic shall match with the process characteristics.		
2.08.00	Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 deg. C.		
2.09.00	Flanged valves shall be rated at no less then ANSI press class of 300 lbs.		
<b>3.00.00</b>	<b>VALVE MATERIALS</b>  Refer mechanical sections for body and trim materials. The exact body and trim materials shall be finalised during detailed engineering depending on the service applications.  However, Bidder may offer valves with body and trim materials better than specified materials and in such cases Bidder shall furnish the comparison of properties including cavitation resistance, hardness, tensile strength, strain energy, corrosion resistance and erosion resistance etc. of the offered material vis-a-vis the specified material for Employer's consideration and approval.		
RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250	PART-B SUB-SECTION-III-C7 CONTROL VALVES, ACTUATORS & ACCESSORIES	PAGE 2 OF 5

CLAUSE NO.



**TECHNICAL REQUIREMENTS**

**4.00.00**

**END PREPARATION**

Valve body ends shall be either butt welded/socket welded, flanged (Rubber lined for condensate service) or screwed as finalised during detailed engineering and as per Employer's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure-temperature class equal to or greater than that of the control valve body.

**5.00.00**

**VALVE ACTUATORS**

All Control Valves shall be furnished with Pneumatic Actuators. The Bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 deg.C continuously.

Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 Kg/sq.cm. per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified.

The travel time of the pneumatic actuators shall not exceed 10 seconds.

**6.00.00**

**CONTROL VALVE ACCESSORY DEVICES**

6.01.00

All pneumatically actuated control valve accessories such as air locks, hand wheels/hand-jacks, limit switches, Microprocessor based Positioner, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.

**7.00.00**

**SPECIFICATIONS FOR MICROPROCESSOR BASED POSITIONERS**

1	Electrical	a) Input signal	4-20 mA
		b) Power Supply	Loop powered from the output card of control system.
		c) Hart Protocol	Compatibility for remote calibration & diagnostics (Super-imposed Hart signal on input signal (4-20 mA))
		d) Valve position sensing	Non contact type position sensing with 4-20 mA output signal



CLAUSE NO.



**TECHNICAL REQUIREMENTS**

2	Environment	a) Operating Temp	(-)30 To 80 Deg. C
		b) Humidity	0-95 %
		c) Protection Class	IP-65 Minimum
4	Test reports/certificates	Factory Valve Signature Tests reports (Pr vs Valve travel and Travel vs I/P signal) are to be provided.	
		Test certificates as per Manufacture Standard/Relevant Standard are To Be Submitted	
5	Configuration/calibration	Remote calibration, Auto & Manual calibration shall be possible. Universal HART Calibrator to be provided.	
6	Operating	Operating Range	Full range & split range signal.
7	Modes	Valve Action	Direct & Reverse valve action(selectable)
		Flow Characterization	Possible to fit valve characteristic curve - Linear & Equal Percentage.
8.	Fail Safe/Fail Freeze	Fail safe/Fail freeze feature is to be provided. (In case, the fail freeze feature is not intrinsic to the positioner, Bidder shall achieve the same externally through solenoid valve connected in the pneumatic circuit).	
9	Pneumatic	Air capacity	Sufficient to handle the valves selected/boosters to be supplied if required.
		Air supply pressure	To suit air supply pressure/quality available.
		Process connection	1/4 inch NPT
10	Electrical Cable Entry	1/2-NPT, side or bottom entry to avoid water ingress.	
11	Performance	Characteristic Deviation	<=0.5 % Of Span

CLAUSE NO.



**TECHNICAL REQUIREMENTS**

		Ambient Temp Effect	<=0.01 %/Deg C Or Better
12	EMC & CE Compliance	Required To International Standard Like EN/IEC.	En50081-2& En50082 Or Equivalent
13	Accessories	In-built operator panel	Display with push buttons for configuration and display on the Positioner itself (password protected/hardware lock).
		Press gauge block	For supply & output pressure.
		Mounting assembly	On as required basis.

**8.00.00**

**TEST AND EXAMINATION**

All valves shall be tested in accordance with the quality assurance programme agreed between the Employer and Contractor, which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following:

8.01.00

Non Destructive Test as per ANSI B-16.34.

8.02.00

Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test.

8.03.00

Valve closure test and seat leakage test in accordance with ANSI-B 16.34 and as per the leakage class indicated above.

8.04.00

Functional Test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.

8.05.00

**CV Test: Refer Cl.no 3.00.00 (8) Subsection IIIC-06 (Type test requirements)**

**9.00.00**

**CONTROL VALVE QUANTITIES**

Bidder shall furnish all the control valves under this package as finalised during detailed engineering stage without any price repercussions whatsoever depending on the process requirements. All the control valves provided by the Bidder for this project shall meet the specifications requirements specified herein. Specification for control valves in this Sub-section has to be read in conjunction with other relevant Sub-sections of this specification.





SUB-SECTION-III-C8


ELECTRIC ACTUATOR

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<p><b>1.00.00</b></p> <p>1.01.00</p> <p>1.02.00</p> <p>1.02.01</p> <p>1.02.02</p> <p><b>2.00.00</b></p> <p><b>2.01.00</b></p> <p>2.01.01</p> <p>2.01.02</p> <p><b>2.02.00</b></p> <p><b>2.03.00</b></p>	<p><b>GENERAL:</b></p> <p>Actuators shall be designed for valve operation to ensure proper function in accordance with specifications given below and complying to EN15714-2 or equivalent. All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.</p> <p>This sub-section of specification is applicable for following types of electric actuators:</p> <p><b>Modulating duty electric actuators:</b></p> <p>These shall be provided as per standard practice of OEM of equipment, meeting other requirements of specifications. For specifications of Blade pitch actuators, refer clause no. 5.00.00 of this chapter.</p> <p><b>Electric actuators for valves/ dampers/ gates (other than covered in 1.02.01):</b></p> <p>These actuators shall be Non-Intrusive type electric actuators. The interface of these actuators with DDCMIS shall be of two types viz. with Hardwired interface and with Fieldbus interface. The common requirements of both these type of actuators are specified at clause 2.00.00, specific requirements of Non-Intrusive hardwired actuators are specified at clause 3.00.00 and specific requirements of Non-Intrusive fieldbus actuators are specified at clause 4.00.00. The applications where these two types of actuators are to be provided is specified in Part-A of Technical Specifications.</p> <p><b>COMMON REQUIREMENTS FOR NON INTRUSIVE ELECTRIC ACTUATORS</b></p> <p><b>TYPE:</b></p> <p>The actuators shall have integral starters with built in SPP (Single Phasing Preventer). 415 V, 3 phase 3 wire power supply shall be given to the actuator from switch board as applicable through a switch fuse unit. Control voltage of the motor starter shall be 110 V AC / 24 V DC, derived suitably from 415V power supply. In case of signal/ power loss, the position of the actuator should freeze at the last position.</p> <p>The actuators shall be Non- Intrusive electric actuator. All actuator settings including torque, limit shall be possible without opening the actuator cover and LCD indication shall be available integral to actuator body.</p> <p><b>RATING:</b></p> <p>(a) Supply Voltage &amp; frequency: 415V +/- 10%, 3 Phase, 3 Wire &amp; 50HZ +/-5%.</p> <p>(b) Sizing:</p> <p>Open/Close at rated speed against designed differential pressure at 90% of rated voltage.</p> <p>For ON/OFF type: Three successive open-close operations or 15 minutes, whichever is higher.</p> <p>For inching type: 150 starts per hour or required cycles, whichever is higher.</p> <p><b>CONSTRUCTION:</b></p> <p>(a) Enclosure:</p> <p>Totally enclosed weatherproof, minimum IP-68 degree of protection.</p> <p>(b) Manual Wheel:</p>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C8 ELECTRIC ACTUATORS</p>	<p>PAGE 1 OF 4</p>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<p><b>2.04.00</b></p>	<p>Shall disengage automatically during motor operation.</p> <p><b>MOTOR:</b></p> <p>(a) Type : Squirrel cage induction motor suitable for Direct On Line ( DOL )starting.</p> <p>(b) Enclosure: Totally enclosed, self-ventilated.</p> <p>(c) Insulation Class F. Temperature rise 70 Deg C. over 50 Deg C ambient.</p> <p>(d) Bearings: Double shielded, grease lubricated antifriction.</p> <p>(e) Earth Terminals: Two</p> <p>(f) Protection: Single Phasing Protection, Over heating protection through Thermostat (as applicable) and wrong phase sequence protection shall be provided over and above other protection features standard to bidder's design. Suitable means shall be provided to diagnose the type of fault locally.</p>		
<p><b>2.05.00</b></p>	<p><b>POSITION/TORQUE TRANSMITTER:</b></p> <p>The Position/ Limit measurement shall be done using absolute encoders which will give information of position/ limit in both the directions. Electronic measurement of torque shall be provided.</p>		
<p><b>2.06.00</b></p>	<p><b>LOCAL OPERATION:</b></p> <p>It shall be possible to operate the actuator locally also. Lockable local/remote selection shall be provided on the actuator.</p>		
<p><b>2.07.00</b></p>	<p><b>LCD DISPLAY:</b></p> <p>A local LCD display shall be provided to give information regarding actuator alarms, status and valve position indications as a minimum in local.</p>		
<p><b>2.08.00</b></p>	<p><b>WIRING:</b></p> <p>Suitable voltage grade copper wire.</p>		
<p><b>2.09.00</b></p>	<p><b>TERMINAL BLOCK:</b></p> <p>For power cables, the grade of TBs shall be minimum 650V.</p>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C8 ELECTRIC ACTUATORS</p>	<p>PAGE 2 OF 4</p>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>			
<p><b>2.10.00</b></p> <p><b>2.11.00</b></p> <p><b>3.00.00</b></p> <p><b>3.01.00</b></p> <p><b>3.02.00</b></p> <p><b>3.03.00</b></p> <p><b>4.00.00</b></p> <p><b>4.01.00</b></p>	<p><b>ACCESSORIES:</b></p> <p>All required accessories (if applicable) for calibration / settings/ configuration of various parameters of actuator shall be provided. For quantities, please refer Part A of technical specifications.</p> <p><b>SIL CERTIFICATION:</b></p> <p>All actuators shall be certified for SIL 2 or better.</p> <p><b>SPECIFIC REQUIREMENTS FOR NON INTRUSIVE HARDWIRED ACTUATORS</b></p> <p><b>INTERFACES:</b></p> <p>For ON-OFF and INCHING type actuators interface with the control system shall be through hardwired signal only.</p> <p>(a) Open/Close command, open/ close status and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local &amp; other protections operated) shall be provided hardwired.</p> <p>(b) The actuator shall be able to accept open/close command at 24V DC with max. 2.5VA load from control system. Accordingly suitable isolated interface in the actuator shall be provided.</p> <p>(c) Open/close command termination logic shall be suitably built inside actuator.</p> <p>(d) For typical wiring diagram Refer Tender Drawing No. 0000-999-POI-A-063 (Except plug &amp; socket connector, if not applicable)</p> <p><b>TERMINAL BOX:</b></p> <p>Suitable terminals/ connectors, integral to actuator, for terminating instrumentation &amp; power cables shall be provided. Necessary glands for power cables and instrumentation cables shall be provided.</p> <p><b>TRAINING:</b></p> <p>Contractor shall provide training on Non-Intrusive hardwired Electric Actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.</p> <p><b>SPECIFIC REQUIREMENTS FOR NON INTRUSIVE FIELDBUS ACTUATORS</b></p> <p><b>INTERFACES:</b></p> <p>For ON-OFF and INCHING type actuators interface with the control system shall be through fieldbus network.</p>			
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C8 ELECTRIC ACTUATORS</p>	<p>PAGE 3 OF 4</p>	

CLAUSE NO.



**TECHNICAL REQUIREMENTS**

- (a) Open/ close commands, open/ close feedback status, disturbance signal etc. shall be available to the Control System through the fieldbus network along with diagnostics. The detailed diagnostics including the actuator operating data shall be available to the DDCMIS through the fieldbus network.
- (b) All actuators shall be Foundation Fieldbus/ Profibus compatible. However the exact protocol shall be based on finalized protocol of DDCMIS. If Profibus DP protocol is envisaged then actuator shall have two (redundant) Profibus DP ports for connecting the redundant Profibus DP cables. That is if one profibus cable is cut or not working/ not available, then complete actuator functionality shall be available through the second redundant cable without any manual intervention.
- (c) Open/close command termination logic shall be suitably built inside actuator.

**4.02.00**

**TERMINAL BOX:**

Suitable terminals/ connectors, integral to actuator, for terminating fieldbus cables and power cables shall be provided. Necessary glands for power cables and armored fieldbus cables shall be provided.

**4.03.00**

**TRAINING:**

Contractor shall provide training on Non-Intrusive Fieldbus Electric Actuator along with detail training on Foundation Fieldbus/ Profibus interface used in actuator for Employer's personnel. The duration of the training shall be as elaborated in Part-C, Section-VI of technical specifications.

**5.00.00**

**SPECIFIC REQUIREMENTS FOR BLADE PITCH ACTUATORS**

Sl No.	Description	Requirement
1.	Duty	Continuous duty / Modulation,
2.	Operating Ambient Temperature	-20 to +60 Deg C or better
3.	Enclosure Protection	IP 68
4.	Resolution/ Precision	0.1%- 0.2% or better of total travel
5.	Supply Voltage & frequency	415V +/- 10%, 3 Phase, 50HZ +/-5% or 230V +/- 10%, Single Phase, 50Hz +/- 5%
6.	Motor Suitable for	Continuous Duty
7.	Motor insulation Class	F
8.	Analog Control	4-20mA, (24VDC)
9.	Position Transmitter	4-20mA (24VDC)
10.	Integral Starter	Yes
11.	Terminal Block	For power cables, the grade of TBs shall be minimum 600V
12.	Accessories (if applicable)	for calibration / settings/ configuration of various parameters of actuator shall be provided
13.	Hand wheel	Yes
14.	Standard Compliance	EN 15714-2 Class D or equivalent




SUB-SECTION-III-C9


CONTROL DESK, PANEL AND FURNITURE


**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<b>1.00.00</b>	<b>CONTROL DESK &amp; PANELS</b>		
<b>1.01.00</b>	<b>GENERAL</b>		
1.01.01	All control desk, panels etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, grounding, ventilation, space heating, anti-vibration pads, internal piping & accessories as required for completeness of the system.		
1.01.02	All panels, desks, cabinets shall be free standing type & have bottom / top entry for cables to be finalised application wise during detailed engineering stage. The bottom of desk & cabinets shall be sealed with bottom plate, compression cable glands (double for field and single for inside rooms) and fire proof sealing material to prevent ingress of dust and propagation of fire. Sufficient number of power receptacles with disconnect switches shall be installed within all panels/desk.		
1.01.03	Exterior steel surface shall be sand blasted, ground smooth, filled, primed, sanded and smooth enamel painted to give a good finish subject to minimum paint thickness of 65-75 microns for sheet thickness of 3 mm and 50 microns for sheet thickness of 2mm. The exact color shall be finalised during detailed engineering.		
1.01.04	The design shall conform to the EN ISO 11064 (Ergonomical design of control room), Part-1,2 and 3.		
<b>2.00.00</b>	<b>CONTROL DESK &amp; PANEL</b>		
<b>2.01.00</b>	<b>GENERAL</b>		
2.01.01	The exact dimensions, material, construction details, grounding, general arrangement etc. of Control Desk etc. shall be as per the actual requirement and shall be finalised during detailed engineering and subjected to Employer's Approval.		
2.01.02	For control desk mounted instruments/ devices etc., which are to be powered from UPS, all required conversion of interface equipments / accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like Input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS, redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover of UPS feeders.		
<b>2.02.00</b>	<b>Control Desk (CD)</b>		
2.02.01	Control desk shall be Modular, non-welded construction free standing table top type with front & back cover constructed of 1.6 mm thick CRCA steel plates. The tabletop of the control desk shall be arc-shaped for mounting TFT monitors & mice. The work surface of control desk shall be 30mm thick with the top 12mm of Acrylic Solid Surface (ASS) and the remaining 18mm of laminated medium density fiber board. Work surface shall be made of two different colors at same level and seamlessly joined in each section. The structure frame shall consist of extruded aluminum top and bottom horizontal beams and vertical support tensioned together to form an integrated, finished curvilinear shaped frame. Vertical & Horizontal supports, minimum 2.5mm and 2mm thick respectively, have to be provided for		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C9 CONTROL DESK &amp; PANELS</b>	<b>PAGE 1 OF 3</b>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>the structure frame. Extreme side legs shall be illuminated type and should complete the overall form and aesthetics of the desk. It shall have concealed cable &amp; wire way management system. Telephone sets shall be mounted on the control desk. Sliding keyboard trays shall be provided on the CD. The exact profile of the desk, dimension and the radius of curvature shall be finalised during detailed engineering stage.</p> <p>2.02.02 All operator monitors &amp; mice shall be mounted on this CD.</p> <p>2.02.03 The cabling / wiring between OWS &amp; CPU's, power supply cables etc. shall be aesthetically routed and concealed from view.</p> <p><b>2.03.00 Internal Panel/Desk Items</b></p> <p>Equipment and devices mounted within the panels/desk shall be mounted on suitable racks/brackets and shall be arranged for convenient access for adjustment and maintenance work.</p> <p><b>2.04.00 Furniture</b></p> <p>Bidder shall provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe. Each module shall have transparent cover and adjustable partition. It shall have locking provision for security. The components shall be suitable for integration/fabrication without any welding technology.</p> <ol style="list-style-type: none"> <li>1. Work Station furniture <p>Modular work station furniture, suitable for mounting servers &amp; historians, programmer stations, PC based systems, printers (inkjet or A4 laser) etc. is to be provided..</p> </li> <li>2. Server Rack <p>Server rack shall be provided to mount programmer stations, PC based systems (of rack type and tower type), Matrix KVM switcher, Mini UPS etc. Suitable arrangement for Ventillation and cooling shall be built in-</p> </li> <li>3. PC rack <p>PC rack shall be provided to mount CPUs of work stations/PCs of OWS/LVS etc in Control Room.</p> </li> <li>4. Chairs <p>Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators &amp; other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back.</p> </li> </ol>		
<p align="center">RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p align="center">PART-B SUB-SECTION-III-C9 CONTROL DESK &amp; PANELS</p>	<p align="center">PAGE 2 OF 3</p>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>5. Tables</p> <p>a Industry standard computer tables shall be provided &amp; shall be as approved by Employer during detailed Engineering.</p> <p>6. Almirahs</p> <p>Steel Almirahs shall be provided for keeping documents in the documentation room.</p> <p>7. Keypad</p> <p>Keypads shall be provided for the storing of keys of relevant areas in the respective control rooms</p> <p>8. Lockers</p> <p>Suitable lockers shall be provided in the room adjacent to the control room for storing of personal articles of control room personnel &amp; also for documents.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-III-C9 CONTROL DESK &amp; PANELS</b>	<b>PAGE 3 OF 3</b>





SUB-SECTION-III-C10


POWER SUPPLY


**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**


<b>CLAUSE NO.</b>	 <b>TECHNICAL REQUIREMENTS</b>		
1.00.00	<p style="text-align: center;"><b>ELECTRICAL POWER SUPPLY SYSTEM</b></p> <p><b>General Requirements</b></p> <p>The requirements of Electrical Power Supply system are specified herein on system basis. The Contractor shall be responsible for engineering and furnishing a complete and operational system fully meeting the intent and requirements of this specification including tender drawings and Employer approved drawings during detailed engineering. All equipment and accessories required for completeness of this system shall be furnished by the Contractor whether these are specifically mentioned herein or not. All the equipments and sub systems offered shall be from reputed experienced manufacturers. All system cabinets, enclosures, &amp; distribution boards shall be manufactured, assembled, wired and fully tested as a complete assembly as per the requirements of this specification at the manufacturer's works.</p> <p>The Contractor shall furnish all required equipment cubicles and wiring required for conversion and/or stabilization of the power sources provided by the Employer to all other levels which may be necessary for meeting the individual requirement of equipment/system furnished by him including the panel/desk mounted equipment.</p> <p>24 V DC power supply system shall be provided as below:-</p> <p>i) 24V DC power supply system for DDCMIS based control system shall comprise of two sets, each set shall consist of 1 x 100% microprocessor controlled, intelligent, modular rectifier banks, Controller – one for each rectifier bank, 1 x 100% Nickel - Cadmium batteries for one (1) hour duty, 1 X 100% DC distribution board. 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS)–common for both the sets.</p> <p>Necessary redundant transformers shall be provided by the contractor to derive the power supply from 415V, 3 phase, 3 wire incomers for above.</p>		
1.01.00	<b>POWER SUPPLY SYSTEM FOR DDCMIS BASED CONTROL PANELS</b>		
1.01.01	Microprocessor based, Intelligent, Modular Power Supply.		
1.01.02	Microprocessor based, intelligent, modular power supply shall be sized to meet connected load requirements and keep the connected battery full charged in Float/ Boost mode. A provision of 10% design margin shall be kept over and above the load requirement. Either of the bank of rectifier modules shall be able to recharge fully discharged battery within 8 hours. It shall also be possible to discharge batteries periodically manually. Each rectifier bank shall have N+1 rectifier modules for all applications. The exact sizing of the rectifiers in one bank shall be as approved by		
RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250	PART-B SUB-SECTION-III-C10 POWER SUPPLY	PAGE 1 OF 7


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
1.01.03	<p>Employer during detailed engineering. While selecting the components and finalizing the cooling arrangements, Bidder to note that these rectifier modules are required to operate at 30-40 % of the rated load for most of the time. While sizing, the temperature derating factor as applicable, is to be considered for arriving at the rating of the modules as per Bidder's manufacturing standard if the modules are rated for lower than the 50 deg. C ambient. For the rectifier bank, matching controller along with applicable software shall be provided to meet system requirements under all modes of operation.”</p> <p>The rectifier module shall be microprocessor controlled, IGBT/Power MOSFET based, high frequency with active load sharing, designed for single and parallel operation with battery and shall have automatic voltage regulators for a close voltage stability even when AC supply voltage and DC load fluctuates, effective current limiting features, front access design, programmable temperature compensation feature for battery charging and filters on both input and output to minimize harmonics. The rectifier module output regulation shall be +/- 1% or better from no load to full load with an input power supply variation of +/- 10% in voltage and +/- 5% in frequency. In addition to indications / display on rectifier panel, alarms along with relevant analog measurements shall also be provided by employing RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for use in DDCMIS system. Further isolated 4-20 mA signals shall be provided for important parameters like rectifier bank voltage, rectifier bank current, battery voltage, battery current, DCDB Voltage, DCDB current etc. The list of alarm output &amp; 4-20 mA signals shall be as approved by Employer during detailed engineering. Necessary provision shall be done in DDCMIS end also.</p>		
1.01.04	<p>“Float / Boost” charge functions shall be provided with alarm / indications.</p>		
1.01.05	<p>Each rectifier bank shall be rated for 100% load requirement and keep the connected battery full charged and one spare rectifier module.</p>		
1.01.06	<p>The rectifier module circuitry shall be of fail-safe design and failure of any component should not result in any rectifier bank output voltage to increase beyond acceptable limits of the C&amp;I system being fed from it.</p>		
1.01.07	<p>The rectifier module shall be current limited for circuit protection and protection of battery from overcharge. The current limit shall be continuously programmable.</p>		
1.01.08	<p>The rectifier module shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energized.</p>		
<p align="center">RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p align="center">PART-B SUB-SECTION-III-C10 POWER SUPPLY</p>	<p align="center">PAGE 2 OF 7</p>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
1.01.09	<p>The rectifier module shall be fed from 415 V AC, 50 HZ, 3 phase, 3 wire system. Bidder shall provide all required power cables &amp; other accessories etc. from 415 V AC power supply system to his electrical power supply system.</p>		
1.01.10	<p>The full load efficiency of rectifier module at nominal input and output shall be 90%. The ripple content shall be limited to +/- 0.5% of output voltage.</p>		
1.01.11	<p>Bidder shall furnish the equipment complete in all respect along with rectifier module rating &amp; voltage drop calculations, supporting curves / data etc.</p>		
1.01.12	<p>The Controller shall be intelligent, microprocessor controlled for monitoring &amp; control of rectifier modules with features viz. auto / manual battery discharge test, battery reserve time prediction, energy management, float / boost mode control etc.</p>		
1.01.13	<p>All software as required for smooth operation and monitoring of rectifier modules in conjunction with controller &amp; BHMS shall be provided by the Contractor.</p>		
1.02.00	<p><b>Batteries for DDCMIS system</b></p>		
1.02.01	<p>The batteries shall be heavy duty Nickel-cadmium type and shall be sized for one hour of full load operation during non-availability of AC supply / chargers. The Ni-Cd batteries shall conform to IS: 10918. The batteries shall be sized as per relevant IEEE Standards. For sizing calculation, an aging factor of 0.8 and a temperature correction factor as per manufacturer's standard at 4 deg. C electrolyte temperature (Based on temperature characteristics curve to be submitted by the Contractor at a temperature of 4 deg. C). Capacity factor, Float Correction Factor, as per Battery Supplier Standard, shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering. However, Contractor shall consider a suitable voltage drop of 2V from battery room to DCDB and DCDB to load, while sizing the battery.</p>		
1.03.00	<p><b>DC DISTRIBUTION BOARD (DCDB)</b></p> <p>Redundant DC feeders (one from each DCDB) shall supply each of the connected panels. From DCDB / panel to driver/load feeder shall be in scope of Bidder. The exact design, rating &amp; number of feeders of the each redundant DCDB shall be as finalized during detailed engineering and as approved by Employer. However, 25% spare feeder (min. 1 no.) with fuses for each rating shall be provided in each DCDB.</p>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C10 POWER SUPPLY</p>	<p>PAGE 3 OF 7</p>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
1.04.00	<p><b>Battery Health Monitoring System (BHMS)</b></p> <p>BHMS, wherever applicable, shall include microprocessor based hardware and software to monitor the condition of each battery cell of 24 V DC systems on-line. With BHMS it shall be possible to measure &amp; analyze the minimum and maximum voltage values of each battery-cell so that any damage to battery shall be prevented by pro-active maintenance. BHMS shall communicate with the charger/DDCMIS and provide alarms as finalized by Employer during detailed engineering.</p>		
1.05.00	<p>The UPS Power Supply for various systems shall consist of one or more of the following configurations.</p> <p>Bidder shall clearly bring out in the proposal the configuration diagram, single line diagram and datasheets etc. &amp; this shall be finalized subject to employer's approval during detail engineering.</p> <p>Configuration B:</p> <p>UPS system shall consist of 1 x 100% charger and inverter with input isolation transformer, 2 x 100% Ni Cd Battery Bank for 1 hour, Bypass Line Transformers and Voltage Stabilizer, static switch, manual bypass switch, 2 x 100% ACDB, 1x100% Microprocessor controlled Battery Health Monitoring System (BHMS) and other necessary protective devices and accessories.</p> <p>The specifications for this UPS configuration shall be as per Cl.No. 1.06.00 to 1.06.05 and specifications for Battery shall be as per Cl. No 1.06.06 for Ni-Cd type Batteries.</p> <p><b>Configuration C:</b> On line UPS with remote monitoring having a battery backup of 30 min. The batteries for UPS System shall be Sealed Maintenance Free type and shall be as per Control System Vendor's standards.</p>		
1.06.00	<p><b>UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM</b></p> <p>The minimum capacity of the UPS at load factor of 0.8 lagging inclusive of 10% design margin at 50 deg c.</p> <p>The UPS system shall meet the following requirements as a minimum.</p> <p>If UPS KVA rating is applicable at a lower ambient temperature than specified 50 deg.c, the bidder shall consider a derating factor of at least 1.5%/deg.c for arriving at the specified UPS capacity at 50 deg.c ambient. The UPS shall have an overload capacity of 125 % rated capacity for 10 minutes and 150 % rated capacity for 10</p>		
RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250	PART-B SUB-SECTION-III-C10 POWER SUPPLY	PAGE 4 OF 7



CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>				
<p><b>1.06.01</b></p> <p><b>1.06.01.01</b></p> <p><b>1.06.01.02</b></p> <p>1.06.01.03</p> <p>1.06.01.04</p> <p>1.06.01.05</p> <p>1.06.01.06</p> <p>1.06.01.07</p>	<p>seconds. The inverter shall have sufficient capability to clear fault in the maximum rated branch circuit, limited to 8 percent of finally selected ups capacity.</p> <p><b>Chargers</b></p> <p>The chargers shall be self regulating, solid state silicon controlled, full-wave rectifier type designed for single and parallel operation with battery and shall have automatic voltage regulators for close voltage stability even when AC supply voltage fluctuates, effective current limiting features and filters to minimise harmonics. The charger should be capable to fully charge the required batteries as well as supply the full rated load through inverter. Furthermore the charger should be able to re-charge the fully discharged battery within 8 hours. The charger output regulation shall be <math>\pm 1\%</math> from no load to full load with an input power supply variation of <math>\pm 10\%</math> in voltage and <math>\pm 5\%</math> in frequency. In addition to indications/display on charger panel, alarms along with relevant analog measurements shall also be provided by employing RS 485 Port Modbus Protocol / Ethernet TCP/IP protocol for use in DDCMIS. The list of alarm output &amp; 4-20 mA signals shall be as approved by Employer during detailed engineering.</p> <p>The charger shall be current limited for charger circuit protection and protection of battery from overcharge shall also be provided. The current limit shall be continuously adjustable. The chargers shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energised.</p> <p>The chargers shall be fed from 415V AC, 50 HZ, 3 phase, 3 wire system. Charger design shall ensure that there is no component failure due to fluctuations of input supply or loss of supply and restoration.</p> <p>The minimum full load efficiency at nominal input and output shall be 90%. The ripple content shall be limited to <math>\pm 2\%</math> of Charger output voltage.</p> <p>The UPS battery shall have sufficient amp-hour capacity to supply the steady state KVA rating of the UPS specified for 60 minute, irrespective of the actual load on UPS.</p> <p>The UPS system shall be capable of operating without D.C. battery in circuit under all conditions of load and the performance of various components of UPS like inverter, charger, static switch etc. shall be guaranteed without the battery in circuit.</p> <p>The UPS system design shall ensure that in case of failure of mains input power supply to one of the chargers, the other charger whose mains input power supply is healthy, shall feed to one or both the inverters as the case may be as per manufacturer's standard practice &amp; continue to charge the D.C. battery at all load conditions. The Bidder should note that this situation should not in any way lead to the discharge of the D.C. Battery.</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C10 POWER SUPPLY</p>	<p>PAGE 5 OF 7</p>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<b>1.06.02</b>	<p><b>Static Inverters</b></p> <p>The static inverter shall be of continuous duty, solid state type using proven Pulse Width Modulation (PWM)/Quasi square wave/step wave technique. Ferro-resonant types Inverters are not acceptable. The nominal voltage output shall be 230 Volts. single phase ,50 Hz. The inverter equipment shall include all necessary circuitry and devices to conform to requirements like voltage regulation, current limiting, wave shaping, transient recovery, automatic synchronization etc. The steady state voltage regulation shall be +/-2% and transient voltage regulation (on application/removal of 100% load) shall be +/-20%. Time to recover from transient to normal voltage shall not be more than 50 mSec. Frequency regulation for all conditions of input supplies, loads and temperature occurring simultaneously or in any combination shall be better than ± 0.5% (automatically controlled). The total harmonic content shall be 5% maximum and content of any single harmonic shall be 3% maximum. The inverter efficiency shall be at least 85% on full load and 80% on 50% load. The synchronisation limit for maintenance of synchronisation between the inverter and stand by AC source shall be 48-52Hz, field adjustable in steps of 1 Hz.</p>		
<b>1.06.03</b>	<p><b>Static Switch and Manual Bypass Switch</b></p> <p>The static switch shall be provided to perform the function of transferring UPS loads automatically without any break from (i) faulty inverter to healthy inverter in case of failure of one of the two inverters and (ii) from faulty inverter to standby AC source in case of failure of both the inverters. The transfer time shall be ¼ cycle maximum in synchronous mode.</p> <p>Manual bypass switch shall be employed for isolating the UPS during maintenance.</p> <p>Continuous and overload capacity of the switches shall be equal to 100% of the continuous and overload rating of each inverter. Peak Capacity shall be 1000% of continuous rating for 5 cycles.</p>		
<b>1.06.04</b>	<p><b>Step Down Transformer and Voltage Stabiliser</b></p> <p>One 415V three phase to 230V, single phase transformer along with associated voltage stablizer shall be furnished with each UPS system. The transformer and stablizer combination shall convert Employer furnished 415V ± 10% three phase plant auxiliary AC supply to 230 V ± 2%, single phase standby AC Power Supply source.</p> <p>The transformer shall be of low impedance air-cooled type and its KVA rating and percentage impedance should be selected so that extremely fast fault clearance is achieved.</p> <p>The overload capacity of the transformer and voltage stabilizer shall not be less than 300% for 200 millisecond duration. The voltage stabilizer shall employ servo-controlled circuitry and shall maintain the specified output voltage for 0-100% load with maximum input voltage variations as indicated above. The efficiency of the</p>		
RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250	PART-B SUB-SECTION-III-C10 POWER SUPPLY	PAGE 6 OF 7

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>			
<p><b>1.06.05</b></p> <p><b>1.06.06</b></p>	<p>stabiliser shall be 95% or better.</p> <p>The type and other details shall be subject to Employer's approval.</p> <p><b>AC Distribution Board (ACDB)</b></p> <p>The details of the AC distribution board, i.e. exact, rating and number of feeders etc. of the 2x100% ACDB shall be designed to cater to the requirements of Contractors systems. 25% Spare feeders of each type and rating to be provided in each ACDB.</p> <p>The batteries shall be heavy duty Nickel-cadmium type and shall be sized for one hour of full load operation during non-availability of AC supply / chargers. The Ni-Cd batteries shall conform to IS: 10918. The batteries shall be sized as per relevant IEEE Standards. For sizing calculation, an aging factor of 0.8 and a temperature correction factor as per manufacturer's standard at 4 deg. C electrolyte temperature (Based on temperature characteristics curve to be submitted by the Contractor at a temperature of 4 deg. C). Capacity factor, Float Correction Factor, as per Battery Supplier Standard, shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering. However, Contractor shall consider a suitable voltage drop from battery room to ACDB and ACDB to load, while sizing the battery.</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C10 POWER SUPPLY</p> <p>PAGE 7 OF 7</p>





SUB-SECTION-III-C11


CONTAINERISED ROOM (PORTABLE CABIN)


**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<b>1.00.01</b>	<p align="center"><b>CONTAINERISED ROOM (PORTABLE CABIN)</b></p> <p><b>Enclosure rating &amp; Design</b></p> <ul style="list-style-type: none"><li>• For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% shall be considered. The equipment shall operate in a highly polluted environment.</li><li>• CONTAINERISED ROOM (PORTABLE CABIN) shall be designed for outdoor application.</li></ul>		
<b>1.00.02</b>	<p><b>General Description</b></p> <p>The Containerised room shall meet all requirements of analysers and analyser panels.</p> <ul style="list-style-type: none"><li>• Containerised room would be closed type, weather proof and made of CRCA steel construction.</li><li>• It shall withstand heavy monsoon, heavy rain and heavy wind condition.</li><li>• Doors would be equipped with hydraulic door closer.</li><li>• Each door shall be fitted internally with "panic" bar exit handles and externally with key lockable handles. Exterior handles will be of stainless steel.</li><li>• Door will be provided with heavy-duty latches, hinges, door stop and pad lock.</li><li>• Personnel doors would be provided with canopy with necessary rubber gaskets to prevent the entry of water.</li><li>• The Containerised room shall be air-conditioned to maintain an air temperature less than 27°C.</li><li>• The Containerised room shall be designed as multiple modular transportable units; they shall be modularized for ease of separation for transport and quick re-assembly at site.</li><li>• Split Modules shall be designed for lifting as single piece along with equipment's.</li><li>• Lifting lugs should be designed to carry the weight of the Containerised room including all the Electrical panel boards.</li><li>• Suitable lifting provisions and accessories shall be provided along with Containerised room.</li></ul>		
<b>1.00.03</b>	<p><b>Structural Arrangements</b></p> <p><b>1) Frame</b></p> <p>The pre-fabricated enclosure(s) frame shall be constructed as a rigid, self-supporting steel structure. Structural steel design and fabrication shall be in accordance with AISC Manual of Steel Construction.</p> <p><b>Construction Materials</b></p> <ul style="list-style-type: none"><li>* Steel: load bearing members: IS 10748; Grade IV</li><li>* Structural Steel: IS 2062.</li><li>* Side-end walls &amp; roof panels: IS 2062.</li><li>* Square/Rectangular hollow sections: JIS STKR-41 / IS 1161</li></ul>		
<p align="center">RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p align="center">PART-B SUB-SECTION-III-C11 CONTAINERISED ROOM (PORTABLE CABIN)</p>	<p align="center">PAGE 1 OF 4</p>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>The roof framing and the columns shall be designed to support any additional dead load suspended from the roof such as air conditioning duct, false ceiling, cable trays, light fixtures, and piping.</p> <p>The pre-fabricated enclosure(s) floor framing (skid) shall be fabricated from ASTM A36/ JIS 3101 or Equivalent steel members to form a rigid rectangular frame. The frame shall be braced with cross members as required to support the equipment installed in the building.</p> <p>The pre-fabricated enclosure(s) shall be analyzed to resist both dead and live loads expected during construction, transportation, installation, and operation.</p> <p>The pre-fabricated enclosure(s) shall be designed for the maximum in-place Structural loading consisting of the structure, equipment dead weight, all operating loads, and the maximum environmental loads</p> <p><b>2) Shell and Base frame</b></p> <p>The outer shell of the Containerised room shall be manufactured with 1.6mm sheet. The main load bearing members such as posts, base members, bottom and top side rails, end rails headers are selected based on approved structural analysis. Lifting hooks shall be provided at minimum at corners. The adequacy of the same shall be verified by structural analysis.</p> <p>Adequate number of doors with reinforced framework and locking device shall be provided as per requirement. The door has to be effectively sealed against water ingress in closed condition. The shell structure is to be rigid enough to withstand rough handling rigorous transportation hazards etc. and able to stand flexing/distortion even when placed on uneven ground.</p> <p>Base members are to be made from press formed steel sections of appropriate Geometry of required thickness. Base frame design shall be accommodating the panels provided inside the room.</p> <p>Panel mounting structure shall be fabricated and drilled with holes for fixing bolts for the site erection panel during site erection. 16 gauge galvanized sheet for cable protection at the bottom sheeting plate.</p> <p><b>3) Side &amp; End Walls</b></p> <p>External walls are to be vertically corrugated 1.6 mm thick GI/CRCA conforming to IS 2062/IS 513.</p> <p>The corrugated panels shall form entire side wall and the assembled side wall shall be assembled with the peripheral frame members.</p> <p><b>4) Roof</b></p> <p>The roof has to be manufactured from 1.6 mm thick GI/CRCA conforming to IS 2062. The roof will have sloping arrangement for effective drainage.</p> <p><b>5) Flooring System</b></p>		
RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250	PART-B SUB-SECTION-III-C11 CONTAINERISED ROOM (PORTABLE CABIN)	PAGE 2 OF 4

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>Floor plating shall be covered with a non-skid surface. The exposed floor shall be covered with a insulating material as per statutory requirement.</p> <p><b>6) Insulation</b></p> <p>Containerised room will be insulated on sides, end walls, roof &amp; doors with 50mm thick Glass Wool/Rockwool insulation. Densities should be 48 kg/m<sup>3</sup></p> <p><b>7) Inner Paneling</b></p> <p>Interiors of the Containerised room shall be aesthetically finished so as to give a pleasing appearance with high quality workmanship. All joints shall be neatly finished. For side, roof and end walls paneling will be done with 1.6mm thick Galvanized sheet.</p> <p><b>8) Doors</b></p> <p>All exterior doors shall be of weather-proof construction with four sided frames. All exterior hardware shall be stainless steel, including, but not limited to hinges. Hinges shall be concealed type. If non concealed type then the hinge should be tamper proof arrangement.</p> <p>Doors shall be fabricated from aluminum with SS panic hardware. Doors shall be lockable with one key for all doors. Provide four keys total.</p> <p>Two doors of Aluminum shall be provided unless otherwise specified. One equipment door and one personnel door shall be provided. The size of equipment door shall be as per equipment sizing. One personnel door minimum 1.2M x 2.5M shall be provided. Doors shall be of 4 hours fire rated.</p> <p><b>9) Protective Coating Procedure</b></p> <p>All steel structure members shall be cleaned prior to finishing. Standard interior finish shall be white. After welding do abrasive blast – SA 2 1/2 thereafter below process to be adapted</p> <p><b>A) Internal Panels Painting (Walls &amp; Roof) :-</b></p> <p>Powder Paint Sheet</p> <ul style="list-style-type: none"> <li>➤ Surface Preparation/Primer :Intercure 200HS Min 150 um</li> <li>➤ Finish : Interthane 990 Min 50 um</li> <li>➤ Total Minimum DFT shall be 200 um</li> </ul> <p><b>B) Exterior Panels Painting (Walls, Roof &amp; Base structure) :</b></p> <p>Powder Paint Sheet</p> <ul style="list-style-type: none"> <li>➤ Surface Preparation/Primer : Interzinc 52 Min 75 um</li> <li>➤ Coating : Interguard 475HS Min 200 um</li> <li>➤ Finish : Interthane 990 Min 50 um</li> <li>➤ Total Minimum DFT shall be 325 um</li> </ul> <p>Both Interior and exterior panels, roof and base frame will be painted in colour shade of RAL 5012.</p>		
<p align="center">RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p align="center">PART-B SUB-SECTION-III-C11 CONTAINERISED ROOM (PORTABLE CABIN)</p>	<p align="center">PAGE 3 OF 4</p>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p><b>10) Grounding</b></p> <p>Internal Earthing inside enclosure with suitable cross sectional GI flats. The building shall be furnished complete with ground pads which shall bond of electrical equipment enclosure frames and ground buses to the building frame at the exterior base in two locations and at opposite ends of the building so as to provide a continuous path to ground. The Grounding system shall connect to each end of the ground bus in each assembly of installed equipment.</p> <p><b>11) Lighting</b></p> <p>The lighting system shall maintain minimum levels as given below:</p> <p>Lux level shall be 200 inside the Containerised room and outside platforms/ stairs shall be 100 Lux.</p> <p>All luminaries shall be suitable for industrial duty and provided with IP65 housings for outdoor enclosures and IP54 for indoor enclosures. All fittings shall be weatherproof and able to withstand direct hosing. The wiring for lighting shall be routed through GI conduits either concealed or the wall of the enclosure</p> <p>External light around Containerised room only shall be considered. All Light Fixtures shall be high efficiency LED type only.</p> <p><b>12) Lifting Tools and Tackles</b></p> <p>Suitable lifting system shall be designed and furnished. The system will consist of a spreader bar, slings, shackles and other tools to lift the equipment building in one piece</p> <p>A lifting system installation &amp; operational diagram shall accompany all shipping documents.</p>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-III-C11 CONTAINERISED ROOM (PORTABLE CABIN)</p>	<p>PAGE 4 OF 4</p>





**PART – B (DETAILED TECHNICAL SPECIFICATION)**

**SUB-SECTION-IV-D (CIVIL WORKS)**

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**





## SUB-SECTION-IV-D


### CIVIL WORKS


**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**


**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>				
<p><b>1.00.00</b></p> <p><b>1.01.00</b></p> <p><b>1.02.00</b></p> <p><b>1.03.00</b></p> <p><b>2.00.00</b></p>	<p><b>GENERAL</b></p> <p>This section of the bidding document deals mainly with the technical specification for the design and preparation of detailed drawings, getting the design and drawings approved by the Employer, fabrication, erection and construction of the necessary civil, structural and architectural works associated with the Flue Gas Desulphurization system package for <b>Rajiv Gandhi Thermal Power Project, Hisar, Unit 1 &amp; 2 (2x600 MW)</b>. The work shall have to be carried out both below and above ground level and shall be involving, basements, equipment foundations, slabs, beams, columns, footings, rafts, walls, steel frames, brick walls, stairs, trenches, pits, access roads, culverts, trestles, silos, sumps, Limestone storage hopper &amp; shed, Crusher House, Transfer points, Conveyor Galleries, Tunnels, Gypsum storage shed, Chimney, Gypsum dewatering building, Ball Mill building, FGD control room building, Tank Foundations, absorber tower foundation, transformer foundation, MCC Building, finishes, complete architectural aspects, drainage, sanitation, water supply (from terminal points to various buildings/facilities) and all other civil, structural and architectural works associated with the complete FGD package.</p> <p>The specifications are intended for the general description of the work, quality and workmanship. The specifications are not, however, intended to cover minutest details and the work shall be executed according to the relevant latest Indian Standard Codes / I. R. S. / I. R. C. specifications. Where provisions are not covered in Indian Standards, reference shall be made to ACI, AISC, ASCE, EN, CICIND and other international standards or to the best prevailing local Public Works Department practices or to the instructions of the Engineer. Some of the relevant I. S. Codes to be followed are mentioned in the Technical Specifications. The Contractor is expected to get clarified on any doubts about the specifications, etc. before bidding, in writing with the Employer in respect of interpretation of any portions of this document.</p> <p>Bidder or his agencies engaged as detailer for fabrication drawings should have the experience of detailing for power plant structures or steel plant or Industrial structures like Petro/ Chemical/ Refinery/ Cement/FGD Plant/Coal Handling Plant/Ash Handling Plant etc.</p> <p>The designer responsible for preparation of scope drawings shall review and approve the fabrication drawings prepared by the detailer before releasing them for fabrication.</p> <p><b>CLAUSE DELETED</b></p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 1 OF 71</p>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<b>3.00.00</b>  <b>3.01.00</b>	<p><b>Work Description</b></p> <p><b>Truck Hopper, Limestone Storage hopper and Underground Tunnel</b></p> <p>Truck Hopper shall consist of underground portion, which shall be of R. C. C. with structural steel shed covered with permanently Colour coated profiled steel sheets.</p> <p>Limestone storage hopper shall be of RCC with structural steel shed covered with permanently Colour coated profiled steel sheets.</p> <p>The structural arrangement to be adopted for the design and construction of Limestone Storage hopper shall essentially consist of R. C. C. frames spaced at approx. 3.0M centers with R. C. C. wall panels on the sides and R. C. C. raft at the bottom, fixed to the frames. Minimum thickness of R. C. C. raft at bottom shall be 600 mm. Minimum thickness of RCC side walls shall be 600 mm at bottom and 300 mm at top.</p> <p>The vertical and inclined portion of hopper shall be provided with 50 mm thick guniting (shotcreting). Details of shotcreting have been given elsewhere in this specification.</p> <p>Expansion joints shall be provided at a maximum distance of 40m. 600 mm wide water stop fabricated with 22G copper plate with bitumen board fillers and polysulphide sealing compound as specified elsewhere shall be used as expansion joint material.</p> <p>Floor shall be provided with cross slope not flatter than 1 in 50 towards side drains. Side drains shall be sloped towards sump where sump pumps as specified elsewhere, shall be provided. The slope of side drains shall not be flatter than 1 in 400. Side drains and sump shall have removable type steel grating cover.</p> <p>Water proofing / Damp proofing of under ground Truck hopper, Limestone Storage hopper, tunnels and underground (i. e. basement) portion of transfer houses shall be done by providing the following treatments:</p> <p>Chemical injection grouting for inner faces (details as specified elsewhere).</p> <p>Polymer modified cementitious coating on earth side face as per the following:</p> <p>(1) On the outer surface of walls, frames and roof slabs coming in contact with earth, polymer modified cementitious coating in two layers as specified and as per manufacturer's specifications shall be provided directly on the concrete surface.</p> <p>(2) 50 mm thick P. C. C. (1 : 2 : 4 with 10 mm nominal size stone aggregates) shall be provided under the raft i.e. over the lean concrete, followed by polymer modified cementitious coating in two layers ( slurry mix application ) as per manufacturer's specification. 50 mm thick P. C. C. ( 1 : 2 : 4 ) with 10 mm nominal size stone aggregates shall then be laid over the polymer modified cementitious coating before laying the raft.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB SECTION-IV CIVIL WORKS</b>	<b>PAGE 2 OF 71</b>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>				
<p><b>3.01A.00</b></p> <p><b>3.02.00</b></p>	<p>Truck hopper and its gratings shall be designed for movement of front end loader/ bulldozer over them. Bull dozer weight shall be considered as about 35T. The gratings shall be built of min. 200x28mm thick flats in main direction and min.100mm x 20mm thick in secondary direction. No painting/galvanization shall be provided in gratings. However, two coats of Red oxide Primer to be provided immediately after fabrication.</p> <p>Plinth protection along with drains shall be provided along the Hopper complex. However, 5m wide paving shall also be provided around machinery hatches and Truck hopper.</p> <p>Earth pressure to be considered for design shall be due to earth pressure at rest (Ko) condition only. Earth pressure due to surcharge intensity of Uniformly Distributed Load (U. D. L) of intensity 2 T / Sq. M. shall be considered in the design.</p> <p>A minimum safety factor of 1.2 against uplift due to ground water shall be ensured during execution and after execution, considering dead weight of the structure to be 0.9 times only, ground water table to be taken at adjoining formation level and soil wedge angle of not more than 15 degrees.</p> <p>Also, FOS against uplift, to be taken as 1.0, considering the dead wt. of structure and soil resting on side projections if any in the vertical plane. Inclined wedge action of soil shall not be considered in this case.</p> <p>Wherever, slope of tunnel exceeds 10°, R. C. C. steps shall be provided for the entire width of each walkway.</p> <p><b>Limestone Storage Silo</b></p> <p>The supporting structure for silo shall be of structural steel.</p> <p><b>Overhead / Ground Conveyor Galleries and Trestles</b></p> <p>Overhead conveyors shall be located in a suitably enclosed gallery of structural steel. The overhead gallery shall consist of two vertical latticed girders having rigid jointed portal frame at both ends. Cross beams at floor level supporting conveyor stringer beams shall be made of single rolled steel beam or single channel section (ISMB or ISMC) or plate girder. Horizontal bracings are to be provided at top &amp; bottom plan of the gallery (latticed girders shall be braced together in plan at the top and bottom). Common end portal frame shall not be used for adjacent conveyor spans. Roof truss shall be provided at upper node points of latticed girders to form an enclosure. Contractor can also use tubular steel sections for roof truss only of conveyor galleries. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS 1161 and rectangular/square steel sections shall conform to IS 4923. The steel structures using tubular sections shall be designed and fabricated as per IS 806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. The maximum span of overhead gallery shall be limited to 25 meters unless higher span is required due to site conditions, which shall be subject to approval of the Engineer. The gallery should as far as possible be erected as a box section keeping all the vertical and horizontal bracing tied in proper position. The gallery should be checked for all</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 3 OF 71</p>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>erection stresses that are likely to develop during handling and erection and if required, temporary strengthening of gallery members during erection shall be made.</p> <p>Seal plates under the conveyor galleries shall be provided in such a way that complete gallery bottom shall form a leak proof floor.</p> <p>The ground conveyors shall be located in suitably enclosed gallery of structural steel consisting of rigid portal frames spaced at regular intervals and suitably braced. Plinth protection along with drains shall be routed along the ground conveyors.</p> <p>For double stream conveyor gallery, two side and one central walkway of width 800 mm and 1100 mm respectively shall be provided. The width of two side walkways for single stream conveyor gallery shall be 800 mm and 1100 mm respectively. Both sides of central and side walkways shall be provided with pipe handrails all along the conveyor gallery. Hand railing should not be supported on conveyor supporting stringers. The walkways shall be chequered plate construction with anti - skid arrangement. The anti - skid arrangement will consist of welding of 10 mm square steel bars at a maximum spacing of 500 mm along the length of the gallery. Where the slope of walkway is more than 10°, chequered plate steps with nosing and toe guard shall be provided. The floor of conveyor gallery all along the gallery length, shall be provided with minimum 12 gauge thick seal plates and other drainage arrangements as specified elsewhere</p> <p>Conveyor gallery shall have permanently colour coated steel sheet covers on roof and both sides. However in roof, a panel of minimum 1.5 m x 1.5 m area at about 6.0 m center shall be provided with translucent sheets of polycarbonate material for natural lighting. A continuous slit opening of 500 mm shall be provided on both sides just below the roof sheeting. Adequate provision of windows shall be kept on both sides of conveyor gallery as appended in Mechanical Section (Belt conveyor system). Windows shall be provided with wire mesh as specified elsewhere in this specification.</p> <p>Cross-over with chequered plate platform and ladder for crossing over the conveyors shall be provided at approximately every 100 M intervals of conveyor. Crossover shall preferably be located over four-legged rigid trestle location.</p> <p>For railway tracks passing below overhead conveyor gallery and along conveyors, the railway clearances both underground as well as over ground shall have to be adhered to for design, execution and erection of foundations, trestles, galleries etc., so that movement of locomotives and wagons is not hampered in any way during execution and afterwards. However at the location where the overhead conveyor gallery crosses road / rail line, minimum clearance of 8.5m above the road crest / rail top shall be provided.</p> <p>For calculation of material load on moving conveyor, a multiplication factor 1.6 shall be used to take care of inertia force, casual over burden and impact factor etc.</p> <p>Thus material load per unit length of each moving conveyor shall be</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB SECTION-IV CIVIL WORKS</b>	<b>PAGE 4 OF 71</b>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	1.6	X	<p style="text-align: center;">Rated capacity of conveyor system</p> <p style="text-align: center;">----- x F</p> <p style="text-align: center;">Conveyor Belt Speed</p> <p>Where, F = 1700/1400 for lime &amp; 1250/900 for gypsum</p> <p>It should be noted that for structural design, unit weight of lime shall be assumed as 1700 Kgs. / Cu. M. instead of 1400 Kgs. / Cu. M., unit weight of gypsum shall be assumed as 1250 Kgs. / Cu. M. instead of 900 Kgs. / Cu. M. considered for system sizing purpose. Conveyor Gallery structure shall be designed considering both conveyors operating simultaneously.</p> <p>Conveyor gallery and supporting trestles located between transfer houses / buildings shall be arranged in any one of the following ways.</p> <p>a) All gallery supporting trestles shall be four legged type only. One end of each gallery span shall be hinged to the supporting trestle and the other end shall be slide type. Slide type support shall be with P. T. F. E. bearings to allow both rotation &amp; longitudinal movements.</p> <p>b) In between transfer houses / buildings, four legged trestles shall be placed at a maximum interval of 90 metres. The arrangement shall be such so as to ensure that force in the longitudinal direction (i. e. along the conveyor length) of conveyor gallery of length not more than 90 m is transferred to any four legged trestle. In the space between each successive four legged trestles, two legged trestles shall be provided at regular intervals. The end supports resting on the four-legged trestle can have either ends hinged or one hinge and the other on slide type depending on the arrangements. Slide type support shall be with P. T. F. E. bearings to allow both rotation &amp; longitudinal movements.</p> <p>End of conveyor gallery which will be supported over transfer house, shall be so detailed that only vertical reaction is transferred from conveyor gallery and no horizontal force in longitudinal direction is transferred from conveyor gallery to transfer house structure and vice - versa.</p> <p>For trestles and trestle foundations for conveyor galleries located adjacent to existing structures, over ground and under ground facilities, location and details of these trestles and foundations shall have to be decided such that there is no interference both underground as well as over ground with existing structures and facilities. Trestle columns / ground conveyor portal column base shall be kept 300 mm higher than the existing ground level.</p>
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB SECTION-IV CIVIL WORKS</b>	<b>PAGE 5 OF 71</b>





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<p><b>3.03.00</b></p>	<p><b>Transfer Houses</b></p> <p>The over ground portion of the transfer house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding (from lowest working floor level till top) and R. C. C. floors comprising of RCC slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. However, the lower portion of side cladding, at ground, for a minimum height of 0.9 m above the finished floor level shall be one brick thick wall plastered on both side. In some areas like MCC floors etc., one brick thick wall cladding shall be provided. Brick wall cladding shall be supported on encased wall beams and suitably anchored to adjoining columns and beams. Vertical bracings shall be provided only on four sides along the periphery. Grade slab with 0.9m height one brick thick wall plastered on both side at periphery shall be provided for all transfer houses.</p> <p>Adequate steel doors and windows for proper natural lighting and ventilation shall be provided. In addition to steel windows, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting.</p> <p>The roof of Transfer points shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water.</p>		
<p><b>3.04.00</b></p>	<p><b>Crusher House</b></p> <p>The crusher house shall be framed structure of structural steel work with permanently colour coated profiled steel sheet side cladding. However, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting. The lower portion of side cladding, at ground, for a height of minimum 0.9m above the finished floor level shall be of one brick thick wall plastered on both faces. Floors shall be of R. C. C. slab over profiled metal deck sheets (to be used as permanent shuttering) over structural beams. Shear anchor studs shall be provided through metal deck at regular interval on all top flange/flange plate of structural beams. Within this building cubicles are to be provided for resting room of operators and these shall be constructed with one brick thick brickwork having both sides plastered and roof slab. Adequate steel doors and windows for natural lighting and ventilation shall be provided. Vertical bracings shall be provided only on four sides along the periphery.</p> <p>The roof of Crusher house shall be provided with pre-fabricated insulated metal sandwich panels. Composition of Insulated Metal Sandwich Panels shall be as described elsewhere in the Technical Specification. Adequate slope shall be provided for quick drainage of rain water.</p> <p>Crushers shall be supported on R. C. C. deck, which in turn will rest on suitable vibration isolation system consisting of springs and dampers. This R. C. C. deck</p>		
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<p><b>3.05.00</b></p>	<p>shall be isolated from the floor. However, the vibration isolation system consisting of springs and dampers may rest on main building framework. Detailed specification of vibration isolation system including the unbalanced force, frequency and amplitude criteria and other design requirements are appended elsewhere in this specification.</p> <p><b>Control building, M. C. C. Buildings</b></p> <p>These shall be framed building with R. C. C. roof and floor. For steel framed building roof /floor shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only ) over structural beams. Cladding shall be of brickwork/concrete block work with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification. Suitable arrangement shall be provided so as to prevent ingress of water into the cable trenches inside the building from cable entry locations.</p> <p>All air - conditioned areas, shall be provided with false ceiling system (details specified elsewhere) with under deck insulation. Control room should be so designed that it shall absorb noise. Also, ceiling of control room should be flame retardant.</p> <p>Adequate aluminium doors and windows shall be provided for natural lighting, ventilation and view. All windows in air conditioned rooms shall have hermetically sealed double glazing.</p>		
<p><b>3.06.00</b></p>	<p><b>Pent House</b></p> <p>These shall be of R. C. C. framed structures with columns, beams, slabs and foundations etc. Cladding shall be of brickwork with plastering on both sides. Roof shall be provided with roof water proofing treatment as specified elsewhere. Adequate nos. of steel doors and windows shall be provided for natural lighting and ventilation.</p>		
<p><b>3.07.00</b></p>	<p><b>Gypsum Storage Shed</b></p> <p>The Gypsum storage shed shall be RCC framed structure with RCC/ Brick infill wall (upto Tripper floor) and structural steel shed with permanently colour coated profiled steel sheet roof and side cladding (above tripper floor). Roof shall be provided with troughed profile permanently colour coated sheet with slope of 1 in 5 for quick drainage of rain water. At grade level Heavy duty paving as detailed elsewhere in the specification shall be provided inside the shed.</p>		
<p><b>3.08.00</b></p>	<p><b>Toilet</b></p> <p>Toilet with potable water line facilities shall be provided in each of the following locations:</p> <p>(a.) In all M. C. C./ Control buildings</p>		
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<p><b>3.09.00</b></p>	<p><b>Staircases, Gratings, Handrails</b></p> <p>All floors of transfer points/crusher houses and other facility buildings shall be accessible through staircase. All staircases of Transfer points and crusher house shall be of steel. Cage ladders (min. 450mm wide) shall be provided for access to roof of penthouses, single storey mcc rooms &amp; mumty. All Stairs shall be minimum 1200 mm wide, maximum rise should not be more than 180 mm and minimum tread with 250 mm. Numbers and arrangement (including enclosures etc.) of stair cases shall be such as to meet the fire safety requirement as per guide lines of statutory regulatory bodies. For steel staircases, Stringers shall be of rolled steel channel ( minimum ISMC 250) and tread shall be of steel gratings. Outside stairs to transfer points/crusher house shall be open type. However sheeting shall be provided at the top. Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection for treads of stairs in underground TP's</p> <p>All gratings shall be electro forged types. Minimum thickness of the grating shall be 40 mm for indoor installation and 32 mm for outdoor installation. However, at entry or road crossing point's minimum thickness of grating shall be 40 mm The opening size shall not be more than 30mmx100mm. The minimum thickness of the main bearing bar shall be 6 mm or as per design requirement whichever is higher. All gratings shall be designed for minimum imposed load of 500Kgs. / Sq. M. If actual expected load is more than the specified load, then actual load is to be considered. All gratings shall be hot dip galvanized at the rate of 610 g. per sq.m. after surface preparation by means of blast cleaning/ acid pickling.</p> <p>Minimum 1000 mm high hand railing shall be provided around all openings, projections / balconies, walkways, platforms, Stairs, etc. All handrails and ladder Pipes shall be 32 mm nominal bore MS Pipes (medium class) as per IS:1161. Handrails shall have top and middle rails at a height of 1000 mm and 500 mm and the vertical post spacing shall not exceed 1.50 M, with provision of kick Plates (100 mm high and 6 mm thick). All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. M as per IS:4736.</p>		
<p><b>3.10.00</b></p>	<p><b>Trenches</b></p> <p>All trenches for cables or any other underground facility as detailed out elsewhere shall be of R. C. C. Cable trenches shall be provided with pre - cast R. C. C. covers / chequered plate cover. Cable trenches as well as pre - cast covers shall be provided with edge protection angles and lifting hooks. All embedments / block outs as required and specified elsewhere in these specifications shall be provided. Proper drainage arrangement shall be provided. Trench pre - cast cover weight shall not be more than 65 Kgs. Trench covers near entry or at road crossings shall be designed for 10 T wheel load at centre. Pre - cast covers shall be designed for central point load of 75 Kgs. R. C. C. cable trenches shall be filled with sand after erection of cables, up to top level and covered with pre - cast R. C. C. covers. For cable trenches outside buildings, top level shall be 200 mm above G. L and sand filling shall be overlaid with 50 thk. PCC.</p> <p>Minimum 50 x 50 x 6 mm size angles with lugs shall be provided as edge protection all around cut outs / openings in floor slabs, edges of drains supporting</p>		
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<p><b>3.11.00</b></p> <p><b>3.12.00</b></p> <p><b>3.12.01</b></p> <p><b>3.12.02</b></p>	<p>grating/precast RCC covers, edges of R. C. C. trenches supporting pre - cast covers, supported edges of pre - cast cover</p> <p><b>Cable gallery/trestles</b></p> <p>Cable galleries/trestles shall be made of structural steel. The contractor can use either rolled sections or tubular steel sections. The tubular steel section shall be of circular/rectangular/square shape. The circular steel tube shall conform to IS:1161 and rectangular/square steel sections shall confirm to IS:4923. The steel structures using tubular sections shall be designed and fabricated as per IS:806 – “Code of Practice for use of steel tubes in general building construction.” and <b>EN 1993-1-8:2005</b>.</p> <p><b>Transformer Foundation</b></p> <p>Foundations of transformers shall be designed for seismic and wind loads in addition to other applicable loads. Block foundations shall be provided for the main transformer block.</p> <p>The oil soak pit, if provided, shall be filled with gravel of size 40mm. The volume of the soak pit shall be sufficient to store complete oil of the transformer/reactor along with 10 minutes of fire water considering only 40% of the volume as available voids between gravel filling. However, in case a separate oil collection tank is provided for the transformer/reactor, oil soak pit of volume equivalent to one-third (1/3) the oil volume of transformer/reactor shall be provided around transformer/reactor. The oil collection tank, in such cases, shall be designed for an effective capacity of complete oil of the transformer along with 10 minutes of fire water. The oil soak pit shall also be provided with a sump at the corner to allow drainage of water/oil from the soak pit.</p> <p>Arrangement for moving the transformer into place using rail cum road, jacking pads and pulling blocks including inserts, as required, shall be provided along with the transformer/ reactor foundations.</p> <p>RCC Firewall shall also be provided between the transformers wherever required.</p> <p>300 mm thick PCC M20 encasement all around the Pylon supports inside soak pit for fire fighting system shall be provided up to top of gravel filling. Coarse aggregate filling inside the transformer oil soak pit shall be carried out only after construction/erection of Pylon supports and PCC encasement.</p> <p><b>Fencing</b></p> <p>Fencing with toe wall and steel gates shall be provided around the transformers. Fencing shall comprise of PVC coated GI chain link fencing of minimum 8G (including PVC coating) of mesh size 75 mm and of height 2.4 m above the toe wall. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 12G. Fence posts shall be of pre – cast R. C. C. of minimum M20 grade. All corner posts will have two stay posts and every tenth post will have</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 9 OF 71</p>


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<p><b>3.13.00</b></p> <p><b>3.14.00</b></p> <p><b>3.14.01</b></p>	<p>transverse stay post. Suitable R. C. C. foundation for the post and stays shall be provided based on prevailing soil conditions. Gates shall be sturdy with locking provisions.</p> <p>Toe walls of brick masonry shall be provided between fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation level with 50 mm thick P. C. C. coping (1: 1. 5: 3) and shall extend minimum 300 mm below the formation level. Toe wall shall be plastered on both sides and painted with two coats of cement paint of approved colour and shade. Toe wall shall be provided with weep holes at suitable spacing</p> <p><b>Booster Fan Foundation &amp; Mill Foundation</b></p> <p>Booster Fan foundations and Mill Foundations shall be RCC block foundation directly resting on virgin soil/ pile below Ground level. The vertical faces of this block foundation shall be isolated from adjacent footings by providing minimum 100mm thick polystyrene board of type-1 conforming to IS: 4671 with density 20 Kg/cum sandwiched between the vertical face of block foundation and 230 thick brick wall all round.</p> <p><b>CHIMNEY</b></p> <p><b>Salient Features</b></p> <p>Configuration and height of chimney(s) shall be as specified in mechanical portion of technical specification. Chimney shall be of reinforced concrete construction. There shall be one flue (liner) for each unit. The centre to centre distance between the proposed chimney(s) and the existing chimney(s) &amp; NDCT in any direction shall not be less than 150 metres.</p> <p>The chimney shell (windshield) shall be constructed using slip form shuttering. Internal platforms of steel structure shall be provided for enabling access to various elevations of the chimney and to provide support to the flue liners. Spacing of internal platforms shall not exceed 45.0 M. The platform beams shall be supported on concrete shell using suitable load bearing arrangement in the recesses provided for the purpose. The platform beams getting supported in the chimney shell shall have complete bearing support within the thickness of shell at that location and shall in no case be supported completely/partially on corbels/ brackets from the shell. "Through openings" in shell if provided to facilitate erection of platform beams shall be closed with cast-in-situ RCC closure wall on the external face of the shell. Necessary dowel bars shall be provided in the shell during construction for this purpose. Openings in the concrete shell for flue duct entry, access door &amp; truck entry door at ground level, air ventilation etc shall be provided. Hand railing shall be provided all around internal staircase &amp; around the ventilation voids in the internal platform using min. 32 mm nominal bore MS pipes of medium class conforming to IS:1161. Spacing of railing posts shall not be more than 1500 mm centre to centre with a minimum height of 1200 mm. The handrail shall have three rows of horizontal members between the railing posts including the top member. Kick plate of min. size</p>	<p><b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b></p>	<p><b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b></p>	<p><b>PART-B SUB SECTION-IV CIVIL WORKS</b></p> <p><b>PAGE 10 OF 71</b></p>

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	<p>100x6 thick shall be provided in the hand railing.</p> <p>The flue duct outside the chimney shall be suitably connected to the flue liner inside the chimney through a transition duct. The transition duct shall be profiled into a circular shape to connect to the flue liner. The flue duct shall be so designed that no load is transferred on the chimney shell due to the duct. The interface between the flue liner and the transition ducting shall be provided with non-metallic expansion joint.</p> <p>The expansion joint in the flue liner shall comprise of non-metallic material suitable for wet stack operations, shall be acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters &amp; operating conditions as specified elsewhere in the specification and shall also prevent dust accumulation. The space between the expansion joint material and the liner shall be packed and sealed by providing a bolster made up of light weight compressible material suitable for wet stack operations and acid resistant to withstand acidic flue gas condensates arising out of flue gas parameters &amp; operating conditions as specified elsewhere in the specification. The bolster shall be confined in texturized glass fabric having a final covering of stainless steel wire mesh.</p> <p>Chimney roof shall be of RCC slab over a grid of structural steel beams and provided with rainwater drainage system. An internal structural steel staircase supported from chimney shell with chequered plate floor panels and pipe handrails, shall be provided upto the platform just below roof platform and an internal cage ladder for a small height, over last staircase landing to access the chimney roof through a roof access hatch.</p> <p>The other components of the chimney include liner test ports (for continuous pollution monitoring and for offline monitoring), liner hatches, grade level slab of RCC with metallic hardener floor finish, acid resistant treatment on roof slab, a large electrically operated grill type roll-up door and personnel access metallic door at grade level, roof drain basin, rain water down comer pipe (150 mm diameter galvanized pipe), connection to plant drains, louvers with bird screens for ventilation and all other openings in the wind shield, all finishing works, electrical power distribution boards, lighting panels, power &amp; control cabling and wiring systems, stair and platforms lighting, socket outlet, lightning protection and grounding system, aviation obstruction lighting with photoelectric controller etc, communication system, a rack and pinion elevator and other items, though not specifically mentioned but reasonably implied and necessary to complete the job in all respects..</p> <p>Aviation Warning Lights (AWL) shall be mounted on door panel of required size (open able from interior of chimney shell) fixed to openings in the chimney shell at locations and levels specified elsewhere. Suitable provision for approach to the AWL shall be provided at the platform level. AWL shall be located at about 1-1.5 metre above the top of platform to enable easy handling for maintenance.</p> <p>The size of roll-up door shall be determined based on minimum requirement for ventilation and transportation &amp; erection of flue segments.</p>		
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<p><b>3.14.02</b></p>	<p><b>Design Concept</b></p> <p>Design and construction of various components and systems of the chimney shall be in accordance with relevant Indian Standard and where provisions are not covered in Indian Standard, reference shall be made to ACI, BS, CICIND and other international standards.</p> <p>In case of any conflict between this document and the Indian and International Standards, the stipulations of this document shall prevail.</p> <p>Imposed loading for design of all chimney components shall not be less than 5 kN/Sq.m. An additional 25% of liner load shall be taken as impact loading for liner erection in addition to the liner load.</p> <p>The min. thickness of web for plate girders shall be kept as 12 mm.</p> <p>Seismic forces on the chimney system shall be determined based on site specific seismic information provided elsewhere in this document.</p> <p>Wind forces on the chimney system shall be determined based on site specific wind design criteria provided elsewhere in this document.</p> <p>The chimney and its components shall be designed to resist the most onerous forces resulting from all the possible combinations of the various loadings.</p>		
<p><b>3.14.03</b></p>	<p><b>Wind Shield</b></p> <p>The wind shield shall be designed for vertical loading, cross wind loading, seismic loading, circumferential wind loading, thermal gradients etc. The analysis and design of wind shield shall be carried out as per IS 4998. The wind shield shall be analysed for cases with and without flue liner loads.</p> <p>Forces/stresses in the wind shield due to eccentricity effects of local loadings, insolation effects, rotation of chimney foundations, construction tolerances and moments of second order shall also be considered.</p> <p>Seismic response of the chimney shall be computed by the response spectrum method. At least, the first five modes of vibrations shall be used for this analysis.</p> <p>The cross wind analysis of the chimney shall be carried out irrespective of the value of the Scruton Number for the chimney and other empirical considerations which suggest structural immunity to cross wind oscillations.</p> <p>The effect of the openings/cut-outs in the chimney shell shall be duly considered in the design of the windshield. The minimum thickness of shell shall not be less than 500mm.</p> <p>The minimum vertical reinforcement shall be 0.3% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 250 mm on each face. The minimum circumferential reinforcement shall be 0.2% of the concrete area. The maximum spacing of the reinforcement bars shall not be more than 200 mm on each face. The circumferential reinforcement in the top 3 meters of the windshield shall be twice that required from design forces. The clear cover to reinforcement shall be 50 mm.</p>		
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<p><b>3.14.04</b></p> <p><b>3.14.05</b></p>	<p>There shall be a continuous ring of concrete shell without any opening for a height of atleast 5m below the soffit of flue duct openings.</p> <p>There shall not be any reverse (outward) slope in the inside face of chimney shell. Where there is a change in slope/ profile of the shell, the circumferential reinforcement shall be increased to twice the requirement as per the design in a circumferential band extending atleast 3m above and below such slope/profile change level.</p> <p>The diameter of the reinforcing bar for the main vertical reinforcement of shell shall not be less than 25mm for a shell height upto the top level of flue duct opening.</p> <p>Shell thickness between any two 10m reference levels shall not vary more than 150mm.</p> <p>The minimum thickness of shell/closure wall at beam support recess/ opening locations shall be 100mm.</p> <p>Grade of concrete for chimney shell, and other super structure shall be minimum M 30. Only OPC cement shall be used for Chimney shell and other super structure.</p> <p>The final design shall be checked &amp; verified by 'Wind Tunnel Test' conducted at a reputed institution. Dynamic interference effects due to additional chimney(s)/NDCTS's and other tall structures located upto distance of 20 times diameter at 2/3rd height of subject chimney, in the area or in the future expansion stage of the project, as envisaged by the owner at the time testing, shall be determined along with the other topographical features of the local area through model test.</p> <p><b>Flue Liners</b></p> <p>The flue gas parameters &amp; various operating conditions for selection of flue liner material, material specification for flue liner and the criteria of flue gas exit velocity for sizing the flue liner shall be as specified elsewhere in the specification.</p> <p>For flue liner with base metal as mild steel, the thickness of the base metal shall be determined from structural considerations. The thickness of any clad metal/coating/block lining etc. provided on the base metal shall not be considered for computing the structural strength of flue liner. The minimum thickness of the mild steel base metal shall, however, not be less than that specified elsewhere in the specification.</p> <p>Two manholes placed diametrically opposite shall also be provided in each flue at all internal platform levels.</p> <p>The supporting/restraining arrangements of the liners should be such that expansion of the liners longitudinally or circumferentially is not restrained.</p> <p><b>Internal Platforms</b></p> <p>The platforms shall be designed for dead, imposed (live), erection work and other possible loadings and temperatures effects. These platforms shall provide support</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 13 OF 71</p>


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<p><b>3.14.06</b></p> <p><b>3.14.07</b></p> <p><b>3.14.08</b></p> <p><b>3.14.09</b></p>	<p>and lateral restraint to the steel liners and provide access for inspections and maintenance. Forces imposed on the floors due to lateral restraint of flues shall be enhanced aptly for impact effects. These platforms shall also be designed suitably for the liner erection works. The platform shall be made up of chequered floor panels supported on grid of structural steel beams. All beams shall have bolted connections. The maximum permissible deflection in main steel girders supporting flue liner shall be span/1000.</p> <p><b>Internal Staircase</b></p> <p>The staircase shall have a clear passage way width of not less than 800 mm and a clear headroom of not less than 2100 mm. The riser height shall not be more than 175 mm and tread width shall not be less than 225 mm.</p> <p><b>Foundation</b></p> <p>The chimney foundation shall be designed as per limit state method as per IS 4998 for the most critical combination of forces and moments, resulting from all possible combinations of the various loadings from the chimney system during all stages of constructions. The effect of water table shall be considered and the foundation shall be checked for overturning for minimum and maximum vertical loads. There should be no uplift under any portion of the foundation/piles for any loading condition. Since chimney is a wind sensitive structure, no allowance shall be made in the load carrying capacity of the bearing strata / piles under any load case/combination with wind. The foundation diameter to depth ratio shall be maintained to around 10 and should preferably not exceed 12. The diameter of the reinforcing bar for the main radial and tangential reinforcement for the foundation shall not be less than 25mm. The spacing of radial steel at the outer edge of the foundation shall not be more than 250mm. Grade of concrete for foundation shall be minimum M 30.</p> <p><b>Thermal insulation (Applicable in case of Titanium / C-276 Flue Liner)</b></p> <p>The insulation shall be semi rigid, resin bonded type, in the form of slabs and shall conform to IS: 8183. Blanket type insulation shall not be used. The density of insulation shall not be less than 64 kg/cu.m for resin bonded glass wool insulation and 100 kg/cu.m for resin bonded rock wool. The coefficient of thermal conductivity of insulation shall not be more than 0.52mW/cm/oC at a mean temperature of 100oC.</p> <p>The insulation thickness shall not be less than 100 mm, in any case, and shall be provided in two layers with the second layer of insulation covering the joints of the first layer. The insulation shall be wrapped on the outer-most surface with galvanized wire mesh using MS galvanised pins and speed washer.</p> <p><b>Chimney Painting</b></p> <p>(i) All exposed steel surfaces (including exterior surface of mild steel flue liner in case the design does not envisage provision of thermal insulation on the</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 14 OF 71</p>





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	<p>exterior surface of flue liner) shall be painted as specified in corrosion protection clause of this specification.</p> <p>(ii) All steel parts embedded in concrete like bolts, nuts, washers, pipe sleeves and insert plate shall be galvanized as per IS:4736. The minimum weight for galvanizing shall be 610 g/sq.m and shall comply with relevant IS Codes.</p> <p>(iii) The inside surface of chimney shell above roof, horizontal surface of shell at top, underside of concrete roof slab etc. shall be painted with epoxy phenolic coating system having total 220 microns DFT.</p> <p>a) All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% <math>\pm</math>2%) of minimum 50 micron DFT to be applied over cleaned surface in multiple coats. Surface to be coated shall be absolutely dry, clean and dust free.</p> <p>b) Sealer coat shall be followed with the application of Intermediate coat of epoxy phenolic coating (solid by volume minimum 63%) of minimum 100 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.</p> <p>c) Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% <math>\pm</math>2%) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 <math>\Delta</math>E) and minimum 70 micron DFT. This coat shall be applied after an interval of minimum 10 hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.</p> <p>(v) The entire external surface of chimney shell shall be painted with epoxy phenolic coating as specified in (iv) above in alternate bands of 'signal red' and 'bright white' colours.</p> <p><b>3.14.11 Rack and Pinion Elevator</b></p> <p>A rack and pinion elevator, with a load carrying capacity of 400 kg (min) (passenger cum goods), cabin floor size of 1100 mm x 1000 mm (min.) and an operating speed of 40 m/min. (approx.), shall be provided for travel from the grade level to the top of the chimney. A landing platform shall be provided at all access/ platform levels. The elevator shall be of a proven and approved make. Enclosure shall be fabricated from tubular steel and expanded metal or wire mesh, 2.1 m high (Approx.). A Safety device comprising of an over speed governor in constant mesh with the rack by means of a flame hardened steel pinion shall be provided to protect the cab against over speed during the cab downward motion and the same shall actuate the brake mechanism and stop the down ward motion gradually. The lift shall be installed using anchor fasteners. The electrical requirement of the system shall conform to the main electrical specification. Drive motor shall be of S3 duty class with CDF of 25%</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB SECTION-IV CIVIL WORKS</b>	<b>PAGE 15 OF 71</b>

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<p>3.15.00</p> <p>3.16.00</p> <p>4.00.00</p> <p>4.01.00</p>	<p>and maximum number of 120 starts per hour in 55 degree Celsius ambient temperature. The motor shall be provided with internal 220V AC single phase space heaters or an alternate heating system. The elevator shall be supplied, installed, painted, tested, commissioned etc. complete with all mandatory spares (as specified in Part-F of this specification) and operation maintenance manual</p> <p><b>Limestone Grinding System building</b></p> <p>This shall be framed building with R. C. C. roof and floor. For steel building roof /floors shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only over structural beams). Cladding shall be of single skin metal sheeting or brickwork/concrete block work with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification.</p> <p><b>Gypsum Dewatering Building</b></p> <p>This shall be framed building with R. C. C. roof and floor. For steel building roof /floors shall comprise of RCC slab over profiled metal deck sheets (to be used as permanent shuttering only over structural beams). Cladding shall be of single skin metal sheeting or brickwork/concrete block work with plastering on both sides. Roof shall be provided with roof water proofing treatment, as specified elsewhere in the Technical specification.</p> <p><b>Drainage &amp; Water Supply Works</b></p> <p>Drainage System:</p> <p>The drainage arrangements shall be so planned so as to ensure quick disposal of drainage water without stagnation and / or overflow. It is envisaged to clean the facility buildings etc. with water periodically.</p> <p>Minimum 4 nos. down comers shall be provided in each building at corners.</p> <p>For Conveyors, each down comer shall lead the water / slurry to pit (of 2 Cu.M capacity) to allow settling of lime/gypsum. The water from the pit shall overflow into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road.</p> <p>For Ball Mill building, Gypsum dewatering building, FGD control room building, peripheral drains (Brick drains with steel gratings provided around the building) shall lead the water / slurry to a local pit (of 2 Cu. M. capacity) near each facility to allow settling. The water from the pit shall overflow into contractor's R.C.C drain, and finally into owner's drain routed alongside the nearby road.</p> <p>In case of Control rooms and M. C. C. buildings Pump houses, etc, water / slurry coming from down comers shall discharge into peripheral drains (Brick drains with</p>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 16 OF 71</p>


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<b>4.02.00</b>	<p>steel gratings provided around the building) which will lead the water / slurry into contractor's R.C.C drain, which will lead the discharge finally into owner's drain routed alongside the nearby road.</p> <p>Contractor's scope shall also include construction of necessary culverts under the rail lines / roads as per railway / I. R. C. standards and approval of Railway culverts from concern Railway authorities.</p> <p><b>Internal and external water supply, drainage etc.</b></p> <p>The scope for potable water supply includes all distribution systems, tanks, pipes, fittings etc. as required and as described here or elsewhere in the specifications.</p> <p>The scope for service water supply and dust control water supply shall be as described elsewhere in the specifications.</p> <p>For water supply, medium class galvanized mild steel pipes conforming to IS: 1239 shall be used.</p> <p>All facility buildings shall be provided with open surface brick drains of minimum size of 300 mm width and 300 mm depth all around the periphery. All drains excepting the peripheral drains around facility building shall be of R. C. C. construction. Drains shall have removable steel grating cover and shall be provided with edge protection angles.</p> <p>For rain water down comer and those to be used for conveying water / slurry generated from cleaning of buildings floors, Galvanised MS pipes conforming to IS: 1239 (for 150 mm NB Medium grade pipes) with welded joints shall be used for MCC buildings, penthouse, control rooms, ball mill building, gypsum dewatering building, storage sheds.</p> <p>Galvanising shall be as per IS: 4736. The minimum mass of zinc coating shall not be less than 400 gms/sq.m. as per IS:6745. The zinc coating shall be smooth and shall be subjected to testing as per IS: 2633, for uniformity of coating. The zinc coating shall be free from all defects as per IS: 2629.</p> <p>All rain water down comers shall be provided with roof drain heads and complete with shoes bends, junctions, sockets, adapters, brackets and finished with anti-corrosive painting over a coat or primer.</p> <p>For design of building drainage system IS: 1742 shall be followed.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB SECTION-IV CIVIL WORKS</b>	<b>PAGE 17 OF 71</b>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<p><b>5.00.00</b></p> <p><b>5.01.00</b></p>	<p>For underground drain pipes, minimum class NP - 2 pipes conforming to IS: 458. At road crossings, concrete pipes of class NP 3 conforming to IS: 458 and at rail crossing R.C.C. box culvert to be provided.</p> <p><b>COLOUR COATED AND OTHER SHEETING WORK</b></p> <p><b>Material</b></p> <p><b>a) Wall Cladding &amp; Roofing Material</b></p> <p>Troughed permanently colour coated sheet of approved shade and colour shall be</p> <ul style="list-style-type: none"> <li>i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150</li> <li>ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150</li> <li>iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150.</li> </ul> <p>Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254.</p> <p><b>b) Metal Deck Roof Material</b></p> <p>Troughed permanently colour coated metal decking sheets shall be</p> <ul style="list-style-type: none"> <li>i) either of steel with minimum 0.8mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275</li> <li>ii) or of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275</li> <li>iii) or of steel of minimum 0.6mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275.</li> </ul> <p>Alternatively aluminium feed material of minimum bare metal thickness of 0.9 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254 can also be used for metal decking.</p>		
<p align="center">RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p align="center">PART-B SUB SECTION-IV CIVIL WORKS</p>	<p align="center">PAGE 18 OF 71</p>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<p><b>5.02.00</b></p> <p><b>5.03.00</b></p> <p><b>5.04.00</b></p>	<p>Thickness tolerance of (+/-) 0.04mm is permissible. However, all design calculations shall be carried out on the basis of lowest value of sheet thickness provided.</p> <p><b>Colour Coating</b></p> <p>Steel shall be colour coated with total coating thickness of at least 40 microns (nominal) comprising of silicon modified polyester (SMP with silicon content of 30% to 50%) paint or Super Polyester paint, of minimum 20 microns (nominal) dry film thickness (DFT) on external face over primer coat of minimum 5 microns (nominal) and minimum 10 microns (nominal) SMP or super polyester paint over primer coat of minimum 5 microns (nominal) on internal face. SMP and Super polyester paint systems shall be of industrial finish of product type 4 of AS/NZ2728.</p> <p><b>Design Criteria</b></p> <p>For wall cladding insulated / uninsulated sides and roof, permanently colour coated sheet of troughed profile shall be used. The nominal depth of trough shall be 30 mm.</p> <p>For profiled metal decking sheets (to be used for RCC floor slab or roof slab) the sectional modulus and moment of inertia of troughed profile per meter width shall be so as to limit the deflection of sheets to span/250 under total super imposed loading (DL +LL) comprising the self-weight of metal deck sheet, dead weight of green concrete and an additional construction load 100kg per sq.m for two span condition. The section modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements.</p> <p>For metal deck sheets used for roofing ( with or without RCC) and side cladding, the sectional modulus and moment of inertia of troughed profile per metre width shall be such that the deflection of sheets is limited to span/250 under design wind pressure for two span condition. The sectional modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS 801 for satisfying the deflection and strength requirements. No increase in allowable stress is permissible under wind load condition.</p> <p><b>Fasteners</b></p> <p>Side cladding/roofing/decking sheets shall be fixed to the runner/purlins using self-drilling special coated fasteners conforming to corrosion resistant class 3 of AS3566 and tested for 1000 hours salt spray test. Spacing of Self-drilling fasteners in transverse direction (along runners/purlin) shall be equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.</p> <p>Shear anchor studs shall also be provided through troughed permanently colour coated metal decking sheets metal deck, which are to be used as permanent shuttering, at regular interval on all top flange / flange plate of structural beams.</p> <p>The shear anchor studs for fixing metal deck sheet to floor structural beams shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 19mm diameter and 100mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by</p>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 19 OF 71</p>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>			
<p><b>5.05.00</b></p> <p><b>5.06.00</b></p>	<p>Drawn Arc Stud Welding through metal deck sheet.</p> <p>The shear anchor studs for fixing metal deck sheet to roof structural purlins shall conform to Type-B studs specified in AWS D1.1/D1.1M or equivalent as shear connector of 16mm diameter and 65mm length manufactured from cold drawn round steel bars conforming to the requirement of ASTM A 29, of grade designation 1010 through 1020, of standard quality with either semi-killed or killed, welded by Drawn Arc Stud Welding through metal deck sheet.</p> <p>Alternatively, J/U type hooks shall be used in roofing which shall be provided in transverse direction (along runners/purlin) at a spacing equal to the pitch of trough or 250(+/-100) mm, whichever is lesser and in longitudinal direction at every runner/purlin location.</p> <p><b>Miscellaneous Details</b></p> <p>To minimize the number of joints, the length of the sheet shall preferably be not less than 4.5m, cut pieces shall not be used, unless specifically approved by the Engineer. However, the actual length shall be such so as to suit the purlin / runner spacing.</p> <p>Lap between the sheets shall be at least 150mm in the longitudinal direction and at least one crest wide in the transverse direction which shall be properly anchored / fixed with fasteners.</p> <p>Z spacers if required shall be made of at least 2 mm thick galvanised steel sheet of grade 350 as per IS 277</p> <p>Sealant used for cladding shall be butyl based, two parts poly sulphide or equivalent approved, non stainless material and be flexible enough not to interface with fit of the sheets</p> <p>Filler blocks as a trough filler shall be used to seal cavities formed between the profiled sheet and the support or flashing. The filler blocks shall be manufactured from black synthetic rubber or any other material approved by the Engineer.</p> <p>All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain sheets having same material and any weather/moisture sealants with appropriate material and coating specification as mentioned above for the outer face of the metal cladding. Overlap shall be min. 150 mm or as specified by manufacturer.</p> <p><b>Pre-Fabricated Insulated Metal Sandwich Panels</b></p> <p>For structures where Pre-Fabricated Insulated Metal Sandwich Panels shall be used for Roofing, the sandwich panels shall comprise top sheet as troughed permanently colour coated sheet &amp; bottom sheet as plain permanently colour coated with 50mm thick insulation sandwiched between the two sheets. Each sheet shall be</p> <p>i) either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p> <p>PAGE 20 OF 71</p>





CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>ii) or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150</p> <p>iii) or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z275 / aluminium-zinc alloy coating to class AZ150.</p> <p>Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254.</p> <p>Metal sheets (steel or aluminium) shall be colour coated with total coating thickness of at least 40 microns (nominal) dry film thickness (DFT) comprising of Silicon Modified Polyester (SMP with silicon content of 30% to 50%) paint or Polyester paint, of minimum 20 microns (nominal) SMP or polyester paint on one side (exposed face), over minimum 5 micron (nominal) primer coat and minimum 10 micron (nominal) SMP or Polyester paint over minimum 5 micron (nominal) primer coat on other side. SMP and Super Polyester paint shall conform to product type 4 of AS/NZS 2728. Troughed sheet shall be of approved profile, sectional properties, (suitable for the specified loading / deflection and purlins / runners spacing), colour and shade.</p> <p>Special coated fastener conforming to corrosion resistant Class 3 of AS3566 and tested for 1000 hours salt spray test shall be used for fixing Pre-Fabricated Insulated Metal Sandwich Panels with the structural members below.</p> <p>The contractor shall prepare working drawings of sheeting system including end and side laps, fixing details etc. before starting sheeting work at site.</p> <p><b>5.07.00 Polycarbonate Sheets</b></p> <p>The polycarbonate sheet to be used for cladding and glazing purpose in conveyor galleries, Transfer points &amp; pump houses shall have toughed profile to match with the metal cladding profile. Minimum 3.0mm thick fire retardant and UV resistant polycarbonate clean sheet of approved make shall be used. The polycarbonate sheet shall be installed along with the metal cladding so as to have a watertight lapping arrangement. Suitable detailing shall be made to cater for the thermal expansion. IS 14434 to be referred for other details</p> <p><b>6.00.00 Roof Details</b></p> <p><b>6.01.00</b> Roof slab shall be minimum 150 mm thick and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom. For roof with metal deck the minimum thickness (150 mm) shall be above the top surface (crest) of the metal deck sheet.</p> <p><b>6.02.00</b> 900 mm high and minimum 100 mm thick R. C. C. parapet wall shall be provided over roofs of all buildings. Parapet wall shall have suitable coping. External face of</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB SECTION-IV CIVIL WORKS</b>	<b>PAGE 21 OF 71</b>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<p><b>6.03.00</b></p> <p><b>6.04.00</b></p> <p><b>6.05.00</b></p>	<p>parapet wall of the buildings provided with metal cladding shall also be finished with metal cladding of design and colour as per approved architectural drawings.</p> <p>Junction of roof and parapet shall be provided with 150 x 150 mm size concrete fillet.</p> <p>Drain level shall be provided with 45 x 45 cm size khurras having minimum thickness of 30 mm of M-15 concrete over PVC sheet of 1 m x 1m x 400 micron and finished with 12 mm 1 : 3 cement : sand plaster.</p> <p>Roofs of all control rooms, M. C. C. rooms, penthouse etc., shall have roof water proofing treatment. Roof water proofing treatment shall be as follows:</p> <ol style="list-style-type: none"> <li>1) Application of polymerised mastic over the RCC roof to achieve smooth surface as primer coat.</li> <li>2) Application of high solid content liquid applied urethane based elastomeric water proofing membrane, over the primer coat, to give uniform joint less dry film thickness of minimum 1.5 mm (as per ASTM C 836 and C 898).</li> <li>3) For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1: 100. This gradient shall be provided by screed concrete M-15 (using 12.5 mm coarse aggregate) and / or cement mortar (1: 4) over the elastomeric water proofing membrane with 25mm thick cement mortar (1:4) topping.</li> <li>4) Wearing course at top, shall consist of 25 mm thick P. C. C. (M-15) cast in panels of maximum 1.2 x 1.2 m size and reinforced with 0.56 mm diameter galvanized chicken wire mesh and sealing of joints using sealing compound / elastomeric water proofing membrane. Pathways for handling of materials and movement of personnel shall be provided with 22 mm thick chequered cement concrete tiles as per IS : 13801 for a width of 1000 mm in place of P. C. C.</li> </ol>		
<p align="center"> <b>RGTPP HISAR (2X600 MW)</b>  <b>FLUE GAS DESULPHURISATION (FGD)</b>  <b>SYSTEM PACKAGE</b> </p>	<p align="center"> <b>TECHNICAL SPECIFICATION</b>  <b>SECTION-VI</b>  <b>BID DOC. NO.:</b>  <b>31/CE/PLG/RGTPP/FGD-250</b> </p>	<p align="center"> <b>PART-B</b>  <b>SUB SECTION-IV</b>  <b>CIVIL WORKS</b> </p>	<p align="center"> <b>PAGE 22 OF 71</b> </p>





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6.06.00	<p>For efficient disposal of rain water, the run off gradient for the roof shall not be less than 1:100. This gradient can be provided either in structure or subsequently by screed concrete M-15 (using 12.5 mm coarse aggregate) and/ or cement mortar (1:4). However, minimum 25 mm thick cement mortar (1:4) shall be provided on top to achieve smooth surface.</p>		
6.07.00	<p>Medium class galvanised mild steel pipes conforming to IS: 1239/ IS: 3589 with welded joints shall be provided for rain water down comers to drain off rain water from the roof. These shall be suitably concealed with masonry work, to match with the exterior finish. The number and size of down comers shall be governed by IS: 1742 and IS: 2527. RCC roof shall be provided with 45 x 45 cm size Khurras having minimum thickness of 30 mm with M-15 concrete over PVC sheet of 1mx1mx400micron and finished with 12 mm thick cement sand plaster 1:3.</p>		
6.08.00	<p>Access to RCC roof of Gypsum dewatering building, FGD Control room building, MCC building, Ball mill building shall be through RCC staircase, and roof access to all other buildings shall be through cage ladder as per requirement.</p>		
6.09.00	<p>Fillets at junction of roof and vertical walls shall be provided with cast - in - situ cement concrete (M-15) nominal mix followed by 12 mm thick 1:4 cement sand plaster.</p>		
6.10.00	<p>The rainwater down comers shall be provided with suitable C.I. grating at inlet point.</p>		
7.00.00	<p><b>RCC Floors, Paving &amp; Grade Slab details</b></p> <p>The floor slabs shall be minimum 150 mm thick and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom.</p> <p>In case Bidder opts for steel super-structure with RCC floors/ roof, the bidder shall necessarily use Troughed permanently colour coated metal decking sheets having minimum thickness of 0.6mm as permanent shuttering. The detailed material property requirement of metal deck sheet is specified elsewhere in the specification. These profiled metal deck sheets shall be fixed to the structural steel beams/ purlins using headed shear anchor studs specified elsewhere in the specification. For floors with metal deck the minimum thickness (150 mm) shall be above the top surface (crest) of the metal deck sheet.</p> <p>Chequered plates (used for floors, walkways etc.) shall be minimum 6 mm thick. Mild steel flats/angles of suitable size shall be welded to the bottom portion of chequered plates at a designed spacing to stiffen chequered plates suitably. Chequered plates shall be fixed by staggered welding of suitable size. Floors of trenches shall have integral finish to concrete base.</p> <p>Toe guard of size 100 x 6 mm shall be provided at various openings provided in floors e.g. around stair case openings, chute openings and other similar cutouts. For conveyor walkways, angle runner to act as toe guard shall be provided.</p>		
<p align="center">RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p align="center">PART-B SUB SECTION-IV CIVIL WORKS</p>	<p align="center">PAGE 23 OF 71</p>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>R. C. C. floors (where no brick masonry walls are provided) shall be provided with handrails all along the periphery.</p> <p>RCC paving of minimum 150 mm thick with M25 grade concrete, over an under bed as specified herein shall be provided for areas mentioned below. RCC paving shall be designed as rigid reinforced concrete pavement for the crane/ vehicular/ equipment movement loads which the paving has to bear. The under bed for paving shall consist of preparation and consolidation of sub-grade to the required level, laying of stone soling of 200mm compacted thick for normal duty paving and 400mm compacted thick for heavy duty paving with 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil followed by 75 mm thick 1:4:8 PCC (1 part cement, 4 parts sand and 8 parts stone aggregate) with 40 mm nominal size aggregate. For normal duty paving, reinforcement of the RCC paving shall consist of minimum 8mm dia bars @ 200 mm c / c in both directions at the centre of the slab. For heavy duty paving/ passage, reinforcement of the RCC paving shall consist of minimum 10mm dia bars @ 200 mm c / c in both directions at the centre of the slab.</p> <p>Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification.</p> <p>Passages shall be provided inside the FGD area connecting to the outer periphery road to have access to the various facilities/buildings. These passage areas shall be provided with heavy duty paving for movement of heavy vehicles. The top surface of the passages shall be finished with 50 mm thick metallic hardener topping. Heavy duty paving shall also be provided for the areas in the equipment lay down area, unloading &amp; maintenance area with 50 mm thick metallic hardener topping.</p> <p>Lightly loaded areas such where no heavy traffic movement is envisaged shall be provided with Normal Duty paving. However, corridors below trestle where no traffic movement is envisaged and in the area over the buried fire water pipes shall be provided with interlocking concrete blocks of minimum M35 grade and minimum 80 mm thickness underlain by 20mm thick layer of sand followed by 200mm thick 63 mm and down aggregate with interstices filled with selected moorum/ non-expansive soil.</p> <p>All facility buildings shall be provided with 750 mm wide plinth protection all around. It consists of 50 mm thick P.C.C. M-20 grade with 12 mm maximum size aggregate over 200 mm thick stone soling using 40 mm nominal size rammed, consolidated and grouted with fine sand</p> <p>An area of minimum 7.5m width all around the tank foundations and other facility buildings shall be paved. This paving shall be beyond the extent of plinth protection. Further, heavy duty paving shall be provided for passages connecting the outer periphery road to have access to the various facilities/buildings.</p> <p>Any functional requirement of paving for FGD facility not specifically mentioned in this document is also in scope of bidder</p> <p>Plinth level of all buildings shall be kept at least 500 mm above the finished grade / formation level.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB SECTION-IV CIVIL WORKS</b>	<b>PAGE 24 OF 71</b>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
8.00.00	<p>Suitable open RCC drains shall be provided to dispose off storm water drain. Separate open RCC drains shall be provided to dispose off floor wash and plant effluents into RCC sump pits. Separate RCC sump pits shall be provided for different types of effluents. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. All drains/pits shall be provided with Heavy duty electro forged GI grating cover.</p> <p><b>GRADE SLAB OF BUILDINGS AT GROUND FLOOR</b></p> <p>In buildings, the grade slab shall consist of 150mm thick RCC M25 grade base slab over an under bed as specified below. The under bed for ground floor slab shall consist of 75mm thick 1:4:8 PCC on stone soling of 200mm compacted thick with 63 mm and down aggregate with interstices filled with well graded selected sand/ moorum/ non-expansive soil on compacted and dressed sub - grade. Reinforcement for the slab shall consist of minimum 8mm dia. bars @ 200 mm c/c at top &amp; bottom of the slab in both directions. However, at unloading &amp; maintenance area, stone soiling of minimum 400mm thick and grade slab with minimum 10mm dia bars @ 200 mm c/c at top and bottom in both directions shall be provided.</p> <p>Further, top surface of grade slabs shall be finished with 50mm thick metallic hardener topping.</p> <p><b>Brickwork and allied masonry works</b></p> <p>All brick walls shall be non - load bearing in-filled panel walls.</p> <p>All brickwork shall be designed as per Indian Standards and shall be plastered on both faces. All external walls shall be minimum one brick thick in 1: 6 cement: sand mortar. Brick walls shall be provided with 12 mm and 18 mm thick 1: 6 cement: sand plaster on smooth and rough face of the brick work respectively.</p> <p>Only fly ash bricks shall be used in all construction. Bricks shall be table moulded/ machine made of uniform size, shape and sharp edges and shall have minimum compressive strength of 75kg/cm<sup>2</sup>. Burnt clay fly ash bricks and fly ash lime bricks shall conform to IS 13757 and IS 12894 respectively. Minimum fly ash content in fly ash based bricks shall be 25%.</p> <p>Brickwork cladding for various structures shall be so provided that there is a clear gap of 40 mm between inside face of external brick wall and outside face of column flange. Structural steel wall beams supporting brickwork shall be suitably encased with plaster or 1: 2: 4 concrete as the case may be. In case of box type steel beam, encasement shall be done with cement sand plaster in specified thickness and proportions over G. I. wire netting of 0.9 mm thickness.</p> <p>Parapets, chajjas, windows and door heads, architectural faces, fins etc. shall be provided with drip course in 1 : 4 cement sand mortar.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB SECTION-IV CIVIL WORKS</b>	<b>PAGE 25 OF 71</b>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>			
<p>9.00.00</p> <p>10.00.00</p> <p>11.00.00</p> <p>12.00.00</p>	<p>50 mm thick Damp proof course shall be provided at plinth level for all brick wall.</p> <p>All R. C. C. ceilings shall be rendered smooth and finished with whitewash unless otherwise specified. Ceiling of control rooms, M. C. C. rooms (except areas provided with false ceiling) shall be provided with 6 mm thick plaster.</p> <p><b>Earthing Mat</b></p> <p>40 mm Dia MS Rods as earthing mat, placed at a distance of 1.0M away and at depths between 0.60M and 1.00M shall be supplied and laid all around the periphery of buildings, structures, and outdoor equipment, as per the approved drawings. Risers of 40 mm Dia MS Rods and connecting to the above Earthing mat shall also be supplied and laid in position by the Contractor, as per the approved drawings. Risers shall be laid up to a height of 300 mm above the local Ground level, at each of the columns of the buildings on outside of the buildings, and minimum 2 (Two) numbers for structures and outdoor equipment. The contractor also supply and lay necessary number of 3.0 M deep vertical 40 mm Dia MS Rods Earthing electrodes and connecting them to the Earthing mat, as per the approved drawings and the supplying and laying of 40 mm Dia MS Rods for connecting the Contractor's earthing mat with the Employer's earthing mat separately at two locations.</p> <p><b>CLAUSE DELETED</b></p> <p><b>CLAUSE DELETED</b></p> <p><b>ROADS</b></p> <p>All roads shall be of rigid pavements unless otherwise specified. The design of rigid pavement shall be carried out as per IRC: 58. The effects of design wheel load, maximum tyre inflation pressures, tyre contact area for the vehicle, traffic loads, environmental factors such as temperature changes in the pavement, other factors, like impact, load repetitions, etc., are to be taken. Detailed plate load tests to determine the modulus of sub grade reaction "K" shall be carried out as per the procedure outlined in IS: 1888. The design traffic load shall be a minimum value of 4 million standard axles. The road shall be designed for 30 years of life and considering a minimum traffic growth rate of 1 per cent per annum. The concrete pavement for roads shall be minimum 250 mm thick slab.</p> <p>The road construction including its shoulders, base, sub base and concrete pavement shall be as per IRC standards. IRC: 58 shall be followed for the pavement design and IRC: 15 shall be followed for the construction of the concrete pavement.</p> <p>The road base shall be with minimum 150 mm thick dry lean concrete over granular sub base. Dry lean concrete shall be laid by a mechanical paver and compacted by vibratory rollers. Concrete pavement of the road shall be done with fully mechanized paver fitted with electronic sensors for construction techniques. Dry lean concrete shall be minimum M10 grade and concrete pavement slab shall be minimum M35 grade concrete.</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p> <p>PAGE 26 OF 71</p>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>The finished top (crest) of all roads shall be 350 mm above the surrounding finished ground level.</p> <p>The sub grade under all roads and its shoulders shall be compacted to achieve 95 per cent or more of Standard Proctor's Density MDD using mechanical means.</p> <p>Cutting / extending / rerouting / remaking of existing roads including associated works to maintain continuity of road system / network shall also be carried out.</p> <p>All culverts and RCC bridges at crossings of all roads / rail tracks / facilities with drains / nallahs / channels / roads / rail tracks / pipes / other facilities, etc. are to be designed and constructed.</p> <p>Unless otherwise specified, all roads shall be double lane roads. Bidder shall provide permanent access to all facilities/structures from the nearby existing roads of the Owner. Roads shall be in concrete as per IRC standards, with minimum thickness of pavement (PQC) as 250mm (in M 35 grade) and DLC of 150 thick (in M 10 grade). Double lane road (width 12m having 7.5m wide pavement &amp; 2.25m wide shoulders on both sides) shall be provided.</p> <p><b>13.00.00      CLAUSE DELETED</b></p> <p><b>14.00.00      LIME &amp; GYPSUM HANDLING AND ASSOCIATED BUILDINGS STORM WATER DRAINAGE SYSTEM</b></p> <p>Storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc with a return period of 50 years. These values shall be based on rainfall intensity of 75mm/hr. All RCC drains shall be either RCC Cast-in-Situ or RCC Pre-cast drains. The minimum grade of concrete shall be M25 for RCC Cast-In-Situ drains and M30 for RCC Pre-cast drains. The maximum velocity for RCC open drains shall be limited to 1.8 metre per second. However, minimum velocity of 0.6 metre per second for self - cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided.</p> <p>Open RCC rectangular section, unless required otherwise due to functioned requirement, shall be provided for all drains. The thickness of side walls and bottom slab of RCC drains shall be minimum 150mm or as per design considerations whichever is higher for drains upto depth of 1m from formation level. For depth of drain more than 1m from formation level, the thickness of side walls and bottom slab of RCC drains shall be minimum 200mm or as per design considerations whichever is higher. The drains shall be provided on both sides of roads .These shall be designed to drain the road surface as well as all the free and covered areas, etc. Box culverts shall be provided at all rail, road and other crossings.</p> <p>All drains inside the building shall have minimum 40 mm thick grating covers. In areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating.</p>		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>						
<p><b>15.00.00</b></p> <p><b>16.00.00</b></p> <p><b>16.01.00</b></p>	<p>The invert levels of the in-plant and plant peripheral drains shall be kept such that water can be discharged by gravity to the main / trunk drains under all conditions. If required lifting facilities shall be provided for discharge in main / trunk drain by bidder.</p> <p><b>SEWERAGE SYSTEM</b></p> <p>The connection of sewer pipe line for the associated buildings of FGD and Lime and gypsum handling area to nearest owner's sewage network is in bidder's scope.</p> <p>Cement concrete pipes of class NP-3 as per IS:458 shall be used below ground level for sewage disposal in all areas . However, for pressure pipes and under roads spun C.I. pipes conforming to IS:1536 of required class shall be used.</p> <p>RCC manholes with CI cover shall be provided at every 30m along the length, at connection points, and at every change of alignment, gradient or diameter of a sewer pipeline. This shall be as per IS:4111.</p> <p>Sewage pumping stations shall be provided as per IS:4111.</p> <p><b>LOADING</b></p> <p>For consideration of loads on structures IS : 875 - 'Code of practice for structural safety of buildings' shall be followed. In addition to the dead load, live load, equipment load (including impact / vibration). Temperature loads etc. various loading conditions arising due to operation and maintenance of equipment shall be considered in the design. The structure and equipment shall also be designed for seismic loads as per the "<b>Criteria for Earthquake Resistant Design of Structures and equipment</b>" and the "<b>Criteria for Wind Resistant Design of Structures and equipment</b>" specified in the "<b>Project Information section</b>" of technical specification. Wind and seismic forces shall not be considered to act simultaneously. The following minimum live loads shall be adopted for the design of various structures. If actual expected load is more than the specified load, then actual load is to be considered.</p> <table border="0"> <tr> <td style="vertical-align: top;">a) Roofs</td> <td style="vertical-align: top;">150 Kgs. / Sq. M. for accessible roofs and 75 Kgs. / Sq. M. for non - accessible roofs. In addition to this dust load (Dead load) of 150 Kgs. / sq. m. on flat roofs &amp; 75 Kgs. / sq. m. on inclined roofs shall also be considered.</td> </tr> <tr> <td style="vertical-align: top;">b) R. C. C. floors</td> <td style="vertical-align: top;">500 Kgs. / Sq. M.</td> </tr> <tr> <td style="vertical-align: top;">c) Stair and balconies</td> <td style="vertical-align: top;">500 Kgs. / Sq. M.</td> </tr> </table>	a) Roofs	150 Kgs. / Sq. M. for accessible roofs and 75 Kgs. / Sq. M. for non - accessible roofs. In addition to this dust load (Dead load) of 150 Kgs. / sq. m. on flat roofs & 75 Kgs. / sq. m. on inclined roofs shall also be considered.	b) R. C. C. floors	500 Kgs. / Sq. M.	c) Stair and balconies	500 Kgs. / Sq. M.
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>d) Toilet rooms</p> <p>e) Chequered plate floors</p> <p>f) Walkways ( including walkways in conveyer galleries )</p> <p>g) Conveyor galleries</p> <p>h) Road Culverts and its allied structures including R. C. C. pipe crossing &amp; road crossing of trenches.</p> <p>i) Channels / trenches</p> <p>j) Covers for trenches / channels</p> <p>k) Sumps and tanks and other underground basement type structures</p>	<p>200 Kgs. / Sq. M.</p> <p>400 Kgs. / Sq. M.</p> <p>300 Kgs. / Sq. M.</p> <p>In addition to the live loads, loads due to cable trays, fire fighting / service water pipes shall also be considered @ 125 Kgs. / m ( minimum ) on each of the longitudinal girder. Roof-truss members are to be checked for supporting fire fighting pipes/ Service water pipes.</p> <p>For class 'AA' loading and checked for class A loading as per IRC standard.</p> <p>In addition to earth pressure and water pressure, etc. additional earth pressure due to surcharge of 2T / Sq. M. shall also be considered for design.</p> <p>Covers for channels &amp; trenches, shall be designed for a live load of 0.4T Sq. M. and loading as mentioned under clause in trenches, whichever is critical.</p> <p>In addition to earth pressure with a surcharge of 2T / Sq. M. (or surcharge due to Railway loading whichever is critical for Railway load bearing structures etc.) and sub - soil water pressure etc. These are also to be designed for the following conditions :</p>	<p>i) Water / liquid inside and no earth outside (applicable only to such structures which are liable to be filled up with water or any liquid ).</p> <p>ii) Earth with surcharge outside and no water / liquid inside</p> <p>iii) For underground (basement) structures protection against buoyancy during execution and after execution shall be ensured without superimposed</p>
<p align="center"><b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b></p>	<p align="center"><b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b></p>	<p align="center"><b>PART-B SUB SECTION-IV CIVIL WORKS</b></p>	<p align="center"><b>PAGE 29 OF 71</b></p>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p style="text-align: right;">loadings with minimum factor of safety of 1.2 against buoyancy. 2500kgs. / sqm As per IRC standard (at road crossing for vehicular traffic.)</p> <p>L ) Grating covers/ Precast RCC covers for drains, trench, sump pit in ground floor/paving area.</p> <p>If the erection load is higher than the specified live loads on any floor or part thereof, then the erection loads are to be considered for the design.</p> <p>Permissible increase in stresses of materials and bearing pressure of soil due to wind load or seismic load shall be as per relevant I. R. S. and I. S. code.</p> <p><b>16.02.00 Crane load</b></p> <p>For crane loads, an impact factor of 25% and lateral crane surge of 10% (of lifted weight + trolley weight) shall be considered in the analysis of frame according to the provisions of IS:875. The longitudinal crane surge shall be 5% of the static wheel load. Longitudinal surge and lateral surge shall not be considered to act simultaneously.</p> <p><b>16.03.00 Temperature load</b></p> <p>For temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily minimum ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The structure shall be designed to withstand stresses due to 50% of the total temperature variation.</p> <p>Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns. The maximum distance of the expansion joint shall be as per the provisions of IS: 800 and IS: 456 for steel and concrete structures respectively.</p> <p><b>17.00.00 DESIGN CRITERIA</b></p> <p><b>17.01.00</b> The design of all R. C. C. structures shall be carried out as per 'code of practice for plain and reinforced concrete for general building construction', IS: 456.</p> <p><b>17.02.00</b> Design of steel structures shall be done as per provisions of IS:800: 2007 (Limit state design) and other relevant IS standards.</p> <p><b>17.03.00</b> Minimum size of the angle section to be used as structural members shall be 50 X 50 X 6. Minimum weld size shall be 6 mm. Connections shall be designed for 70 % of shear capacity of the member or the actual shear force, whichever is higher. The steel structures using tubular sections shall be designed and fabricated as per</p>		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>IS:806 – “Code of Practice for use of steel tubes in general building construction.” and EN 1993-1-8:2005. Minimum grade of steel &amp; thickness of Tubular/Hollow sections shall be Yst 240 Mpa &amp; 4.0mm respectively</p> <p><b>17.04.00</b> The building shall conform to local bye - laws, rules and regulations for industrial buildings and also B. I. S. publications, SP 32 and 41.</p> <p><b>17.06.00</b> Slotted holes shall not be assumed to act as expansion joint for relieving of stresses and suitable bearings shall be provided at the supports.</p> <p><b>17.07.00</b> Stresses for all structures shall be checked for the higher of the forces obtained from gust factor method and the peak wind speed method.</p> <p><b>17.08.00</b> Horizontal bracing system shall be provided at floor levels around the openings.</p> <p><b>17.09.00</b> Shear force in steel columns shall be transferred to the pedestals / foundations exclusively either through foundation bolts or the shear key arrangement.</p> <p><b>17.10.00</b> For design of liquid retaining structures, IS : 3370 ( Part - I to IV ) ( latest ) shall be followed. Face of the structure in contact with liquid shall be designed as un - cracked section. For design of R. C. C. pipes for culverts, latest editions of IS : 458, IS : 783 should be followed.</p> <p><b>17.11.00</b> For design of all underground structures / foundations, ground water table shall be assumed at the formation level ( i. e. the adjoining ground level ). For all underground structures like tunnel, underground transfer point and underground hopper etc. crack width shall be limited to 0.2mm.</p> <p><b>17.11A.00</b> The loads for all railway load bearing structures e. g. tunnel, culverts and underground transfer houses etc. and the analysis and the design of these structures shall be made strictly in accordance with the provisions of Indian Railway Bridge rules (latest edition), and Indian Railway Codes of practice (latest edition) with all amendments up to the date of opening of bids. The analysis, design and detailed drawing for tunnel, underground transfer houses, culverts etc. coming directly below the railway track shall be got approved by the contractor from the concerned railway authorities. All necessary payment for the above work shall be made by the bidder to the railway authority.</p> <p><b>17.11B.00</b> Minimum clearance of 8.5m above the road crest / rail top shall be maintained at the location where the overhead conveyor gallery/cable gallery crosses road / rail line. The horizontal distance between Centre line of rail track and edge of any nearby building/structure shall not be less than 3.0m.</p> <p><b>17.12.00</b> Design of masonry walls shall be made as per IS : 1905.</p> <p><b>17.13.00</b> Civil task drawing indicating various equipment loading and supporting arrangement and floor loads to be submitted along with the design calculation.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB SECTION-IV CIVIL WORKS</b>	<b>PAGE 31 OF 71</b>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>											
<p><b>17.14.00</b></p> <p><b>17.15.00</b></p> <p><b>17.16.00</b></p> <p><b>17.17.00</b></p> <p><b>17.18.00</b></p> <p><b>17.19.00</b></p> <p><b>17.20.00</b></p>	<p>Minimum 0.12% of reinforcement shall be provided on the top face of the foundation concrete on either direction and minimum percentage of reinforcement at bottom face of foundation shall be same as that stipulated for beam as per IS:456.</p> <p>Foundations for all tanks shall be designed for as per IS: 803.</p> <p>Footings shall be so proportioned to as to minimise the differential settlement.</p> <p>All gallery supporting trestles shall be so proportioned that the transverse deflection of gallery due to wind / seismic load should not exceed trestle height / 1000 as stipulated in IS: 11592. This deflection condition shall be strictly followed. Peak wind speed method shall be considered for checking the transverse deflection.</p> <p>The crusher and transfer house structures shall be so designed that transverse deflection at places where conveyor galleries meet, should be equal to the respective transverse deflection of conveyor supporting trestles.</p> <p><b>Deflection criteria</b></p> <p>The maximum Horizontal Deflection for various structures shall not exceed and be limited to the following:</p> <table border="1"> <thead> <tr> <th>Sl. No.</th> <th>Description</th> <th>Maximum value of</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)</td> <td>Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)</td> </tr> <tr> <td>2.</td> <td>For other Buildings</td> <td>Height/325</td> </tr> </tbody> </table> <p>a) Permissible deflection (unless specified otherwise in this specification) for latticed framework and beams of floors other than drive floor shall be span/325.</p> <p>b) The allowable deflection for beams directly supporting drive machinery shall be restricted to span/500 unless specified otherwise in this specification.</p> <p>c) The deflection for manually operated cranes &amp; monorail supporting beams shall not exceed span/500.</p> <p>For electric overhead cranes :</p> <p>1) upto 50 t capacity : span/750</p>			Sl. No.	Description	Maximum value of	1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)	2.	For other Buildings	Height/325
Sl. No.	Description	Maximum value of										
1.	For Trestles and transfer points (Transverse deflection at Conveyor gallery supporting level)	Height/1000 (For Wind load by Peak Wind Speed Method / Seismic Load)										
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<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 32 OF 71</p>									

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<p>17.21.00</p> <p>17.22.00</p> <p>17.23.00</p>	<p>2) over 50 t capacity : span/1000</p> <p>d) The vertical deflection of metal deck sheet for roofing and side cladding shall be limited to span/250</p> <p>e) The permissible vertical deflection for beams supporting drive machinery shall be restricted to span / 500 and for other beams it shall be within span / 325.</p> <p>f) Permissible deflection for all purlins, cladding runners, roofing/cladding sheets and grating / chequered plates shall be span/250. However, the maximum vertical deflection of Grating/ Chequered plate shall be limited to 6 mm.</p> <p>a) Dispersion of load in any direction through soil shall be as per IS: 8009 (relevant part).</p> <p>b) Dispersion of load through concrete shall be considered at an angle of 45 degrees with horizontal from the edge of contact area.</p> <p>a) The design and construction of RCC structures shall be carried out as per IS: 456. Working stress method shall be adopted for the design wherever specifically mentioned in this specification.</p> <p>b) For design and construction of steel-concrete composite members, IS: 11384 shall be followed.</p> <p>c) For reinforcement detailing, IS: 5525 and SP: 34 shall be followed.</p> <p>d) Two layers of reinforcement (on both inner and outer faces) shall be provided for RCC wall sections having thickness 150 mm or more.</p> <p>a) All RCC liquid retaining/conveying shall be designed by working stress method as outlined in clause no. 4.5 of IS 3370 (Part-2) 2009 unless specified other wise.</p> <p>b) Water proofing treatment shall be provided for liquid retaining/ carrying structures and basement type structures (requiring dry working condition). Dense and durable concrete with water cement ratio not more than 0.45 shall be used. Plasticiser /super-plasticiser cum water proofing compound shall be added to the concrete. All the construction/expansion joints shall be provided with PVC water bar and/or chemical injection grouting as per IS:6494. As applicable internal/external surface of such structures shall be provided with acrylic based polymer modified cementitious composite coating system for critical structures. For liquid carrying/retaining structures, minimum two coats of such coating shall be applied. For external application wherever the surface is in contact with the earth, fine silica/quartz sand of 0.6 mm nominal size shall be added in the coating mix for better abrasion resistance and total nominal thickness of such coating shall be minimum 1.5 mm. For non critical structures minimum two coats of bitumen grade 85/25 as per IS:702, mixed with 1% of anti-stripping compound meeting the requirement of IS:6241, shall be applied. The total application of bitumen shall not be less than 1.7 kg/sq.m.</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 33 OF 71</p>

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<p><b>17.24.00</b></p> <p><b>17.25.00</b></p> <p><b>17.26.00</b></p> <p><b>17.27.00</b></p>	<p>Bidder shall submit a comprehensive scheme for water proofing treatment based on above or any other alternative scheme, internationally accepted for Employer's approval prior to commencement of work.</p> <p>c) All liquid retaining/carrying structures shall be tested for water tightness as per the provisions of IS: 3370 and IS: 6494 and in case of leakage, the same shall be rectified by chemical injection grouting through nozzles.</p> <p>deleted.</p> <p>Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest or co-efficient of active earth pressure, whichever is applicable, depending upon the structural configuration. However, for the design of substructure of pump houses, earth pressure at rest shall be considered. Co-efficient of passive earth pressure shall be used only in design of shear keys for stability against sliding.</p> <p>a) Following loading conditions shall be considered in addition to the loading from super structure for the design of substructure of pump house, channels, sumps, tanks, trenches and other underground structures containing liquid</p> <p>i) Water pressure from inside and no outside pressure, like earth pressure, ground water and surcharge pressure (applicable only to structures, which are liable to be filled up with water or any other liquid.)</p> <p>ii) Earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.</p> <p>iii) Design shall also be checked against buoyancy due to the ground water during construction as well as after construction stages. Minimum factor of safety of 1.2 against buoyancy shall be ensured considering empty condition inside and ignoring the superimposed loadings. Provision of pressure relief valves/flap valves, etc., shall not be permitted to counter the buoyancy unless specified otherwise.</p> <p>iv) Base slab and piers of the pump houses shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum ground water level.</p> <p>b) Intermediate dividing pier of pump sumps and partition wall (if applicable) in channel shall be designed considering water on one side only and other side being empty for maintenance.</p> <p>c) All pump houses and other substructures (wherever applicable) shall be checked for stability against sliding and overturning during construction as well as operating conditions for various combinations of loads.</p> <p><b>Design of Block Foundation</b></p> <p>a) Block foundation resting on soil shall be analyzed using elastic half space theory. In case the foundation is supported over piles, Novak's approximation shall be used for determining the spring constant and damping ratio of pile groups. The mass of the RCC block shall be at least three times the mass of</p>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 34 OF 71</p>

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	<p>machine. Free vibration analysis of the foundation shall be carried out to evaluate the natural frequencies. The fundamental natural frequency shall be kept at least 20% away from the operating frequency (speed). Forced vibration analysis shall be carried out if the dynamic forces are made available by the machine supplier in which case the amplitude limits stipulated by the machine supplier and ISO 10816, whichever is lower, shall be satisfied.</p> <p>Reinforcement design shall be done by working stress method as per IS:456-2000 and IS:2974 (Part-IV).</p> <p>b) For the foundations supporting minor rotating equipment weighing less than one ton or if the mass of the rotating parts is less than one hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment is to be supported on building structure, floors, etc., suitable vibration isolation shall be provided by means of springs, neoprene pads, etc., and such vibration isolation system shall be designed suitably.</p> <p><b>17.28.00</b> Design drawings of steel structures shall include the connection, joint &amp; fastener details for Main columns, Beams &amp; Bracings.</p> <p><b>17.29.00</b> Unless specified all sand filling shall be compacted to minimum 80% of the relative density and backfilled earth shall be compacted to minimum 90% of the Standard proctor density at OMC.</p> <p><b>18.00.00</b> <b>Coating on RCC water retaining structures (other than drinking water)</b>  Epoxy phenolic coating shall be applied on internal surfaces of the RCC water retaining structures, as per details specified below:  All concrete surfaces shall be provided with two component transparent polyamide cured epoxy sealer coating (having solid by volume minimum 40% <math>\pm</math>2%) of minimum 50 micron DFT. Surface to be coated shall be absolutely dry, clean and dust free.  Sealer coat shall be followed with the application of epoxy phenolic coating (solid by volume minimum 63%) of minimum 400 micron DFT. This coat shall be applied after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.</p> <p><b>Coating on RCC water retaining structures (drinking water)</b>  Internal surfaces of RCC water retaining structures shall be provided with minimum 400 micron Food grade epoxy coating complying to FDA Title 21, Part 175.300. Surface to be coated shall be absolutely dry, clean and dust free.</p> <p><b>19.00.00</b> <b>Fabrication</b>  All steel structures shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections.</p> <p>Silo with hopper &amp; Chimney flue liners can either be fabricated at factory in segments, transported and welded at site before erection or fabricated at site. For Chimney flue liners, to prevent flue gas leakages, the applicable field joints shall necessarily be welded.</p>		
<b>RGTPP HISAR (2X600 MW)  FLUE GAS DESULPHURISATION (FGD)  SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION  SECTION-VI  BID DOC. NO.:  31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B  SUB SECTION-IV  CIVIL WORKS</b>	<b>PAGE 35 OF 71</b>

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<p><b>20.00.00</b></p> <p>20.01.00</p> <p>20.02.00</p> <p>20.03.00</p> <p>20.04.00</p> <p>20.05.00</p> <p>20.06.00</p> <p><b>20.07.00</b></p> <p><b>20.08.00</b></p>	<p><b>Electrodes</b></p> <p>The electrodes used for welding shall be of suitable type and size depending upon specifications of the parent material, the method of welding, the position of welding and quality of welds desired. Only low hydrogen electrodes shall be used for welding of medium /high tensile steel and for mild steel plate thickness above 20 mm.</p> <p>All low hydrogen electrodes shall be baked and stored before use as per manufacturer's recommendation. The electrodes shall be re-baked at 250°C - 300°C for one hour and later on cooled in the same oven to 100° C. It shall be transferred to a holding oven maintained at 60°C - 70°C. The electrodes shall be drawn from this oven for use.</p> <p>Where coated electrodes are used they shall meet the requirements of IS: 814 and relevant ASME - Sec. II. Covering shall be heavy to withstand normal conditions of handling and storage.</p> <p>Only those electrodes that give radiographic quality welds shall be used for welds, which are subjected to radiographic testing.</p> <p>Where bare electrodes are used these shall correspond to specification of the parent material. The type of flux-wire combination for submerged arc welding shall conform to the requirements of F-60 class of AWSA-5-17-69 and IS: 3613. The electrodes shall be stored properly and the flux shall be baked before use in an oven in accordance with the manufacturer's requirements as stipulated.</p> <p>The contractor shall take specific approval of the weld for the various electrodes proposed to be used on the works before any welding is started.</p> <p><b>Edge Preparation for Welding</b></p> <p>Suitable edge as per weld joint detail shall be prepared either by machines or by automatic gas cutting. All edges cut by flame shall be ground before they are welded.</p> <p><b>Pre Heating and Post Heating</b></p> <p>Mild steel and medium / high tensile steel plates thicker than 20mm, will require Pre-Heating of the parent plate prior to welding as mentioned in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, however, higher pre heat temperature may be required as per approved welding procedure and it shall be followed. In welding materials of unequal thickness, the thicker part shall be taken for this purpose.</p> <p>Base metal shall be preheated, notwithstanding provisions of IS: 9595 to the temperature given in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, prior to welding or tack welding. When base metal not otherwise required to be</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 36 OF 71</p>



pre heated is at a temperature below 0°C it shall be pre heated to atleast 20°C., prior to tack welding or welding. Pre heating shall bring the surface of the base metal to the specified pre heat and this temperature shall be maintained as minimum inter-pass temperature welding is in progress.

**TABLE - 1  
MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR  
WELDING MILD STEEL**


----- Welding Using -----		
Thickness of thicker part at Point of welding	Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode
-----		
Upto and including 20mm	None	None
Over 20mm and up to and including 40mm	20°C	Not allowed
Over 40mm and up to and including 63mm	66°C	Not allowed
Over 63mm	110°C	Not allowed
-----		

Note: Type of electrode and the preheating requirements for welding shall be as per approved welding procedure.


**TABLE - 2  
MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR  
WELDING MEDIUM / HIGH TENSILE STEEL**


----- Welding Using -----		
Thickness of thicker part at Point of welding	Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode
-----		
Upto and including 20mm	None	Not Allowed
Over 20mm	120oC - 140°C	Not Allowed
-----		


Note : Type of electrode and the preheating requirements for welding of medium and high tensile steel shall be as per approved welding procedure.


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20.09.00	<p>Pre heating may be applied by external flame which is non-carbonizing like LPG, by electric resistance or electric induction process such that uniform heating of the surface extending up to a distance of four times the thickness of the plate on either side of the welded joint is obtained.</p>		
20.10.00	<p>Thermo-chalk, thermo-couple or other approved methods shall be used for measuring the plate temperature.</p>		
20.11.00	<p>All butt welds with plates thicker than 50mm and all site butt welds of main framing beam supporting the bunker shall require post weld heat treatment as per procedure given in AWS D-1.1. Post heating shall be done up to 600oC and rate of application shall be 200oC per hour.</p>		
20.12.00	<p>The post heat temperature shall be maintained for 60 minutes per 2.5cm thickness. For maintaining slow and uniform cooling, asbestos pads shall be used for covering the heated areas.</p>		
<b>21.00.00</b>	<p><b>Drainage and Sewage</b></p> <p>The plant storm water drainage shall be designed taking into account the finished grade levels of the plant area, drainage pattern, intensity of rainfall, etc., The storm water drainage shall cater to storm water run off resulting from one hour rainfall intensity, with a return period of 50 years. The value of minimum rainfall intensity shall be taken as 75mm/hr. The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8 m/sec. respectively. However, minimum velocity of 0.6m/sec. for self-cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. The open drains shall be open rectangular drains of RCC unless required otherwise due to functional requirement. RC box culverts shall be provided at rail, road or other crossings.</p> <p>Sewers shall be designed for a minimum self-cleansing velocity of 0.75m/sec and the maximum velocity shall not exceed 2.4m/sec .</p>		
<b>22.00.00</b>	<p><b>Statutory Requirements</b></p> <p>Bidder shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules at Tariff Advisory Committee. Water Act for pollution control, Explosives Act, etc.</p> <p>Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include provision of continuous walkways along the crane - girder level on both sides of building, comfortable approach to EOT crane cabin, railing, fire escape, locker room for workmen, pantry, toilets, rest room etc.</p> <p>Provisions for fire proof doors, number of staircases, fire separation wall, lath plastering/encasing the structural members (in fire prone areas), type of glazing etc. shall be made according to the recommendations of Tarrif Advisory Committee.</p> <p>Statutory clearances and norms of State Pollution Control Board shall be followed.</p> <p>Bidder shall obtain approval of Civil/Architectural drawings from concerned</p>		
<p align="center">RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p align="center">PART-B SUB SECTION-IV CIVIL WORKS</p>	<p align="center">PAGE 38 OF 71</p>





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<p><b>23.00.00</b></p> <p><b>24.00.00</b></p>	<p>authorities before taking up the construction work.</p> <p><b>INSPECTION, TESTING AND QUALITY CONTROL</b></p> <p>Sampling and testing of major items of civil works viz. earthwork, concreting, structural steel work (including welding), piling, sheeting, etc. shall be carried out in accordance with the requirements of this specification. Wherever nothing is specified relevant Indian Standards shall be followed. In absence of Indian Standard equivalent International Standards may be used.</p> <p>The Bidder shall submit and finalise a detailed field Quality Assurance Programme before starting of the construction work according to the requirement of this specification. This shall include frequency of sampling and testing, nature/type of test, method of test, setting of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of format for record, Field Quality Plan, etc. Tests shall be done in the field and/or at a laboratory approved by the Engineer. The Bidder shall furnish the test certificate from the manufacturer's of various materials to be used in the construction.</p> <p><b>CONCRETE</b></p> <p>All R. C. C. works to be done under this specification, unless specified otherwise shall be design mix concrete. Minimum grade of concrete for various structures shall be as follows:</p> <table border="1"> <tr> <td>a )</td> <td>M25 -</td> <td>For all underground / sub-structural/ super-structure R. C. C. work.</td> </tr> <tr> <td>b )</td> <td>M30-</td> <td>For Block Foundation</td> </tr> <tr> <td>c )</td> <td>M35-</td> <td>For spring supported RCC deck and rail load bearing structure (if applicable)</td> </tr> </table>			a )	M25 -	For all underground / sub-structural/ super-structure R. C. C. work.	b )	M30-	For Block Foundation	c )	M35-	For spring supported RCC deck and rail load bearing structure (if applicable)
a )	M25 -	For all underground / sub-structural/ super-structure R. C. C. work.										
b )	M30-	For Block Foundation										
c )	M35-	For spring supported RCC deck and rail load bearing structure (if applicable)										
<p align="center"><b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b></p>	<p align="center"><b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b></p>	<p align="center"><b>PART-B SUB SECTION-IV CIVIL WORKS</b></p>	<p align="center"><b>PAGE 39 OF 71</b></p>									


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<p><b>25.00.00</b></p> <p><b>25.01.00</b></p> <p><b>25.02.00</b></p>	<p>Minimum 75 mm thick P.C.C M-7.5 shall be provided as mud mat below all foundations.</p> <p>For concreting of underground structures requiring water tightness, plasticizer cum water proofing admixture shall be added to the concrete mix.</p> <p>Both coarse and fine aggregates shall conform to IS: 383 for concrete, shotcreting etc. unless otherwise mentioned.</p> <p><b>Excavation, Backfilling, Disposal and Stacking of materials Details</b></p> <p><b>Excavation in Soil</b></p> <p>Excavation for foundation shall be to the bottom of lean concrete and as shown on drawing or as directed by the Engineer. The bottom of all excavations shall be trimmed to required levels and when excavation is carried below such levels by error, it shall be brought back to the specified level by filling with concrete of nominal mix 1 : 3 : 6 (cement: coarse sand: 40 mm down aggregates ), as directed by the Engineer.</p> <p>The Contractor shall ascertain for himself the nature of materials to be excavated and the difficulties, if any, likely to be encountered in executing this work. Cofferdams, sheet piling, shoring, bracing to maintain suitable slopes, draining etc. shall be provided and installed by the contractor, to the satisfaction of the Engineer.</p> <p>Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer.</p> <p>The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, Backfilling is completed. The Contractor shall remove all slush/muck from the excavated areas to keep the work area dry. The Contractor, if required, shall employ sludge pumps, for this purpose.</p> <p>For other details, excavation clauses as given at “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of technical specification, are to be referred.</p> <p><b>Excavation in Rock</b></p> <p>For the work of excavation in rock, Contractor shall engage specialised agency having experience of excavation in rock involving wedging and blasting. The agency shall be subject to approval of Engineer and the Contractor shall furnish details of relevant experience in support while seeking approval for the agency. Blasting shall be resorted to only with the written permission of the Engineer. All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards etc. pertaining to the acquisition, transport, storage, handling and use of explosives etc. shall be strictly followed. The contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p> <p>PAGE 40 OF 71</p>

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<b>25.03.00</b>	<p>the explosives as per Explosives Act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive materials. Surplus excavated materials shall be disposed off by the contractor at locations up to a lead of 5 kms from the plant boundary wall as directed by the engineer. The Contractor shall have to constantly pump out any water collected in excavated pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the excavation, placement of reinforcement, shuttering, concreting, backfilling is completed. For other details for excavation in rock, clauses as given at “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of Technical specification, are to be referred.</p> <p><b>Backfilling, Disposal and Stacking of materials</b></p> <p>Backfilled earth shall be compacted as per “Foundation system and Geotechnical Data Chapter” given at “Project Information section” of technical specification.</p> <p>However, the backfill under the rail lines and roads shall be compacted to minimum 95 % of the standard proctor density at OMC unless otherwise stated by rail Authorities.</p> <p>The contractor is required to excavate upto any depth as shown on the drawings or as directed by the Engineer. Lifting of excavated materials shall be done either by manual or mechanical or both means if called for by the Engineer.</p> <p>The disposal / stacking areas for excavated materials shall be indicated by the Engineer. The carriage of excavated materials shall be done by the methods mentioned below:</p> <p>The excavated materials shall be carried beyond the initial lead of 50 m but upto 500 m by manual / animal labour or by mechanical means. If directed by the Engineer this material shall be used directly for filling purposes.</p> <p>For leads exceeding 500 m the Contractor shall transport the excavated materials by mechanical means only and as directed by the Engineer. The Contractor may be allowed to carry materials through Kuccha roads. Providing and maintaining of the Kuccha roads shall be the responsibility of the Contractor. The transported material shall be neatly stacked as directed by the Engineer.</p> <p>Some excavated materials required for filling purposes, may have to be carried upto a lead of 500 m and stacked as per instructions of the Engineer. Excavated materials carried beyond 500 m shall normally be for disposal purpose only. Double handling of materials shall be avoided as far as possible. However, depending on site condition excavated materials carried beyond a lead of 500 m may also be required to be brought back for filling purpose.</p> <p>Materials to be used for filling purpose shall be stone, sand or other inorganic materials and they shall be clean and free from shingle, salts, organic matter, large roots and excessive amount of sod, lumps, concrete or any other foreign substances which could harm or impair the strength of the substances in any manner. All clods shall be suitably broken to small pieces. When the material is mostly rock boulders,</p>		
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<p><b>26.00.00</b></p> <p><b>27.00.00</b></p>	<p>these shall be broken into pieces not larger than 150 mm size before backfilling and shall be backfilled in layers of 300mm interstices filled with sand. In case of broken rock boulders used for back filling, the top cover shall be with 1.0m thick soil. The layers of rock boulders, interstices filled with sand shall be compacted by plate vibrators. Sand used for filling shall be clean, medium grained and free from impurities. Fines less than 75 microns shall not be more than 20%. In any case, the materials to be used for filling purposes shall have the prior written approval of the Engineer.</p> <p>In case the materials have to be brought from pits / quarries, then it shall be the Contractor's responsibility for identification of such quarry areas, obtaining approval from their use from concerned authorities, excavation / quarrying loading and carriage of such material, unloading and filling at specified locations. The Contractor shall pay any fees, royalties etc. that may have to be paid for utilisation of borrow areas.</p> <p><b>GALVANISING</b></p> <p>All burrs and irregular edges of the structural steel members to be galvanised shall be ground smooth before galvanising.</p> <p>Purity of Zinc to be used for galvanising shall be 99.5 % as per IS : 209 ( latest edition ).</p> <p>The weight of the zinc coating shall be at least 610 Gms. / m<sup>2</sup> unless noted otherwise.</p> <p><b>CHEMICAL INJECTION GROUTING</b></p> <p>Minimum, 12 mm dia ( NB ) threaded nozzle of suitable length, shall be provided over the surface and along the construction joint line in a grid pattern at a spacing not exceeding 1.5 m c / c before concreting operation. Adequate precaution shall be taken to keep the nozzles plugged at both ends to prevent them from getting closed by concrete.</p> <p>For fixing of any nozzle in set concrete suitable size hole shall be drilled, preferably by using percussive hammer drill electrically operated, in grid pattern and grouting nozzle shall be fixed in these holes.</p> <p>After the nozzles are fully set, neat cement slurry admixed with water soluble non - shrink polymer / monomer based chemical shall be injected through the net - work of nozzles with low pressure grout pumps at a pressure of about 2.0 Kgs. / cm<sup>2</sup>. Cement slurry shall be prepared by mixing cement with non-shrink polymer/monomer @ 500 gm/50 kg bag of cement and water, ensuring that Water: Cement ratio does not exceed 2 (by weight). Wetter the structure, lesser should be the water cement ratio. The property of the polymer/monomer should be such that when it is mixed with water @0.5% by weight of water, the viscosity of the resultant solution (water and polymer/monomer) should not be more than 1.2 centipoises.</p>	<p><b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b></p>	<p><b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b></p>	<p><b>PART-B SUB SECTION-IV CIVIL WORKS</b></p> <p><b>PAGE 42 OF 71</b></p>

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<p><b>28.00.00</b></p> <p><b>28.01.00</b></p> <p><b>28.02.00</b></p> <p><b>28.03.00</b></p>	<p>Plasticizing agent shall be added wherever required. The grouting shall be started at very low pressure and increased gradually to a required pressure. The grouting shall continue, till the hole refuses to take any further grout, even at an increased pressure. Applied pressure shall not be more than the designed strength of the concrete. After completion of grouting operation, the nozzles shall be sealed properly to the satisfaction of the Engineer.</p> <p><b>POLYMER MODIFIED CEMENTITIOUS COATING</b></p> <p><b>Materials</b></p> <p>Modified liquid polymer blend shall be a dispersion containing 100 % acrylic based polymer solids. Polymer shall be mixed in the ratio of 1 cement: 0.5 polymer (for minimum solid content of polymer 30%).</p> <p>Portland cement based dry powder.</p> <p>Clean, fine specially prepared quartz sand approximately 0.6 mm size.</p> <p><b>Mixing</b></p> <p>The liquid polymer shall be stirred well and cement based powder shall then be added slowly to make a Slurry Mix. For preparation of Brush Topping Mix, quartz sand shall be added slowly and mixed well till a homogeneous mixture is obtained. The mix shall be used within half an hour of the preparation. Addition of quartz sand may not be necessary, in case dry power contains the same.</p> <p><b>Properties of Coating</b></p> <p>It must adhere to wet surface.</p> <p>It should develop adequate bond strength, with the concrete surface, not less than 2 N / Sq. mm.</p> <p>Co - efficient of permeability shall be about <math>5 \times 10^{-10}</math> Cm / Sec.</p> <p>Water absorption after continuous soaking shall not be more than 1 %.</p> <p>The materials shall be permeable under water vapour.</p> <p>The material shall be resistant to acids and alkalis present in the soil and underground water with normal pH value between 4 and 14.</p> <p>The co - efficient of thermal expansion of the material shall be close to that of concrete.</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p> <p>PAGE 43 OF 71</p>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<b>28.04.00</b>	<p><b>Application</b></p> <p>The concrete surface shall be cleaned and made free from grease, oils or loosely adhered particles. The surface shall be damp without any free water. For exterior underground part, application (b) pertaining to Brush topping Mix shall be followed.</p> <p><b>(a) For Slurry Mix</b></p> <p>A minimum of 2 coats shall be applied on the surface. The first coat being applied, when the surface is still damp and left to harden for 4 to 6 hours. After 4 to 6 hours of the application of second coat, it shall be finished by rubbing down with a soft dry sponge. The coverage shall not be less than 1 : 1 Kgs. / m<sup>2</sup> in the 2 coats. A lap of 75 mm shall be provided at the joints.</p> <p>The coating shall be air dried for 4 to 6 hours and, thereafter, cured for 7 days after the application of last coat.</p> <p><b>(b) For Brush Topping Mix</b></p> <p>This shall be applied in two coats. A primary coat of slurry mix can also be first applied on the surface as first coat. After the coating has dried up, a coat of Brush Topping Mix shall be applied over it with a push broom or any other similar brush. It shall be left in broom finished condition. The nominal thickness shall be 1.5 mm and minimum thickness shall be 1.0 mm. A lap of 75 mm shall be provided at the joints. It shall be ensured that no pinhole exists and rebrushing shall be done to cover the pinholes, if any.</p> <p>The Coating shall be air dried for 4 to 6 hours and thereafter cured for 7 days after the application of last coat.</p> <p>Rate of application of coating shall be established to achieve the required thickness.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB SECTION-IV CIVIL WORKS</b>	<b>PAGE 44 OF 71</b>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>			
<p><b>29.00.00</b></p> <p><b>29.01.00</b></p> <p><b>29.01.01</b></p> <p><b>29.01.02</b></p> <p>29.02.00</p>	<p><b>Architectural Concepts</b></p> <p>Buildings shall be architecturally treated in such a way that it presents a pleasing composition of mass and void with suitable and functionally designed projections and recesses. The overall impact of the building shall be one of aesthetically unified architectural composition having a comprehensive scale, blending with the surroundings and taking full consideration of the climatic conditions and the building orientation. All the buildings shall be architecturally treated in such a way so as to be in harmony with the surroundings. The over all composition may have straight or curvilinear profiles.</p> <p>Necessary projections, fins, parapets, chajjas etc. in addition to the minimum area specified elsewhere in this specification shall be provided as required.</p> <p>Nothing extra shall be payable for any changes required while getting the drawings / scheme approved and for executing the same.</p> <p>All structures, buildings and facilities shall be designed as per provisions of National Building Code 2016 and Local building by - laws as applicable including provisions of the Factories Act of the State concerned, with regard to requirement of free access, stairs, minimum head room, walkways, ventilation, toilets etc. and safety requirements like railings, fire escapes etc. Further all layouts and detailed drawings shall meet the relevant statutory requirements specified in recommendations of Petroleum act, Explosives act and Indian Electricity rules' as applicable.</p> <p><b>FINISHING SCHEDULE</b></p> <p><b>Flooring</b></p> <p>The nominal total thickness of floor finish shall be 50mm i.e. underbed &amp; topping. The floor shall be laid on an already laid and matured concrete base. Flooring of tiles / stone shall be fixed with cement sand mortar 1:4, above PCC under bed (M 20 (with graded aggregate of nominal size 12.5mm) design mix)</p> <p>Flooring of Concrete hardener topping shall be provided above the PCC underbed (M 20 (with graded aggregate of nominal size 12.5mm) design mix).</p> <p>Wherever specified Heavy duty ceramic tiles of size 300x300x7 mm thick (minimum) of reputed manufacturer of approved finish shade and colour to be used. Vitrified matt finish ceramic tiles wherever specified shall be 600x600 mm with minimum 9.5 mm thickness and of reputed manufacturer.</p> <p>Floor finish &amp; skirting:</p> <p>The nominal thickness of floor finish shall be 50 mm.</p> <p>Floors of toilets, pantries / kitchen shall be finished with Heavy duty (grade-5) dust pressed ceramic tiles 300mmx300mm x7 mm thick as per IS:15622, including pointing the joints with white cement mixed with matching pigment, of approved make, size &amp; colour shade.</p> <p>(1) Floors of Office Room, Labs, Control Rooms, RIO Rooms and all other A/c Room shall be finished with Mirror polished Vitrified ceramic tiles ( minimum 9.5 mm thk) with 3 mm groove joints as per approved pattern, pointed neatly</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p> <p>PAGE 45 OF 71</p>





CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>with 3X4mm stainless epoxy grout SP- 100 of Laticrete or approved equivalent in approved colour to match colour of tile.</p> <p>(2) Suitable supporting arrangement shall be provided with M.S. angles / channels on cable trenches in MCC and Control rooms for mounting Control panels / MCC.</p> <p>(3) In rest of the areas, IPS (Cement concrete flooring) with Concrete hardener topping shall be 12mm thick with ordinary grey cement using uniformly graded, properly treated iron particles shall be provided.</p> <p>(4) Floors and sides of under ground RCC structures like valve pits, trenches and tanks shall have simultaneous (integral) neat cement finish at the time of concreting.</p> <p>(5) The interconnecting walkway between various structures, buildings and facilities shall be finished with 22 mm chequered concrete tiles at top. 1000 mm wide walkway of 22mm thick chequered concrete tiles shall be provided on terrace for maintenance purpose, in all RCC /Metal deck roof buildings.</p> <p>(6) Skirting in general shall be 150mm high, Dado in toilet, kitchen &amp; pantry shall be up to specified height (up to 2200 mm for toilets, up to 600 mm high above counter top in kitchen and pantry area). The dado height shall be measured from finished floor level. Skirting and Dado shall match with the floor finish.</p> <p>(7) Battery Room shall be provided with Acid resistant tile on horizontal and vertical surfaces, at all levels for all type of works, including One coat of bitumen primer followed by 12 mm thick bituminastic layer, 20 mm thick Acid Resistant tiles, 6 mm thick under-bed by potassium silicate mortar, 6 mm thick pointing of joints of tiles with acid/alkali resistant epoxy/furane mortar up to a depth of 20 mm and bituminastic end sealing. 1200 mm high dado on wall shall be with 12 mm thk Acid resistant tiles of the similar finish and the joints to be finished as per flooring tiles, with the rest of wall height and ceiling finished in chemical resistant paint (chlorinated rubber based).</p> <p>(8) Well polished 18 mm thick granite stone jointed with neat cement slurry mixed with pigment to match the shade of the stone including rubbing and cleaning, complete, to be provided in entrance area, entrance steps, Entrance area, staircases (tread, riser, landings, skirting).</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB SECTION-IV CIVIL WORKS</b>	<b>PAGE 46 OF 71</b>





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<p><b>29.03.00</b></p> <p><b>29.04.00</b></p> <p><b>29.05.00</b></p>	<p>Sunken RCC slab shall be provided in false flooring area and toilet, Kitchen and pantry, so as to keep the finished floor level of these areas same as that of the surrounding area.</p> <p>Water proofing treatment to be provided on sunken portion of all vertical and horizontal surfaces of depressed portions of all toilets, W.C., kitchen, Pantry and the like consisting of :</p> <p>(i) Ist course of applying cement slurry @ 4.4 kg/sq.m mixed with water proofing compound conforming to IS 2645 in recommended proportions including rounding off junction of vertical and horizontal surface.</p> <p>(ii) IInd course of 20 mm cement plaster 1:3 (1 cement: 3 coarse sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface.</p> <p>(iii) IIIrd course of applying blown or residual bitumen applied hot at 1.7 kg. per sq.m of area.</p> <p>(iv) IVth course of 400 micron thick PVC sheet. (Overlaps at joints of PVC sheet should be 100 mm wide and pasted to each other with bitumen @ 1.7 kg/sq.m).</p> <p>Acid / Alkali Resistant Treatment:</p> <p>Acid / alkali resistant lining treatment shall be provided in different areas as follows:</p> <p>Neutralization Pit: The walls shall be provided with one coat of bitumen primer, followed by 18 mm thick bitumastic layer, 115 mm thick A.R. bricks, 6 mm thick under bed of potassium silicate mortar, pointing the joints of bricks with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing. Suitable plasters shall be provided with A.R. bricks at regular intervals depending upon the height of lining, as per the specification.</p> <p>The floor of neutralization pit shall be provided with acid / alkali resistant lining treatment as given in the above para, except that the 115 mm thick A.R.tile layer shall be replaced by 75 mm thick A.R. tile layer and pilasters shall be omitted.</p> <p>The ceiling of neutralization pit shall be provided with one coat of epoxy primer followed by 2 coats of epoxy paint (150 micron).</p> <p>Acid / Alkali storage area / projections above the floor, pedestals projecting from the floor / saddles. : The floor shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick under - bed by potassium silicate mortar, 6mm thick pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar up to a depth of 20 mm and bitumastic end sealing. Dado of 12 mm thk Acid Resistant tiles up to 1.0M high shall also be provided if applicable in case of walls nearby.</p> <p>Alum/Lime Storage area and first floor of Chemical House : One coat of bitumen primer followed by 12mm thick bitumastic layer, 20 mm thick A.R. tiles, 6 mm thick underbed of potassium silicate mortar, 6mm thick pointing of joints of tiles with acid /alkali resistant epoxy /furane mortar up to a depth of 20 mm and bitumastic end sealing.</p>		
<p align="center"><b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b></p>	<p align="center"><b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b></p>	<p align="center"><b>PART-B SUB SECTION-IV CIVIL WORKS</b></p>	<p align="center"><b>PAGE 47 OF 71</b></p>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>Alum solution preparation tank:</p> <p>The wall shall be provided with one coat of bitumen primer followed by 12 mm thick bitumastic layer, 75 mm thick A.R. tiles, 6 mm thick underbed by potassium silicate mortar, pointing of joints of tiles with acid / alkali resistant epoxy / furane mortar upto a depth of 20 mm and bitumastic end sealing.</p> <p>The floor shall be provided with acid / alkali resistant lining treatment as given in the above para except that the 75 mm thick A.R. tile layer shall be replaced by 12 mm thick A.R. tile layer.</p> <p>Basket of Alum solution preparation tank: 5 mm thick epoxy lining over a coat of epoxy primer.</p> <p>Curved surfaces of saddles shall have minimum 12 MM thick bitumastic layer to support the vessel / tanks.</p> <p>Effluent Drains: Acid Resistant lining treatment indicated for the storage area shall be provided on the bed as well as walls of the drains with 38 MM AR tiles. The underside of the pre-cast slab cover shall be applied with one coat of epoxy primer and two coats of epoxy coating, total DFT 150 microns.</p> <p>Lime tank: Two coats of bitumen paint conforming to IS: 9862, with total DFT 150 microns.</p> <p><b>29.06.00 Walls</b></p> <p><b>29.06.01</b> All walls shall be non-load bearing infilled panel walls. All external walls shall be minimum one brick thick masonry wall.</p> <p><b>29.06.02</b> All external and internal walls shall be with minimum one brick masonry (230 or 250 mm) including toilet walls. Toilet partition low height walls shall be minimum half brick masonry.</p> <p><b>29.06.03</b> For all air conditioned areas/ rooms, wherever metal cladding is envisaged as cladding material, additional brick masonry wall (230mm thick) shall also be provided in addition to metal cladding for effective air conditioning. This brick wall shall be plastered &amp; painted as specified elsewhere in the specification.</p> <p><b>29.06.04</b> RCC transoms and mullions of size 115x115mm with suitable reinforcement shall be provided wherever necessary to reinforce the brickwork.</p> <p><b>29.06.05</b> 50 mm thick DPC in Cement concrete (M-20) with water proofing compound followed by two layers of bitumen coating 85/ 25 grade as per IS: 702 @ 1.7 kg/sq.m. shall be provided at plinth level before starting the masonry work.</p> <p><b>29.06.06</b> The bricks shall be laid with cement mortar (1:6) for one brick thick walls and (1:4) for half brick thick walls IS: 1905, IS: 2212 and SP -- 20 shall be followed for brick work design and construction.</p> <p><b>29.07.00 Plastering</b></p>		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
29.07.01	<p>External (rough) surface of walls shall be plastered with 18 mm thick cement plaster, consisting first (base) layer of 12 mm thick plaster in cement sand mortar (1:6) and second (finishing) layer of 6 mm thick plaster in cement sand mortar (1:4).</p> <p>The internal (smooth) surface of walls shall have 12 mm thick plaster in cement sand mortar (1:6).</p> <p>All external / internal RCC surfaces including RCC parapet walls shall be provided with minimum 12mm thick plaster in cement sand mortar (1:4) except walls of underground structures like cable trenches / valve pits etc.</p>		
29.07.02	<p>All exposed faces of R.C.C. walls of structures, buildings and facilities shall have minimum 12 mm thick cement sand plaster 1:6.</p>		
29.07.03	<p>All RCC ceilings (except areas provided with false ceilings and cable vault ceiling) shall be provided with 6 mm thick cement sand plaster 1:4.</p>		
29.07.04	<p>All plastering work shall conform to IS: 1661.</p>		
29.08.00	<p><b>Painting</b></p>		
29.08.01	<p>All painting on masonry or concrete surface shall preferably be applied by roller. If Applied by brush then same shall be finished off with roller.</p>		
29.08.02	<p>All paints shall be of approved make including chemical resistant chlorinated rubber paint.</p>		
29.08.03	<p>Minimum two finishing coats of paint shall be applied over a coat of primer.</p>		
29.08.04	<p>Deleted</p>		
29.09.00	<p><b>Internal Finish</b></p>		
29.09.01	<p>All Air conditioned areas shall have 2mm of polymer based water resistant putty (wall putty) to given an even and smooth surface.</p>		
29.09.02	<p>Acrylic emulsion paint shall be as per IS: 5411 (Part - 1). Acrylic distemper shall be as per IS: 428. Air - conditioned areas shall be applied with minimum 2 coats of acrylic emulsion paint. All other areas shall be applied with minimum 2 coats of Acrylic distemper.</p>		
29.09.03	<p>Toilet, Pantry / Kitchen areas shall have dado with Designer ceramic tiles, 300x450mm upto 2.2 m height and shall match with floor finish. Above dado, Acrylic distemper shall be applied.</p>		
29.09.03	<p>Areas coming in contact with chlorine fumes or acid / alkali shall have two coats of acid / alkali resistant chlorinated rubber paint over suitable primer on walls above dado &amp; ceiling.</p>		
29.10.00	<p>The paint shall be of approved colour shade and make.</p>		
29.10.00	<p><b>External Wall Finish</b></p> <p>Acrylic Smooth Exterior Paint with silicone additives (minimum two coats) over suitable primer as per manufacturer's specifications of approved colour, and shade for all types of plastered and / or exposed concrete surface, in all kinds of works, at all levels, including preparation of surface, preparation of working drawing, labour,</p>		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>material, equipment, handling, transportation, mixing, laying, applying finishing, testing, curing, making grooves, scaffolding, staging, etc., all complete, as per specifications, drawings and instructions of the Engineer-in-charge.</p> <p>Toe wall of chain link fencing shall be provided with two coats of Acrylic Smooth Exterior Paint with silicone additives.</p> <p>The finish shall be of approved colour shade and make.</p> <p><b>29.11.00 Ceiling Finish</b></p> <p>Ceiling shall have min. two (2) coats of Acrylic distemper except AC areas &amp; Battery room.</p> <p><b>29.11.01</b> For painting on concrete, masonry and plastered &amp; surface, IS: 2395 shall be followed. For painting on steel work and ferrous metals, IS: 1477 shall be followed.</p> <p><b>29.11.02</b> Fire resistant transparent paint (confirming to IS: 162 ) shall be provided on all wood work, over French police or flat oil paint. French polish shall confirm to IS : 348. Flat oil paint shall confirm to IS: 1237.</p> <p><b>29.12.00 Doors, Windows, Ventilators, Louvers, Rolling Shutters &amp; Glazing</b></p> <p><b>29.12.01</b> Adequate Doors, Windows, Louvers and Ventilators shall be provided for proper lighting and ventilation of all buildings. The area of windows shall be at least 10% of the floor area of the respective building. In addition to the above, wherever room height is more than 3.5 m, a band of ventilators of 600 mm height (minimum) shall be provided at the top.</p> <p><b>29.12.02</b> Entrance of FGD control room and Control Equipment Room shall be provided with air-locked lobby with provision of double doors. Unless specified all doors, of air conditioned areas, entrance door of air lock lobby of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. Windows, ventilators &amp; partitions of all buildings shall have electro colour coated (anodised) aluminium frame work with glazing. All doors of toilet, kitchen, pantry &amp; store areas shall be of factory made pre - laminated solid core flush door shutters, as per IS: 2202 (Part-I) with pressed steel door frame. Control room shall have Aluminium glazed door &amp; partitions. All other doors (unless otherwise specified) shall be of steel.</p> <p><b>29.12.03</b> All steel doors shall consist of double plate flush door shutters. The door shutter shall be 45 mm thick with two outer sheets of 18 G rigidly connected with continuous vertical 20 G stiffeners at the rate of 150 mm centre to centre. Side, top and bottom edges of shutters shall be reinforced by continuous pressed steel channel with minimum 18 G. The door shall be sound deadened by filling the inside void with mineral wool. Doors shall be complete with all hardware and fixtures like door closer, tower bolts, handles, stoppers, aldrops, etc.</p> <p><b>29.12.04</b> Wherever functionally required, rolling shutters of suitable size approved by the Owner, with suitable operating arrangement manual/ electric shall be provided to facilitate smooth operations. Rolling shutters shall conform to IS: 6248.</p> <p><b>29.12.05</b> All windows and ventilators at ground floor level shall be provided with suitable anodised aluminum grill.</p>		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
29.12.06	Fire proof doors with panic devices shall be provided at all fire exit points as per the requirements. However minimum Fire rating shall be 2 hours. These doors shall be double cover plated type with mineral wool insulation. Vision Panel in minimum 11 mm thick inter layered fire resistant glass shall be provided in Fire Doors.		
29.12.07	Hollow excluded Section of minimum 2 mm wall thickness as manufactured by INDAL, Jindal, Hindalco or equivalent shall be used for all Aluminium doors, windows, ventilators and Partitions.		
29.12.08	The doors, Windows & ventilators frame shall be of suitable size & thickness for fixing the glazing. The Glazing thickness shall be minimum 6 mm thk clear toughened glass for all glazed doors, windows, ventilators & partitions. Windows in air conditioned areas shall be provided with 24mm thick hermetically sealed composite double glazing.		
29.12.09	Doors and windows on external walls shall be provided with sunshade over the openings with width 600 mm more than the opening width. The projection from the finished face of the wall for sunshade shall generally be 450 mm over window openings, 750 mm over door openings and 900 over Rolling shutters, or as decided and approved by the Engineer.		
29.12.10	Deleted		
29.12.11	All glazing work shall conform to IS: 3548.		
29.12.12	Windows in conveyor gallery shall be provided with welded wire fabric of 1.6mm thick wire as per IS: 4948 and 12mm x 30mm mesh size.		
30.00.00	<b>WATER SUPPLY, DRAINAGE AND SANITATION</b>		
30.01.00	Polyethylene water storage tank conforming to IS: 12701 shall be provided (for the use of toilet, pantry and kitchen) over the roof, with adequate capacity depending on the number of users and 8 hours requirement complete with all fittings including float valve, stop cock etc. The capacity of tank shall be calculated minimum 500 liters, per toilet, pantry and kitchen		
30.02.00	CPVC pipes as per IS code 15778 shall be used for internal piping works for portable water supply.		
30.03.00	UPVC Pipes as per relevant IS code shall be shall be used for sanitary works above ground level.		
30.04.00	The facilities provided in the toilet block shall depend on the number of users. However, minimum facilities to be provided shall be as stipulated below. IS: 1172 shall be followed for working out the basic requirements for water supply, drainage and sanitation. In addition, IS: 2064 and IS: 2065 shall be also be followed.		
30.05.00	<p>Each toilet block shall have the following minimum facilities. Unless specified all the fittings shall be of chromium plated brass (fancy type).</p> <p>The toilet area shall have finished floor level at 15 mm below the finished floor level of surrounding area.</p>		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<p>Following minimum fittings &amp; fixtures together with associated plumbing works shall be provided as specified below.</p>	<b>Sl. No.</b>	<b>Type of Fitting / Fixtures</b>	<b>Gents Toilet /Ladies Toilet</b>
	i)	1 no wall mounted coloured glazed vitreous china European water closet with flush valve.	1 No./1 No.
	ii)	Coloured glazed vitreous china flat back lipped urinals with photo voltaic controlled automatic flushing system including all requisite fittings and fixtures	1
	iii)	Wash Basin (oval shape) with photo voltaic control system and all requisite fittings and fixtures to be fixed on concrete platform finished with 18mm thick first grade polished granite stone	1 No./1 No.
	iv)	Wall to wall mirror minimum 900 mm high (minimum 6mm thick float glass) including all fittings	1 No./1No.
	v)	Stainless steel Towel Rail 600mm Long x 20 mm dia.	1 No. /1 No.
	vi)	Stainless steel Liquid soap holder cum dispenser with requisite fittings.	1 No.
	vii)	Overhead Drinking water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type.	1
	viii)	Overhead Service water storage tank (Minimum 500 Litres capacity)- High density polyethylene (cylindrical/vertical) molded seamless type	1 No.
	<p><b>30.06.00</b></p> <p><b>30.07.00</b></p>	<p>One No. drinking water connection with C.P. brass valve for fixing water cooler by Owner.</p> <p>Required plumbing work from Owner's service water terminal point to the service water tank and from tank to the toilet accessories mentioned above.</p> <p>Required plumbing work from Owner's potable water terminal point to the drinking water tank and from tank up to the water coolers.</p> <p>Janitor room. Adequate space shall be provided.</p> <p>Provision for installation of water cooler.</p> <p>All structures, buildings, facilities, liquid storage tanks shall be provided with peripheral surface drains of all around periphery and suitably connected to nearest Owner's drain. Overflow and drains from storage tanks shall be laid to and suitably connected to Owner's open surface drains.</p> <p>The sewerage and waste water disposal system shall consist of providing all associated plumbing and underground pipe works together with all fittings and</p>	
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<p><b>30.08.00</b></p>	<p>fixtures and inclusive of ancillary works such as connections, manholes and inspection chambers, including connection to Owner's nearest main sewer line or as directed by Engineer. If required, lifting facilities for connecting to the manhole of owner's sewer line shall be in bidder's scope.</p> <p>Miscellaneous Architectural Items</p> <p>(a.) In all buildings suitable arrangement with provision of floor traps for draining the water collected from leakage, floor washing, fire fighting etc. shall be provided on all floors which shall be connected to rain water down comers.</p> <p>(b.) Wherever required minimum 1000 high hand railing with 32 NB M.S. pipes medium class as per IS : 1239 shall be provided, with toe &amp; knee rail and toe guard plate, around all floor / roof openings, around periphery of Neutralisation Pit, projections of balconies, walkways, platforms, steel staircase etc.</p> <p>(c.) However for RCC staircases in structures, buildings and facilities, railings with 20 mm square MS bar balustrades with suitable anti corrosive paint of approved colour MS flats for knee &amp; toe guard with 50mm Ø NB MS pipe hand rail at top shall be provided.</p> <p>(d.) All air conditioned areas / common corridors shall be provided with false ceiling constructed from 15 mm mineral Fibre Board in tile form of 600x600mm with supporting system as per manufacture guidelines. 50 mm thick mineral wool insulation (conforming to IS : 8183) shall be provided with as under deck insulation). Additional hangers and height adjustment clips shall be provided for return air grills, light fixtures, Air conditioning ducts etc. Minimum headroom below false ceiling shall be 3.0 m.</p> <p>(e.) Under - deck insulation shall be provided on the ceiling (underside of roof slab) and underside of floor slab of air - conditioned areas depending upon the functional / air - conditioning requirements. The under - deck insulation shall consist of 50 mm thick mineral wool insulation conforming to IS : 8183 backed with 0.05 mm thick aluminium foil &amp; 24 G x 25 mm mesh wire netting and shall be fixed to ceiling with 24 G wire ties and suitable fixing arrangements.</p> <p>(f.) Parapets, chajjas, window / door heads, architectural facias, fins etc., shall be provided with drip course in cement mortar (1 : 3).</p> <p>(g.) 150mm thick fillets at junction of roof slab / chajja slab and parapet / vertical walls shall be provided with cast - in - situ cement concrete 1 : 2 : 4 nominal mix, followed by 12 mm thick cement sand plaster (1 : 4).</p> <p>(h.) Suitable provision shall be made for fixing of ceiling fans in office areas of different structures, buildings and facilities.</p>		
<p><b>31.00.00</b></p>	<p><b>CORROSION PROTECTION</b></p>		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
31.01.00	<p><b>GENERAL</b></p> <p>(a) All Steel structures shall be provided with painting as given in the specification. Further, painting system shall also meet the requirements of Corrosivity category C3 (durability High) as per ISO 12944.</p> <p>Painting system for steel surfaces embedded in Concrete is given separately.</p> <p>(b) All Painting shall be done as per technical specification. Painting scheme shall be submitted by the bidder for approval of employer.</p> <p>(c) All steel structures shall be designed by following basic design criteria in ISO 12944 Part 3. However, where it is not feasible to follow the design criteria given in ISO 12944 Part 3 where the steel surface are inaccessible for application of protective coating, corrosion allowance of 1.5 mm shall be kept in thickness(over the design thickness) of structural steel members.</p>		
31.02.00	<p><b>PAINTING OF STEEL SURFACES EMBEDDED IN CONCRETE:</b></p> <p>a) For the portion of Steel surfaces embedded in Concrete, the surface shall be prepared by Manual Cleaning and provided with Primer Coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron Dry Film Thickness (DFT).</p> <p>b) All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, sleeves, etc. shall be coated with temporary rust preventive fluid and during execution of civil works, the dried film of coating shall be removed using organic solvents.</p>		
31.03.00	<p><b>PAINTING OF STEEL SURFACES (OTHER THAN THOSE EMBEDDED IN CONCRETE)</b></p> <p>a) All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% <math>\pm 2\%</math>) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00.</p> <p>b) Primer coat shall be followed with the application of Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% <math>\pm 2\%</math>) of minimum 100 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.</p> <p>c) Intermediate coat shall be followed with the application of finish coat of two pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% <math>\pm 2\%</math>) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 <math>\Delta E</math>) and minimum 70 micron DFT. This coat shall be applied shop after an interval of minimum 10 hours and</p>		
<p align="center"><b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b></p>	<p align="center"><b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b></p>	<p align="center"><b>PART-B SUB SECTION-IV CIVIL WORKS</b></p>	<p align="center"><b>PAGE 54 OF 71</b></p>





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	<p>within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.</p> <p>Notes:</p> <ol style="list-style-type: none"> <li>1. For Primer, high quality surface preparation is necessary and good amount of moisture is required for proper curing. Below 70 % relative humidity, curing time may go up to 7 days or more. In such a case additional water sprinkling may be ensured for completion of curing. Additionally Inorganic zinc silicate cannot be recoated; even with itself. Typically it should be used when coating bare steel surface for first time.</li> <li>2. The most frequent problem associated when top coating Primer is bubbling/pin holing especially with non-weathered zinc silicate coatings. To a great extent, this bubbling of finish paint can be eliminated by applying a mist coat of intermediate/topcoat as the first pass of the product, allow the bubbles to subside and then apply a full coat, as required.</li> <li>3. In case top coating of zinc silicate with epoxy/polyurethane coatings, is expected to be delayed, it is advisable to use a suitable tie coat to avoid formation of white rust. However, if white rust forms then clean the surface with high pressure water, dry and apply the subsequent coats as required.</li> <li>4. Touch up paintings on damaged areas: Surface preparation by manual tools, wire brush/ emery paper etc. Minimum 6 inches peripheral area, adjoining to damaged area to be covered. If metal surface is exposed, it is to be painted with Zinc rich epoxy (70 micron) or suitable primer with existing paint scheme. If primer is intact, intermediate &amp; top coat to be done with specified DFT in scheme.</li> </ol> <p>31.04.00 <b>COATING FOR MILD STEEL PARTS IN CONTACT WITH WATER.</b></p> <ol style="list-style-type: none"> <li>a) All mild Steel parts coming in contact with water or water vapour shall be hot dip galvanised. The Minimum Coating of Zinc shall be 610 Gms / Sq. M. for galvanised Structures and shall comply with IS: 4759 and other relevant Codes. Galvanising shall be checked and tested in accordance with IS: 2629.</li> <li>b) The galvanising shall be followed by the application of an etching Primer and dipping in black bitumen in accordance with BS: 3416, unless otherwise specified.</li> </ol> <p>31.05.00 <b>Gratings</b></p> <p>All gratings shall be blast cleaned to Sa 2 ½ finish or cleaned by acid pickling as per ISO 8501-1 and shall be hot dip galvanized at the rate of 610 Gms / Sq. M.</p> <p>31.06.00 <b>Hand Railings and Ladders</b></p> <p>All Mild steel handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS: 4736.</p> <p>31.07.00 <b>Sea Worthiness</b></p>		
<p align="center">RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p align="center">PART-B SUB SECTION-IV CIVIL WORKS</p>	<p align="center">PAGE 55 OF 71</p>


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<p>31.08.00</p>	<p>All Steel Sections and fabricated Structures, which are required to be transported on sea, shall be provided with anti corrosive Paint before shipment to take care of sea worthiness.</p> <p><b>For Reinforced Concrete Work.</b></p> <p>i) The protection for concrete sub-structure shall be provided based on aggressiveness of the soil, chemical analysis of soil/sub-soil water and presence of harmful chemicals/salts.</p> <p>ii) The protection to super structure shall depend on exposure condition and degree of atmospheric corrosion.</p> <p>This shall require use of dense and durable concrete, control of water cement ratio, increase in clear cover, use of special type of cement and reinforcement, etc., coating of concrete surface, etc.,</p> <p>Bidder shall furnish the details of corrosion protection measures.</p>		
<p>32.00.00</p>	<p><b>Miscellaneous</b></p>		
<p>32.01.00</p>	<p>Ordinary form work shall be used in roofs and floor slabs in transfer houses, footings, pedestals, cable trenches, pits etc., Plywood form work shall be used for all over ground exposed work like columns, beams, floors and ceilings in control room and M. C. C. buildings.</p>		
<p>32.02.00</p>	<p>Monorail girders and fixtures shall be provided for monorails at the locations as required and as described elsewhere in these specifications or drawings. Monorail openings in the walls shall be provided with steel frame doors preferably sliding type or otherwise open able inside, access platforms and ladders.</p>		
<p>32.03.00</p>	<p>Steel frame around openings in roof and on external walls for mounting of exhaust fans shall be provided.</p>		
<p>32.04.00</p>	<p>Ready mix non - shrink cementitious grout of reputed manufacturer as approved by the Employer shall be used for grouting of block outs and foundation bolts, underpinning of base plates and machine bases. Crushing strength of grout shall be one grade higher than the foundation concrete. Minimum crushing strength shall be 30 N / mm<sup>2</sup> unless higher strength requirement is specified by the equipment supplier or the grout manufacturers.</p>		
<p>32.05.00</p>	<p>The bottom of steel in case of cable / pipe galleries and trestles shall be generally 3m above the ground except for rail / road crossing where it shall be 8m above the rail top / road crest/ground. Further in bunker areas it shall be 8 m above the ground.</p>		
<p>32.06.00</p>	<p>Polysulphide Sealing Compound shall be two-part polysulphide sealant and shall be from approved manufacturer, conforming to IS : 12118. Materials shall consist of polysulphide polymer and a curing agent. Gun grade material shall be used unless otherwise specified. The application of the sealant shall be strictly followed as per manufacturer's guidelines.</p>		
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<p><b>33.00.00</b></p> <p><b>33.01.00</b></p> <p><b>33.01.01</b></p> <p><b>33.01.02</b></p> <p><b>33.01.03</b></p> <p><b>33.01.04</b></p> <p><b>33.01.05</b></p> <p><b>33.02.00</b></p> <p><b>33.02.01</b></p> <p><b>33.02.02</b></p> <p><b>33.02.03</b></p> <p><b>33.03.00</b></p> <p><b>33.03.01</b></p>	<p><b>SHOTCRETING</b></p> <p><b>General Requirements</b></p> <p>Generally, shotcreting shall be done in accordance with IS : 9012.</p> <p>Reinforcement for shotcreting shall be as detailed below, unless specified otherwise.</p> <p>Reinforcement in one direction consisting of 6 mm M. S. bars at 750 mm c / c shall be connected to the lugs for fastening of the wire fabric. This shall be used in case of 50 mm or above thick shotcreting.</p> <p>Wire fabric conforming to IS : 1566 shall be used as reinforcement and shall consist of wire, 3 mm diameter, spaced 50 mm both ways and shall be electrically cross welded. Wire fabric shall be securely tied to 6 mm bars for 50 mm thickness. Adjacent sheet of wire fabric shall be lapped at least 100 mm and tied.</p> <p>Clear cover to reinforcement mesh shall not be less than 15 mm.</p> <p>Minimum thickness of shotcreting shall be 50 mm. for abrasion resistant work and 25 mm for ordinary surface protection work.</p> <p><b>Material</b></p> <p>Generally, the materials shall be in accordance with aggregates specification given hereunder.</p> <p>Fine aggregate shall consist of natural sand or crushed stone from a known source and shall be strong, hard, coarse, sharp, chemically inert, clean and free from any coating. It shall be free from clay, coal or coal residue, organic or any other impurities that may impair the strength or durability of the concrete and shall conform to IS : 383.</p> <p>Fine aggregate (Sand) shall be well graded and particles shall range in size within the following limits. The Engineer, may approved the use of any other grading as per requirement or as per IS : 9012.</p> <p>The fineness modulus shall be preferably between 2.5 and 3.3. Any other value can be used, with prior approval of the Engineer.</p> <p><b>Application</b></p> <p>After the placement of reinforcement and / or welded mesh and not more than six hours prior to the application of shotcrete, the surface shall be thoroughly cleaned of all loose materials and dirt. The Contractor shall properly prepare the surfaces, reinforcement and / or welded mesh to receive the shotcrete. Cleaned surfaces shall be wetted not more than hour prior to shotcreting.</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 57 OF 71</p>

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33.03.02	<p>The mix as placed on surface shall be one part cement to three parts approved sand by mass. Cement and sand shall be dry mixed; not water shall be added after mixing and before using in the gun. The quantity of water when added shall be only that which is sufficient to hydrate the cement. For average atmospheric conditions, the water cement ratio for shotcrete in place shall be between 0.35 and 0.5 by mass. Suitable admixture shall be used wherever required.</p>		
33.03.03	<p>A uniform pressure of not less than 3 Kg/cm<sup>2</sup> at the nozzle shall be maintained. Necessary adjustments shall be made to ensure this pressure, taking into account the length of hose and height of the place to be shotcreted, above location of the machine.</p>		
33.03.04	<p>The application shall proceed in an upward direction. Beams, stiffeners and intermediate walls, if any, shall be wrapped with wire fabric and completely covered with shotcreting. All rebound shall be removed from the area of application as the work progresses and such rebound material shall not be reused.</p>		
33.03.05	<p>As soon as the freshly shotcreted surface shows the first dry patches, a fine spray of water shall be applied to keep too moist. After the surface has hardened, it shall be kept continuously moist for minimum seven days. If there is extreme heat, especially when accompanied by hot winds, the shotcreted surface, immediately upon completion, shall be covered with burlap or similar covering, which must be kept continuously moist for 14 days after shotcreting. The temperature of the lining shall not be permitted to exceed 38<sup>o</sup>C during placing of concrete.</p>		
34.00.00	<p><b>VIBRATION ISOLATION SYSTEM</b></p> <p>These specifications are meant for the design, supply and erection of vibration isolation system for supporting crushers.</p>		
34.01.00	<p><b>Supporting Arrangement</b></p>		
34.01.01	<p><b>For Crushers:</b></p> <p>The crushers shall be supported on vibration isolation system consisting of steel helical springs and viscous dampers. The supporting arrangement for each crusher shall consist of an R. C. C. deck supported on steel helical spring units and viscous damper units which in turn shall be supported on girders. The girders shall be an integral part of the crusher house building.</p> <p>The part of the structure consisting of the R. C. C. deck, springs and viscous dampers shall hitherto be referred to as “spring supported foundation”. The part of the structure, which is below the spring shall hitherto be called “supporting structure”.</p>		
34.01.02	<p>The Contractor should do the Engineering / design, supply and erection of vibration isolation system consisting of steel helical spring units and viscous dampers supporting the top deck which in turn would support the crushers. The vibrations isolation system supplied shall be of a proven make. The Contractor or his sub -</p>		
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	<p>contractor who designs and supplies the system should have designed, supplied and installed such systems for not less than five machines of speeds and unbalance forces comparable to the machine proposed by the vendor. The vibration isolation systems installed by the contractor or his sub - contractor in such machines should have been working satisfactorily for at least five years.</p>		
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<b>34.02.00</b>  <b>34.02.01</b>	<p><b>Scope of Work</b></p> <p>Scope of work shall include the following :</p> <p>(a.) <b>Engineering</b></p> <p>(1.) Design of the vibration isolation system using steel helical springs and viscous dampers to support an R. C. C. top deck supporting the equipment. This includes the static and dynamic analysis of the vibration isolation system with the R. C. C. top deck and the equipment.</p> <p>(2.) Structural design of the R. C. C. top deck including preparation of General Arrangement drawings, detailed reinforcement drawings, bar - bending schedules etc.</p> <p>(3.) Calculation of loads on the structure supporting the springs and viscous dampers, their points of application and the stiffness requirements of the supporting structure.</p> <p>(4.) Drawings showing embedments and their locations and details on the R. C. C. top deck.</p> <p>(5.) Drawings showing blockouts, recesses etc. on the top deck.</p> <p>(6.) Design of the supporting structure, including preparation of detailed drawings and bill of materials.</p> <p><b>(b.) Supply including packing and transportation to site</b></p> <p>(1.) Steel helical spring units and viscous dampers, including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads etc.</p> <p>(2.) Frame ( s ) for pre-stressing of spring elements.</p> <p>(3.) Suitable hydraulic jacks system including electric pumps, high pressure tubes etc. required for the installation, alignment etc. of the spring units, two extra hydraulic jacks, one hand operated pump and spares for the hydraulic jack system as required.</p> <p><b>(c.) Erection and Commissioning</b></p> <p>(1.) Complete erection and commissioning of the vibration isolation system including :</p>		
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	<p>(2.) Pre-stressing of spring elements, placing of spring elements in position, checking clearances on the shuttering of the R. C. C. top deck, construction of the supporting structure and the R. C. C. top deck, releasing to pre-stress in spring elements and making final adjustments and alignments after machine installation etc.</p> <p>(3.) The scope of work shall be deemed to include all activities which may not have been explicitly mentioned but are reasonably implied for the successful completion of the work for which these specifications are intended.</p> <p>(4.) This part of the specifications is for vibration isolation system. For the construction of the supporting structure for the crusher and the top deck, the relevant parts of the specification should be referred to.</p> <p><b>(d.) Documentation</b></p> <p>(1.) Submission of detailed design calculation, analysis ( static and dynamic ) and drawings for Employer’s acceptance and approval.</p> <p>(2.) Furnishing methodology of providing shuttering and its removal as well as concreting of deck slab, installation of springs and dampers and the sequence of operation.</p> <p>(3.) Furnishing installation and maintenance manual indicating equipment, procedure etc., necessary for installation, maintenance of vibration isolation system.</p> <p>(4.) Furnishing a check list for confirming the readiness of the civil fronts for the installation of vibration isolation system and equipment required at each stage installation.</p> <p>(5.) Bill of materials of various elements such as springs, visco-dampers, with their rating, stiffness etc., included in supply.</p> <p>(6.) Detailed specifications of the vibration isolation system and various items included in the supply and the standard (local or international) to which they conform.</p> <p>(7.) Proposed erection strategy of the entire system.</p> <p><b>34.03.00 Design Requirements for Crusher Foundation</b></p> <p><b>34.03.01 Dynamic Analysis</b></p> <p>Detailed dynamic analysis shall be done for the top deck together with springs and dampers and the natural frequencies and amplitudes of vibration shall be</p>		
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	<p>determined. A mathematical model of the top deck shall be formulated with three - dimensional beam / plate finite elements for the purpose of analysis with the spring idealised with vertical and horizontal stiffnesses. The mass of the machine together with that of the top deck shall be considered for the analysis.</p> <p>Natural frequencies upto at least 10 % above the operating speed shall be determined and these frequencies shall be checked against the design criteria.</p> <p>Forced response dynamic analysis shall be carried out for the operating condition unbalance forces using a sinusoidal forcing function. Unbalance forces as given by this specifications shall be used for his purpose. The amplitudes shall be checked against the design criteria. The dynamic forces from this analysis shall be used for structural design with a suitable fatigue factor.</p> <p><b>34.03.02 Isolation Efficiency</b></p> <p>The vibration isolation system shall be designed for about 90 % isolation efficiency.</p> <p><b>34.03.03 De-coupling</b></p> <p>A ratio of the least 10 ( ten ) shall be ensured between the stiffness of the supporting structure and the stiffness of the spring system in the vertical direction to achieve de-coupling between the two ( the stiffness of the spring system being lower ). This ensures that dynamic analysis of the supporting structure need not be carried out.</p> <p><b>34.03.04 Frequency Criteria</b></p> <p>The frequency criterion has already been laid down implicitly by the isolation efficiency criteria and de-coupling required.</p> <p>The first bending mode frequency of the top deck shall be at least 20 % above the operating speed.</p> <p><b>34.03.05 Unbalance Forces for Crushers</b></p> <p>Unbalance forces arising out of all the following cases shall be considered for checking the design and amplitudes.</p> <p>(a.) Balance quality grade Q 40 as per VDI 2060 - 1966.</p> <p>(b.) One hammer broken condition. The missing hammer shall be assumed to be closest to the crusher non - drive end of the crusher.</p> <p>(c.) Three hammers broken condition. All the three hammers broken shall be assumed to be from the same suspension bar and located at the non - drive end of the crusher.</p>		
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CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<p><b>34.03.06</b></p>	<p><b>Amplitude Criteria for Crushers</b></p> <p>The calculated amplitudes (mean to peak values) shall not exceed following limits under the specified conditions.</p> <ol style="list-style-type: none"> <li>1) Operating speed of 750 RPM           <ol style="list-style-type: none"> <li>(a.) 150 microns for an unbalance force arising out of balance quality grade Q 40 as per VDI 2060 - 1966.</li> <li>(b.) 300 microns in case of a one hammer broken condition.</li> <li>(c.) Amplitudes need not be checked for a three hammer broken condition.</li> </ol> </li>   <li>2) Operating speed of 450 RPM           <ol style="list-style-type: none"> <li>(a.) 200 microns for an imbalance force arising out of balance quality grade Q-40 as per VDI -2060-1966.</li> <li>(b.) 400 microns in case of a one hammers broken condition.</li> <li>(c.) Amplitude need not be checked for a three hammer broken condition.</li> </ol> </li> </ol> <p>For intermediate operating speed between 450 to 750 RPM the amplitude limits can be linearly interpolated.</p> <p>The amplitude limits mentioned above are in both vertical and horizontal directions. The amplitudes shall be calculated at critical points on the top surface of the R. C. C. deck. The amplitudes shall be checked for the most unfavorable superposition of modes in any direction. However, phase difference between the maximum amplitude occurring in different directions due to the rotating vector may be considered while superimposing the modes.</p>		
<p><b>34.03.07</b></p>	<p><b>Unbalance force and Amplitude Criteria</b></p> <p>The unbalance forces and amplitude criteria shall be as per the equipment manufacturer's recommendations or as per VDI 2060/ VDI 2056, whichever is more stringent.</p>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 63 OF 71</p>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>				
<p><b>34.03.08</b></p> <p><b>34.04.00</b></p> <p><b>34.05.00</b></p>	<p><b>Transient Resonance</b></p> <p>Transient resonance, which may occur during the start - up or coasting down condition of the crusher, shall be checked, and the amplitudes in such a condition should not exceed one - and - half times those at operating speed for each design condition.</p> <p><b>Strength Criteria</b></p> <p>The following criteria shall apply for the design of top deck :</p> <p>(a.) Dead loads, live loads, Seismic loads and dynamic loads shall be considered for the design. The most unfavorable combination shall considered for design.</p> <p>(b.) Seismic loads shall be assumed to act together with dynamic loads for a one millimeter eccentricity in the rotor. However, seismic loads and dynamic loads arising out of hammer breakage need not be considered together</p> <p>(c.) Fatigue shall be considered while designing for dynamic forces. A fatigue factor of 2.0 shall be used on all dynamic forces to arrive at the equivalent static force for the purpose of design.</p> <p>(d.) Working stress method shall be used for the design of R. C. C. deck. In survival condition, 10 % overstressing may be permitted.</p> <p>(e.) The R. C. C. top deck shall be at least of M35 grade of concrete as per IS : 456.</p> <p>(f.) Fatigue need not be considered for the three hammer broken condition.</p> <p>(g.) For calculating unbalance forces, the heaviest hammer ( plain or toothed ) shall be considered.</p> <p><b>Approval of Designs and Drawings</b></p> <p>All design calculation, drawings and documents shall be in English. All design calculations and drawings shall be submitted to Employer for approval. However, approval of such designs and drawings shall not relieve the contractor of his responsibility regarding the adequacy of the foundation to carry the design forces.</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 64 OF 71</p>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<p><b>34.06.00</b></p>	<p><b>Standards</b></p> <p>Latest revisions of the following Codes shall be used for the design of the crusher foundations.</p> <p>(a.) IS : 456 Code of Practice for Plain and Reinforced concrete.</p> <p>(b.) IS : 2974 ( Part IV ) Code of Practice for Design and Construction of Machine Foundations ( Part IV ) for rotary type machine of low frequency.</p> <p>(c.) IS : 1893 ( Criteria for Earthquake Resistant Design of Structures ).</p> <p>(d.) DIN 4024 Machine Foundations :</p> <p>Flexible supporting structures for machines with rotating masses.</p> <p>(e.) DIN 2089</p> <p>Helical Compression Springs out of round wire and rod; calculation and Design.</p> <p>(f.) DIN 2096</p> <p>Helical Compression Springs out of round wire and rod; quality requirements for hot formed compression springs.</p> <p>(g.) VDI 2056 - Criteria for assessing mechanical vibrations of machines.</p> <p>(h.) VDI 2060 - Criteria for assessing the state of balance of rotating rigid bodies.not be permitted to exceed 38°C during placing and curing</p>		
<p><b>35.00.00</b></p>	<p><b>Packaging and Transportation.</b></p> <p>All the equipment shall be suitably protected coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials the limitations from the point of view of availability of railway wagon sizes in India should be taken into account. The contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.</p>		
<p><b>36.00.00</b></p>	<p><b>Plant Life</b></p> <p>The plant shall be designed for a minimum operating life of 30 years under the conditions of operation. Assurance shall be given that plant components are adequate for this lifetime. If there are any exceptional items of the plant on which an</p>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 65 OF 71</p>


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>				
<p><b>37.00.00</b></p> <p><b>38.00.00</b></p> <p><b>39.00.00</b></p> <p><b>39.01.00</b></p> <p><b>39.02.00</b></p>	<p>assurance of meeting this clause cannot be given, life of such components and the difficulties associated with them shall be stated.</p> <p><b>PTFE (Poly Tetra Fluoroethylene) Bearing</b></p> <p>The bearing shall be of reputed make and manufacturer as approved by the Engineer, for required vertical load and end displacement/rotation. PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/sq.cm. In order to prevent cold flow in PTFE surface it shall be rigidly bonded by a special high temperature resistance adhesive to the stainless steel substrata. The stainless steel surface that slides against the PTFE is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of stainless steel plate shall be between 1.0 mm to 1.5 mm.</p> <p><b>TESTS FOR MATERIAL / WORKMANSHIP</b></p> <p>All tests required for all materials, quality of workmanship or any other tests as desired by the Engineer shall be at contractor's cost.</p> <p><b>MATERIALS</b></p> <p><b>For Civil, Structural and Architectural works</b></p> <p>Employer will not supply any material. All materials including cement, reinforcement steel and structural steel, whatsoever required for execution and completion of the entire scope of work covered under this specification shall be arranged by the contractor at his own cost. All materials procured by the contractor shall meet the quality requirements specified in this specification.</p> <p>The contractor shall keep sufficient stock of cement and steel at site at any point of time when the work is in progress excluding what has been already incorporated in the works, so that any disruption / delay in availability of these materials during procurement will not affect the progress of work at site. The minimum quantity of such materials in stock at site shall not be less then the Requirement of one ( 1 ) month in case of Cement and Requirement of two ( 2 ) Consecutive months in case of Steel.</p> <p><b>Structural steel</b></p> <p>Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects. Structural steel shall comprise of mild steel, medium strength steel and high tensile steel as specified below.</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 66 OF 71</p>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<b>39.02.01</b>	<b>Mild Steel</b> a) Rolled sections shall be of grade designation E250, Quality A/BR, Semi-killed/ killed conforming to IS 2062. All steel plates shall be of Grade designation E250, Quality BR (fully killed), conforming to IS 2062 and shall be tested for impact resistance at room temperature. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2. b) Pipes shall conform to IS 1161. c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS: 4923 and shall be of minimum Grade Yst 240. d) Chequered plate shall conform to IS 3502 and shall be minimum 6 mm thick excluding projection. Steel for chequered plate shall conform to grade E250A semi killed of IS: 2062 or equivalent grade conforming to ASTM & BS standards only.		
<b>39.02.02</b>	<b>Medium and High Tensile Steel</b> Rolled Sections and plates shall be of grade designation E350 or higher, Quality B0 (Fully killed), conforming to IS 2062. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.		
<b>39.03.00</b>	<b>Cement</b>		
<b>39.03.01</b>	Fly ash based portland pozzolana cement conforming to IS:1489 (Part-1) shall be used for all areas other than for the critical structures identified below. Other properties shall be as per IS code.		
<b>39.03.02</b>	Ordinary Portland Cement (OPC) shall necessarily be used for the following structures. a) Spring supported decks of limestone crusher b) RCC for Chimney shell. The grade of cement shall be Grade 43 for OPC conforming to IS:269.		
<b>39.03.03</b>	In place of fly ash based portland pozzolana cement, OPC mixed with Fly Ash can be used. Batching plant shall have facility for mixing fly ash. Fly ash shall conform to IS:3812(Part I & Part II). Percentage of fly ash to be mixed in concrete shall be based on trial mix. Mix design shall be done with varying percentage of fly ash mix with cement.		
<b>39.04.00</b>	<b>Reinforcement steel shall conform to:</b> a) Mild steel bars of grade I of IS: 432 Part – I or grade A of IS: 2062. b) High yield strength deformed TMT steel bars of grade Fe-500 having minimum elongation of 14.5 % or Fe-500D, and conforming to other requirements of IS 1786.		
RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250	PART-B SUB SECTION-IV CIVIL WORKS	PAGE 67 OF 71


CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<b>39.05.00</b>	<p><b>Aggregates</b></p> <p><b>a) Coarse Aggregate</b></p> <p>Coarse aggregate for concrete shall be crushed stones chemically inert, hard, strong, durable against weathering of limited porosity and free from deleterious materials. It shall be properly graded. It shall meet the requirements of IS: 383.</p> <p><b>b) Fine Aggregate</b></p> <p>Fine aggregate shall consist of natural sand/ crushed sand and shall be hard, durable, clean and free from adherent coatings of organic matter and clay balls or pellets. Fine aggregate in concrete shall conform to IS: 383. For plaster, it shall conform to IS: 1542 and for masonry work to IS: 2116.</p> <p>However, in case of chimney shell construction, natural sand conforming to IS: 383 shall only be used.</p> <p><b>c) Petrographic examination of aggregate shall be carried out by the contractor at National Council for Cement and Building Materials (NCB), Ballabgarh, or any other approved laboratory to ascertain the structure and rock type including presence of strained quartz and other reactive minerals. In case, the coarse aggregate sample is of composite nature, the proportions (by weight) of different rock types in the composite sample and petrographic evaluation of each rock should also be ascertained. While determining the rock type, special emphasis should be given on identification of known reactive rocks like chalcedony, opal etc. The procedure laid down in IS 2430 for sampling of aggregates may be followed.</b></p> <p>The laboratory shall determine potential reactivity of the aggregate, which may lead to reaction of silica in aggregate with the alkalis of cement and / or potential of some aggregates like limestone to cause residual expansion due to repeated temperature cycle. If the same is established, the contractor shall further carry out alkali aggregates reactivity test as per IS 2386 (Pt.VII) and / or repeated temperature cycle test to establish the suitability of the aggregates for the concrete work. The test results, with the final recommendations of the laboratory, as to a suitability of the aggregate, for use in the concrete work for various structures and suggested measures, in case of results are not satisfactory, shall be submitted to the Engineer for his review, in a report form.</p> <p>In case in the report, it is established, that the aggregates contain reactive silica, which would react with alkalis of the cement, the contractor shall change the source of supply of the aggregate or use low alkali cement as per recommendation or take measures as recommended in the report as instructed by Engineer.</p> <p>In case aggregates indicate residual expansion, under repeated temperature cycle test (from 10° Celsius to 65° Celsius and for 60 temperature cycles) the material shall not be used for concreting of Lime stone crusher decks, Mills, Fans and other equipment foundations which are likely to be subjected to repeated temperature cycle. The contractor shall use aggregates free from residual expansion under repeated temperatures cycle test.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB SECTION-IV CIVIL WORKS</b>	<b>PAGE 68 OF 71</b>

CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
<p><b>39.06.00</b></p> <p><b>NUTS AND BOLTS</b></p> <p>M.S. Nuts and Bolts shall conform to IS:1363,IS:1364, IS:1367.</p> <p>High tensile fixing with bolts and nuts shall respectively be as per IS:3757 and IS:6623.</p> <p>Washers shall conform to IS:5369, IS:5370, IS:5372, IS:5374, IS:6610, IS:6649, as appropriate.</p> <p><b>40.00.00</b></p> <p><b>CODES AND STANDARDS</b></p> <p>All standards, specifications, acts and code of practice referred to herein shall be the latest editions including all applicable official amendments and revisions. Other Indian, foreign Codes and Standards not listed here but referred to elsewhere within this specification shall also be deemed to be part of this list.</p> <p>In case of conflict between this specification and those (IS standards, codes etc.) referred to herein, the former shall prevail.</p> <p>Some of the relevant Indian standards, Acts and Codes applicable to this section of the specification are listed below</p> <p>IS : 383                      Specification for coarse and fine aggregates from natural sources for Concrete.</p> <p>IS : 432                      Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.</p> <p>IS : 456                      Code of practice for plain and reinforced concrete.</p> <p>IS : 458                      Specification for concrete pipes.</p> <p>IS : 516                      Method of test for strength of concrete.</p> <p>IS : 800                      Code of practice for use of structural steel in general building construction.</p> <p>IS : 814                      Specification for covered electrodes for metal arc welding for weld steel.</p> <p>IS : 816                      Code of practice for use of metal arc welding for general construction.</p> <p>IS : 817                      Code of practice for training and testing of metal arc welders.</p> <p>IS : 875 (Pt. I to V)      Code of practice for design loads other than earthquake) for buildings and structures.</p>			
<p align="center">RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p align="center">PART-B SUB SECTION-IV CIVIL WORKS</p>	<p align="center">PAGE 69 OF 71</p>



CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>IS : 1038 Steel doors, windows and ventilators.</p> <p>IS : 1172 Basic requirements for water supply, drainage and sanitation.</p> <p>IS : 1361 Steel windows for industrial buildings.</p> <p>IS : 1786 Specification for high strength deformed steel bars and wires for concrete reinforcement.</p> <p>IS : 1892 Code of practice for subsurface investigation for foundation.</p> <p>IS : 1893 Criteria for earthquake resistant design of structures.</p> <p>IS : 1904 Code of practice for design and construction of foundations in soils; general requirements.</p> <p>IS : 1905 Code of practice for structural safety of buildings - Masonry walls.</p> <p><b>IS : 1948 Specification for aluminium doors, windows and ventilators.</b></p> <p><b>IS : 2062 Steel for general structural purposes.</b></p> <p>IS : 2131 Method of standard penetration test for soils.</p> <p>IS : 2212 Code of practice for brickwork.</p> <p>IS : 2645 Specification for Integral cement water proofing compounds.</p> <p>IS:2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils - determination for water content etc code of practice for earth work on canals.</p> <p>IS : 2911 Code of practice for design and construction of pile foundations.</p> <p>(Part-1/Sec.1) Driven cast in situ concrete piles.</p> <p>(Part-1/Sec.2) Bored cast-in-situ concrete piles.</p> <p>(Part-IV) Load test on piles.</p> <p>IS : 2974 (Part - I TO V) Code of practice for design and construction of machine foundations.</p> <p>IS : 3370 (Part I to IV) Code of practice for concrete structures for the storage of liquids.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB SECTION-IV CIVIL WORKS</b>	<b>PAGE 70 OF 71</b>



CLAUSE NO.	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>IS : 3658</p> <p>IS : 3664</p> <p>IS : 4326</p> <p>IS : 4990</p> <p>IS : 5624</p> <p>IS : 7215</p> <p>IS : 8112</p> <p>IS : 9103</p> <p>IS : 9595</p> <p>IS : 10262</p> <p>IS : 13311</p> <p><b>IS : 13755</b></p> <p>ASTM 898 -89</p> <p>AS/NZS 2728</p> <p>AS : 1365</p> <p><b>AS : 1397</b></p> <p>AS : 3566</p> <p>IRC : 37</p> <p>-</p> <p>Indian Explosives Act. 1940 as updated.</p> <p><b>For “Foundation System and Geotechnical Data” refer “Project Information section” of Technical specification.</b></p>	<p>Code of practice for liquid penetrant flaw detection.</p> <p>Code of practice for ultra sonic testing by pulse echo method.</p> <p>Code of practice for earthquake resistant design and construction of buildings.</p> <p>Specification for plywood for concrete shuttering work.</p> <p>Specification for foundation bolts.</p> <p>Tolerances for fabrication steel structures.</p> <p>Specification for 43 grade Ordinary Portland Cement.</p> <p>Specification for admixtures for concrete.</p> <p>Code of procedure of manual metal arc welding of mild steel.</p> <p>Recommended guidelines for concrete mix design.</p> <p>Method of non - destructive testing of concrete.</p> <p><b>Dust pressed ceramic tiles with water absorption of 3%, E6% (Group B11a)</b></p> <p>Standard guide for use of high solid content, cold liquid-applied elastomeric water proofing membrane for use with separate wearing course.</p> <p>Pre finished / pre painted sheet metal product for interior / exterior building applications – Performance requirements.</p> <p>Standards for steel manufacturing.</p> <p><b>A steel sheet &amp; strip – hot – dipped-zinc-coated or Aluminium-Zinc coated.</b></p> <p>Self drilling screws for building and construction industry.</p> <p>Guidelines for the design of flexible pavements.</p> <p>Manual on sewerage and sewage treatment (Published by CPH &amp; EEO) As updated.</p>	
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB SECTION-IV CIVIL WORKS</p>	<p>PAGE 71 OF 71</p>



PART – B (DETAILED TECHNICAL SPECIFICATION)  
SUB-SECTION- V-Q (QUALITY ASSURANCE)

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



(MECHANICAL)

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**





## SUB-SECTION-V-QM1


# FLUE GAS DESULPHURISATION SYSTEM


**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**

CLAUSE NO.	 <b>QUALITY ASSURANCE</b>		
<b>FLUE GAS DESULPHURISATION SYSTEM</b>			
<b>1.00.0</b>	<b>FLUE GAS DESULPHURISATION SYSTEM</b>		
<b>1.01.0</b>	<b>Mills:</b>		
1.01.01	Raw material for shaft, coupling, gears and pinions, top and bottom races and other rotating components shall be subjected to UT. MPI/LPI shall be carried out to check surface soundness.		
1.01.02	Wear-resistant parts shall be UT/RT tested to check soundness after suitable heat treatment. Check for chemical composition, hardness and microstructure shall be carried out.		
1.01.03	Butt welds in the tube/separator/body casing of the mill shall be tested by RT and MPI. All other welds in main tube/separator shall be tested by MPI/LPI for acceptance. The tube shall be statically balanced.		
1.01.04	All gearboxes shall be run tested for adequate duration to check rise in oil temperature, noise level and vibration. Check for leak tightness of gear case also shall be performed.		
<b>1.02.0</b>	<b>Feeders:</b>		
1.02.01	Any welds in the casing/pulley fabrication shall be checked with MPI.		
1.02.02	Routine tests shall be done as per relevant Indian Standards or equivalent International Standards.		
1.02.03	All major items like plates for casing, head pulley, tail pulley, pulley shaft and major castings shall be procured with respective material test certificates.		
1.02.04	Calibration check shall be carried out on all feeders.		
<b>1.03.0</b>	<b>Dampers:</b>		
1.03.01	All the dampers shall be subjected to operational test/checks.		
1.03.02	Gas tight Dampers shall be subjected to shop leakage test to demonstrate the guaranteed tightness.		
<b>1.04.0</b>	<b>PIPING, VALVE AND SPECIALITIES:</b>		
1.04.01	All pipes and fittings shall be tested as per applicable code.		
1.04.02	All valves shall be hydraulically/Air tested for body, seat and back-seat (if applicable) as per relevant standard.		
1.04.03	NDT on valves shall be as per relevant standard.		
1.04.04	Valves shall be offered for hydro test in unpainted conditions.		
1.04.05	Functional checks of the valves for smooth opening and closing shall also be done.		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-V-QM1 FGD SYSTEM</b>	<b>Page 1 of 4</b>

CLAUSE NO.	 <b>QUALITY ASSURANCE</b>		
<p><b>1.05.00</b></p> <p><b>1.05.01</b></p> <p><b>1.05.02</b></p> <p><b>1.06.00</b></p> <p>1.06.01</p> <p>1.06.02</p> <p>1.06.03</p> <p>1.06.04</p> <p><b>1.07.00</b></p> <p>1.07.01</p> <p>1.07.02</p> <p>1.07.03</p> <p>1.07.04</p> <p>1.07.05</p>	<p><b>TANKS / VESSELS:</b></p> <p><b>Atmospheric tanks:</b></p> <p>i) All welds joints shall be DP tested and complete tanks shall be water fill tested.</p> <p>ii) All atmospheric storage tanks fabricated and erected at site shall be subjected to tests (Hydro, NDT and Vacuum) according to design code as applicable.</p> <p>iii) Rubber lining shall be tested for hardness and spark test, as applicable.</p> <p><b>Pressure vessels:</b></p> <p>1) NDT on weld joint shall be as per respective code requirements or the minimum as specified as below:</p> <p>i) 100% DPT on root run of butt weld, nozzle welds and finished fillet welds.</p> <p>ii) 10% DPT on all finished butt welds.</p> <p>iii) 10% RT (covering all 'T'/cross joints) of butt welds.</p> <p>2) Butt welds of dished ends shall be stress relieved and subjected to 100% RT.</p> <p>3) Each finished vessels shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes.</p> <p><b>HEAT EXCHANGER/HEATER:</b></p> <p>All material shall be tested for chemical and mechanical properties and NDT as per relevant standard.</p> <p>NDT on welds and other checks shall be as per relevant code.</p> <p>Air heaters shall be subjected to dimensional and clearance checks as per standard practice</p> <p>Lub. oil system, drive system, soot blowing system etc. of Air heaters shall be checked suitably as per standard practice</p> <p><b>PUMPS:</b></p> <p>UT on shaft forgings (greater or equal to 40mm) and MPI/DPT shall be done on shafts and impeller to ensure freedom from defects.</p> <p>The pump casing shall be hydraulically tested at 200% of pump rated head or at 150% of shut off head, whichever is higher. The test pressure shall be maintained for at least half an hour.</p> <p>The pump rotating parts shall be subjected to static and dynamic balancing.</p> <p>All pumps shall be tested at shop for capacity, head efficiency and brake horse power at rated speed as per relevant/applicable standard.</p> <p>Noise and vibration shall be measured during the performance testing at shop.</p>		
<p><b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b></p>	<p><b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b></p>	<p><b>PART-B SUB-SECTION-V-QM1 FGD SYSTEM</b></p>	<p><b>Page 2 of 4</b></p>


CLAUSE NO.	 <b>QUALITY ASSURANCE</b>		
<p><b>1.08.00</b></p> <p>1.08.01</p> <p>1.08.02</p> <p>1.08.03</p> <p>1.08.04</p> <p><b>1.09.00</b></p> <p>1.09.01</p> <p>1.09.02</p> <p>1.09.03</p> <p>1.09.04</p> <p>1.09.05</p> <p><b>1.10.00</b></p> <p>1.10.01</p> <p>1.10.02</p> <p><b>1.11.00</b></p> <p>1.11.01</p> <p>1.11.02</p> <p>1.11.03</p> <p><b>1.12.00</b></p> <p>1.12.01</p>	<p><b>STRUCTURES , DUCTS, HOPPERS:</b></p> <p>All materials shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested.</p> <p>Visual inspection of all welds shall be performed in accordance with AWS D1.1.</p> <p>NDT requirements of structural steel welds shall be as under:</p> <ul style="list-style-type: none"> <li>i) 100% RT/UT on butt-welds of plate thickness <math>\geq 32</math>mm.</li> <li>ii) For plates of <math>25\text{mm} \leq \text{thickness} &lt; 32\text{mm}</math> - 10% RT and 100% MPI.</li> <li>iii) For plates of thickness <math>&lt; 25\text{mm}</math> - 10% MPI/LPI.</li> </ul> <p>Edge for shop and field weld shall be examined by MPI for plate thickness <math>\geq 32</math>mm.</p> <p><b>VACUUM BELT FILTER SYSTEM:</b></p> <p>Impeller, casing and shaft of vacuum pumps shall be tested for chemical and mechanical properties as per relevant standard. All plates above 40mm shall be 100% Ultrasonically tested.</p> <p>UT on shaft (if greater or equal to 40mm) and impeller shall be carried out.</p> <p>All vacuum pumps shall be tested at shop for capacity, power, pressure, efficiency, noise and vibration etc.</p> <p>Filter cloths and belts shall be tested for physical properties as per relevant standard</p> <p>Hydro cyclones shall be checked by visual, dimensional etc.</p> <p><b>SPRAY NOZZLES:</b></p> <p>Spray nozzles shall be tested for physical properties</p> <p>Spray nozzles also shall be subjected to performance test.</p> <p><b>AGITATORS:</b></p> <p>Rubber lining shall be tested for hardness and spark test</p> <p>Impellers shall be tested for dimensional and balancing check</p> <p>Gear Boxes shall be tested for run test as per standard practice</p> <p><b>FANS:</b></p> <p>Rotor components shall be subjected to ultrasonic test at mill and magnetic particle inspection / liquid penetrant examination after rough machining.</p>		
<p><b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b></p>	<p><b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b></p>	<p><b>PART-B SUB-SECTION-V-QM1 FGD SYSTEM</b></p>	<p><b>Page 3 of 4</b></p>


CLAUSE NO.	 <b>QUALITY ASSURANCE</b>		
1.12.02	Butt welds in rotor components shall be subjected to 100% RT and all welds shall be magnetic particle/dye penetrant tested after stress relieving.		
1.12.03	All rotating components and assemblies of fan shall be balanced dynamically		
1.12.04	Performance test shall be carried out on fans as per Technical specification/ Relevant standard		
1.12.05	Test for Natural Frequency and hardness of Fans blades shall be carried out as per Technical specification/ Relevant standard		
1.13.00	<p><b>Thermal Insulation, Lagging &amp; Cladding:</b></p> <p>(a) <b>Lightly resin bonded mineral wool:</b></p> <p>LRB mattresses/sections of Rockwool/ Glasswool shall conform to &amp; tested as per relevant clauses of Indian Standards and shall meet the requirements of bidding documents. Type tests except Thermal Conductivity shall be regularly carried out once in three months, Thermal Conductivity Type Test shall be carried out minimum once in twelve months by the manufacturer. Requirements of various components like Binding wires, Lacing wires, Wire mesh, etc. shall be as given in respective Sub-Section of Technical Requirements of Steam Generator &amp; Auxiliaries.</p> <p>(b) <b>Lagging &amp; Cladding:</b></p> <p>All insulation shall be protected by means of an outer covering of Aluminium sheeting conforming to ASTM B-209-1060 temper H14 from reputed manufacturer meeting the requirements of bidding documents.</p>		
1.14.00	<b>OTHER CRITICAL EQUIPMENTS:</b>		
1.14.01	Checks/ NDTs shall be done as per relevant Indian Standards or equivalent International Standards.		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-V-QM1 FGD SYSTEM</b>	<b>Page 4 of 4</b>





Project : RGTTP Hisar (2X600 MW)				<b>MECHANICAL ITEMS- INDICATIVE SUB-VENDOR LIST</b>				Doc No	:	
Package : FGD Package				<b>LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL</b>				Rev No	:	
Supplier :								Date	:	
Contract No.:								Page	:	
SI No	ITEM	QP / Insp. Cat.	QP No:	QP Sub. Sch.	QP approval Sch.	Proposed sub-supplier	Place	Sub-Supplier approval status / category	Sub-supplier Details submission sch	Remark
1	Slurry re-circulation Pumps									Refer Sub.QR List
2	Oxidation Blowers									Refer Sub.QR List
3	Wet Limestone Grinding Mill									Refer Sub.QR List
4	Slurry Pumps									Refer Sub.QR List
5	Agitators									Refer Sub.QR List
6	Vacuum Belt Filters									Refer Sub.QR List
7	Bucket Elevator					Indiana Conveyors Pvt.Ltd.	Jejori, Pune	A		
8	Absorber tank					Quality Engineering Works	Kokatta	A		
9	Atmospheric Tanks / Air Receiver Tanks					Main Contractor Approved Sub.vendors				
10	MS Pipes (ERW)					Jindal	Ghaziabad	A		
						TATA STEEL	Jamshedpur	A		
						SAIL	Rourkela	A		
						Surya Roshni	Bahadurgarh	A		
						Welspan	Anjar	A		
						MSL	Raigad	A		
						Gujarat Infra	Vadodara	A		
						Indus Tube	G. B. Nagar	A		
						Jindal Industries	Hissar	A		
						APL Apollo	Sikandrabad	A		
Dadu Pipes	Sikandrabad	A								
ISMT	Ahmedabad	A								
11	Spiral welded upto 1600 mm.					Ratnamani	Anjar / Chatrral	A		
						JCO Gas Pipes	Chindwara	A		
						SAIL	Rourkela	A		
						Surya Global	Kutch	A		

	Project : RGTPP Hisar (2X600 MW)			<b>MECHANICAL ITEMS- INDICATIVE SUB-VENDOR LIST</b>				Doc No	:							
	Package : FGD Package			<b>LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL</b>				Rev No	:							
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SI No	ITEM	QP / Insp. Cat.	QP No:	QP Sub. Sch.	QP approval Sch.	Proposed sub-supplier	Place	Sub-Supplier approval status / category	Sub-supplier Details submission sch	Remark						
12	LRB Insulation					Lloyd Insulation	Chennai	A								
						Rockwool Industries	Bhilai / Medak	A								
						Minwool Rock Fibres Ltd.	Rajnandgaon	A								
						Lapinus Rockwool Ltd.	Gwalior	A								
						Punjstar(PIFCO)	Bhilai	A								
						Goenka Rockwool	Raipur	A								
						Rockwool India Ltd.	Medak-AP	A								
						Thermocare Rockwool Pvt.Ltd.	Rajnandgaon	A								
						Minsulate Mfg.Co	Jamshedpur	A								
						Dhanbad Rockwool	Dhanbad	A								
13	Gates and Dampers					Hitech RockwoolFibre	Rajnandgaon	A								
						Roxul Rockwool Insulation	Dahej(Bharuch)	A								
						Indra Damper	Ranipet	A								
						Bachmann	Faridabad	A								
						Kamal Engineering	Yamunanagar	A								
						Fouress	Bengaluru	A								
						BHEL	Ranipet	A								
						14	Valves for FGD application					BHEL	Trichy	A		As per approval (Type/Class/Rating & Material
												Bankim Valves	Howrah	A		CI Gate/Check/Globe upto600NB,PN16.
												H.Sarkar & Co	Howrah	A		CI Gate/Check/Globe upto 700NB,PN16
Leader	Jalandhar	A		CI Gate/Check/Globe upto 300NB,PN10.SS upto 300NB & CS upto 300NB,Class 150, GM Valve upto 150NB												
Weir BDK	Hubli	A		Gate/Globe/Check Valves upto300NB,Class300 for SS,CI&CS												
KBL	Kondapuri	A		CI, Gate/Globe/Check Valve upto 300NB,Class300												
A.V Valves	Agra	A		CI Gate/Globe/Check Valves upto 300NB,PN10												
Tyco Valves / Pentair Valves	Halol(Gujarat)	A		For CS,CI&SS Butterfly Valve												
L&T	Coimbatore	A		CS&AS-Low Pr. Valves-Gate/Globe/Check Valves upto 26",class600, High Pr. Upto20",2500class Forged Steel upto 1" 4500 class.												
Weir BDK	Hubli	A		CS Ball Valves(upto 350NB-class150)												

	Project : RGTPP Hisar (2X600 MW)			<b>MECHANICAL ITEMS- INDICATIVE SUB-VENDOR LIST</b>				Doc No	:	
	Package : FGD Package			<b>LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL</b>				Rev No	:	
	Supplier :							Date	:	
	Contract No.:							Page	:	
SI No	ITEM	QP / Insp. Cat.	QP No:	QP Sub. Sch.	QP approval Sch.	Proposed sub-supplier	Place	Sub-Supplier approval status / category	Sub-supplier Details submission sch	Remark
14	Valves for FGD application					Leader	Jalandhar	A		CS Ball Valve(upto350NB,class150)
						Leader	Jalandhar	A		Forged Steel(CS) upto300NB,class150.
						Fouress Engineering	Thane,Aurangabad	A		Forged Steel(CS)upto 300NB,Class150)
						Weir BDK	Hubli	A		Diaphragm Valves
						Advance Valve	Noida	A		CI Butterfly valves 1400 NB, PN 10; 300 NB PN16
						Fouress Engineering	Bangalore	A		Knife Gate valves
						Micro Finish	Hubli	A		Ball Valve 350 NB Class 150. upto 50 NB Class 800
						Inter Valves	Pune	A		CI Butterfly valves 1400 NB, PN 10; 300 NB PN16
						Xomos Sanmar	Pune / Chennai	A		Forged Steel Gate globe check valve upto 50 NB Class 800
						Dembla	Pune	A		CI Butterfly valves 1400 NB, PN 10; 300 NB PN16
					Hawa Engineers	Ahmedabad	A		Forged Steel Gate globe check valve upto 50 NB Class 800	
15	Flap Gate, R&P Gate,					TKII	Pune	A		
						Mining&Material Handling	Kolkata	A		
						United Technomac	Pune	A		
						MBE	Kumardhubi	A		
						Prepec	Howrah	A		
						HMTTC	Kolkata	A		
						Elecon	VV Nagar	A		
					Indiana Conveyor	Jejori, Pune	A			

SI No	ITEM	QP / Insp. Cat.	QP No:	QP Sub. Sch.	QP approval Sch.	Proposed sub-supplier	Place	Sub-Supplier approval status / category	Sub-supplier Details submission sch	Remark
Project : RGTPP Hisar (2X600 MW)		<b>MECHANICAL ITEMS- INDICATIVE SUB-VENDOR LIST</b>								
Package : FGD Package		<b>LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL</b>								
Supplier :										
Contract No.:										
16	Water Pumps(process water)					Kirloskar Brothers	Pune	A		
						Sam Turbo	Coimbatore	A		
						Mather & Platt	Pune	A		
						KSB	Pune	A		
						Wire Minerals	Bangalore	A		
						WPIL	Kolkata/Gaziabad	A		
						Kishore	Pune	A		
						Flow More	Gaziabad	A		
17	Metallic Expansion Joints					Lonestar Industries	Chennai	A		
						Mechwell	Nasik	A		
18	Non Mettalic Expansion joint for duct					Keld Ellentoff	Chennai	A		
						Eagle Burgmann	Chennai / Denmark	A		
						HKR	Korea	A		
						Safetech	Spain	A		
19	Electrical Hoist					Hercules Hoist Ltd.	Mumbai	A		Electric Hoist upto 15MT
						Reva Industries	Faridabad	A		Upto 40MT
						Consolidated Hoist	Satara / Pune	A		EOT Cranes upto 40MT and Hoists above 15MT
						Lifting Equipment and Accessories	New Delhi	A		Hoists upto 5MT
						Grip Engineering Pvt.Ltd	Faridabad	A		EOT upto 5MT & Hoist upto 20MT
						Brady & Moriis	Ahmedabad	A		Upto 10 Tons
						Consolidated Hoist	Pune	A		Upto 35 Tons at Satara & Upto 15 Tons at Pune works
						Tuobro Furguson India Pvt.	Kolkata	A		Upto 5 Tons
						Grip Engineers	Faridabad	A		Upto 20 Tons
						Tractel Tirfor India Pvt. Ltd	Palwal	A		Upto 15 Tons
						Universal Hoisto Fabrik	Thane	A		Upto 20 Tons
						Mangla Hoist	Greater Noida	A		Upto 10 Tons
						Reva Industries	Faridabad	A		Upto 25 Tons
						Eddy Cranes	Pune	A		Upto 14 Tons
						Alpha Services	Bhiwadi	A		Upto 15 Tons
						Century Crane Engineers	Ballabgarh	A		Upto 15 Tons
						Grip Engineers	Hyderabad	A		Upto 40 Tons
						Armsel MHE Pvt.Ltd.	Bangalore	A		Hoist upto 15MT,EOT upto 10MT



Project : RGTPP Hisar (2X600 MW)  
 Package : FGD Package  
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**MECHANICAL ITEMS- INDICATIVE SUB-VENDOR LIST**

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**LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL**

SI No	ITEM	QP / Insp. Cat.	QP No:	QP Sub. Sch.	QP approval Sch.	Proposed sub-supplier	Place	Sub-Supplier approval status / category	Sub-supplier Details submission sch	Remark
20	Rubber Lining of Pipes					Jasmino Polymertech	Taloja	A		
						CORI Engineers	Chennai	A		
						Western Rubber	Mumbai	A		
						Elastomer Lining	Ambernath	A		
						Emkay Rubber	Mumbai	A		
						Rishi	Bahalgarh	A		
						Poly Rubber	Mumbai	A		
						Temsec Rubber	Kolkata	A		
						Presidency Rubber	Howrah	A		
						Arul Rubber Pvt.Ltd	Hosur	A		
					Industrial Moulders	Vadodara	A			
21	FRP PIPE with fittings					Main Contractor Approved Source				
22	Rubber Lining for Tank and Absorber					MIL Industries	Chennai	A		
						TIP TOP	USA / India	A		
						Stealuer	Germany/ India	A		
						Arul Rubber	Hossur	A		
						Temsec Rubber	Kolkata	A		
23	Ventillation Fans					Patel Air	Ahmedabad	A		
						Marathan Electric	Kolkata	A		
						Howden	Kolkata / Chennai	A		
						SK System	Sonepat	A		
						Andrew Yule	Kalyani	A		
24	Structual Steel Rolled /Plate Sections(CS)					SAIL	INDIA	A		
						TATA STEEL	INDIA	A		
						JSPL	INDIA	A		
						ESSAR	INDIA	A		
						Ispat Industries	INDIA	A		
						Lloyeds Steel	INDIA	A		
					JSW	INDIA	A			
25	Structural Steel - Pipes IS 1161					Main Contractor Approved Source				
26	S S Plate					SAIL	India	A		
27	Insulation Cladding					Main Contractor Approved Sources				




## SUB-SECTION-V-QM2

### LIME & GYPSUM HANDLING

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**

CLAUSE NO.	 <b>QUALITY ASSURANCE &amp; INSPECTION</b>		
<h2 style="margin: 0;">Lime &amp; Gypsum Handling</h2>			
<b>1.01.00</b>	<b>Brakes and Clamps:</b>		
1.01.01	Final testing of brakes shall include load, HV/IR & heat run tests.		
<b>1.02.00</b>	<b>Monorails and Hoists</b>		
1.02.01	All electric hoist shall be tested as per IS 3938 and chain pulley block shall be tested as per IS 3832.		
<b>1.03.00</b>	<b>Hoppers &amp; Liners</b>		
1.03.01	<b>Rack &amp; Pinion Gates/Flap Gates/Rod Gates</b>		
	a)	MPI/DP test shall be conducted on rack and pinion/rod/weld joint.	
	b)	Functional checks on the gates shall be carried out along with respective actuator, if applicable.	
<b>1.04.00</b>	<b>Storage Silo</b>		
1.04.01	All material shall be tested for Chemical & Mechanical properties as per relevant standard. 10% RT and 100% DP test on butt welding shall be carried out. Fit up assembly checks shall be carried out at shop for all despatchable segments		
1.04.02	Bag Filters: Leakage test shall be carried out for pressure parts. Pulsing and sequential test on bag filter shall be done.		
<b>1.05.00</b>	<b>Belt Conveyor System</b>		
	The details of the checks to be carried out in the various equipments are to be submitted by the Contractor for Owner's approval. However, some indicative checks on different items are given below which should necessarily form a part of the Quality Assurance Plan to be agreed with the Owner.		
<b>1.05.01</b>	<b>Idlers</b>		
	a)	Check for run out and free movement shall be carried out on idlers. Run out shall be restricted as per IS:8598	
	b)	Test for dust proofness, water proofness and dynamic friction factor of the Idlers shall be conducted at shop. The detailed procedures for the same shall be submitted for review and approval.	
<b>1.05.02</b>	<b>Belting</b>		
	(a)	Rubber cover of finished belt shall be checked for tensile strength and elongation at break before and after ageing. Rubber cover shall also be checked for abrasion, tear strength and hardness.	
	(b)	For finished belts, checks for elongation at 10% nominal tensile strength, tensile and elongation at break in longitudinal (warp) direction and tensile in transverse (weft) direction shall be carried out.	
	(c)	Adhesion test between ply to ply and cover to ply shall be carried out.	
	(d)	Troughability test and Test for fire resistance shall be carried out.	
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-V-QM1 LIME &amp; GYPSUM HANDLING</b>	<b>PAGE 1 OF 8</b>



- (e) Test for procedure qualification for belt vulcanizing joint (at site) shall be done. Procedure for belt vulcanizing joint shall be discussed and finalized during FQP finalization.
- (f) There will be a limitation on the no. of repairs allowed on the belts. Following will be the acceptance norm for the cover repairs.
  - i) The maximum size of a repair shall be limited to a size equivalent to one fifth the belt width. No single dimension shall exceed one fifth (1/5) of belt width.
  - ii) Small local repair by dough filling of size 25mm x 25mm to a limited extent shall not be counted of repairs. However, in case of cluster of repairs, same shall be counted as a patch repair.
  - iii) The maximum number of patch repair shall not exceed 5 per 100 mts. However, the total number of patch and dough filling repairs shall not exceed 10 per 100 meters.
- (g) In addition to above, Steel Cord belt shall also be tested for following.
  - i. Cord dia and breaking strength
  - ii. Finished belt shall be tested for cord pull-out strength before and after aeging, peeling resistance.
  - iii. Dynamic cord pull out test
  - iv. Cord dia, pitch and number of cords
- (h) In no case shall the cover thickness or the width of belt be less than that given in specification.
- (i) For testing purpose, belt sample shall be taken from anywhere of the belt roll length offered

**1.05.03 Belt Vulcanizing Machine**

- a) Check for tensile strength shall be carried out on a sample vulcanized belt joint for each type of belt in shop. However if such test has been done earlier, the report for same shall be submitted for verification.
- b) Complete assembly shall be tested at shop for temp. and pressure developed

**1.05.04 Pulleys**

- a) In addition to chemical, mechanical, hardness, microstructure as per applicable material specification, pulleys shaft forgings shall be subjected to ultrasonic testing.
- b) 100% MPI/DPT on all welds shall be conducted and 10% RT/UT on butt welds shall be conducted.
- c) Static balancing of pulleys shall be carried out after rubber lagging.
- d) Checks on rubber lagging to include abrasion loss, shore hardness test, peel-off strength test and physical properties. Peel-off strength shall be 10 Kg/Cm, Abrasion loss shall be less than 250 cubic mm when tested as per DIN 53516.


**1.05.05 Pull Chord & Belt Sway Switches**


Acceptance tests


- i) Over all dimension and functional test.
- ii) HV & IR test





SI No.	Item	QP/ Insp. Cat.	INDICATIVE SUB VENDOR LIST			APPROVAL STATUS	REMARKS
			ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING			
1	APRON FEEDER WITH DRIBBLE CONVEYOR		TKII	HYDERABAD	A	UPTO 2400 TPH	
			L&T	KANSBAHL	A	UPTO 2200 TPH	
			ELECON	VV NAGAR	A	UPTO 2200 TPH	
			TENOVA INDIA	CHENNAI	A	UPTO 2200 TPH	
			TRF	JAMSHEDPUR	A	UPTO 2400 TPH	
			MCNALLY SAYAJI	KUMARDHUBI	A	UPTO 2200 TPH	
2	PADDLE FEEDER		L & T	KANCHEEPURAM	A	UPTO 2250 TPH	
			ELECON	V V NAGAR	A	UP TO 1750 TPH	
			FAMAK FAMUR S.A.	POLAND	A	UP TO 1750 TPH	
			TKII	PUNE	A	UPTO 1950 TPH	
			TRF	JAMSHEDPUR	A	UP TO 2475 TPH	
3	RING GRANULATOR		PENNSYLVANIA CRUSHER CORPORATION	USA	A	UP TO 1760 TPH	
			AMERICAN PULVERISER	USA	A	UPTO 1875 TPH	


 <b>PACKAGE: FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		INDICATIVE SUB VENDOR LIST				
SI No.	Item	QP/ Insp. Cat.	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS
			TKII	PUNE	A	UP TO 2035 TPH 1. Vetting of GA drawing and QAP shall be done by TKIS -Germany. Inspection and trial run for first Ring Granulator & Vibrating Screen Feeder at TKII work's and installation and trial run at Kudgi site for first Ring Granulator & Vibrating Screen Feeder shall be done in presence of TKIS - Germany. 2. TKIS-Germany shall submit performance back up guarantee on their letter head duly signed by authorized signatory for Ring granulator and vibrating screen feeder, in addition to performance guarantee by TKII. 3. Spherical roller bearings and raw materials for screen plate for Ring granulator and double balance exciter units, cardon shaft, coupling between exciters and support springs for Vibrating screen feeder shall be imported from TKIS - Germany/ sources approved from TKIS – Germany.
			TRF	JAMSHEDPUR	A	UP TO 1800 TPH. TRF SHALL GIVE EXTENDED WARRANTY OF 5 YEARS OVER & ABOVE CONTRACTUAL WARRANTY
			L&T	KANSBAHAL	A	UP TO 1600 TPH
			ELECON	V V NAGAR	A	UP TO 1320 TPH
			MCNALLY SAYAJI	KUMARDHUBI	A	UPTO 1000 TPH
4	VIBRATING SCREEN/FEEDER		TECHNO VIBRAZIONI	ITALY	A	UPTO 1875 TPH
			ELECON	V V NAGAR	A	UP TO 1320 TPH


 <b>PACKAGE: FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		INDICATIVE SUB VENDOR LIST					
SI No.	Item	QP/ Insp. Cat.	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS	
			GENERAL KINEMATICS	USA	A	UP TO 2000TPH	
			TKII	PUNE	A	UP TO 2035 TPH 1. Vetting of GA drawing and QAP shall be done by TKIS -Germany. Inspection and trial run for first Ring Granulator & Vibrating Screen Feeder at TKII work's and installation and trial run at Kudgi site for first Ring Granulator & Vibrating Screen Feeder shall be done in presence of TKIS - Germany. 2. TKIS-Germany shall submit performance back up guarantee on their letter head duly signed by authorized signatory for Ring granulator and vibrating screen feeder, in addition to performance guarantee by TKII. 3. Spherical roller bearings and raw materials for screen plate for Ring granulator and double balance exciter units, cardon shaft, coupling between exciters and support springs for Vibrating screen feeder shall be imported from TKIS - Germany/ sources approved from TKIS – Germany.	
			TRF	JAMSHEDPUR	A	UP TO 1800 TPH. TRF SHALL GIVE EXTENDED WARRANTY OF 5 YEARS OVER & ABOVE CONTRACTUAL WARRANTY	
			MCNALLY SAYAJI	KUMARDHUBI	A	UPTO 1210 TPH	
5	TRAVELLING TRIPPER		BENGAL TOOLS	KOLKATA	A		
			TKII	PUNE	A		
			ELECON	V V NAGAR	A		

 <b>PACKAGE: FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		INDICATIVE SUB VENDOR LIST				
SI No.	Item	QP/ Insp. Cat.	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS
			MBE	KUMARDHUBI	A	
			TRF	JAMSHEDPUR	A	
			INDIANA CONVEYOR	PUNE	A	FOR UP TO 50 TPH RATING LIME HANDLING / GYPSUM HANDLING PLANT.
			HMTC	KOLKATA	A	
			L & T - MACNIL	CHENNAI	A	
			L & T	KANSBAHAL	A	
			L & T - EWL	KANCHEEPURAM	A	
6	FABRIC BELTING(FR GRADE)		PHOENIX CONVEYOR BELT	KOLKATA	A	UPTO 2200 MM WIDTH
			IMASS S.A	GREECE	A	UPTO 2400 MM WIDTH
			MRF	CHENNAI	A	UPTO 1600 MM WIDTH
			SEMPELTRAN NIRLON	MUMBAI	A	UPTO 1600 MM WIDTH
			HINDUSTAN RUBBER	SILVASA	A	UPTO 1600 MM WIDTH
			NORTHLAND RUBBER	SONEPAT	A	UPTO 2200 MM WIDTH.
			SOMI CONVEYOR	JODHPUR	A	UPTO 2000 MM WIDTH
			RAVASCO TRANSMISSION LTD.	VAPI	A	UPTO 2200 MM WIDTH
			ORIENTAL RUBBER	PUNE	A	UPTO 2200 MM WIDTH
			FORECH	CHENNAI	A	UPTO 2000 MM WIDTH
7	STEEL CORD BELT (FR GRADE)		PHOENIX CONVEYOR BELT	KOLKATA	A	UPTO 2400 MM WIDTH
			YOKOHAMA	JAPAN	A	UPTO 2400 MM WIDTH
			IMASS S.A	GREECE	A	UPTO 2400 MM WIDTH
			FORECH	CHENNAI	A	UPTO 2000 MM WIDTH
			CAMOPLAST	KOREA	A	UPTO 2400 MM WIDTH
8	IDLERS		ELECON	V V NAGAR	A	


 <b>PACKAGE: FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		INDICATIVE SUB VENDOR LIST				
SI No.	Item	QP/ Insp. Cat.	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS
			MBE	KUMARDHUBI	A	
			KALI	KUMBAKONAM	A	
			AMPS	JAMSHEDPUR	A	
			A.ADAK	HOWRAH	A	
			BENGAL TOOLS	KOLKATA	A	
			V V N MFG	V V NAGAR	A	Upto 150 NB Dia
			TKII	HYDERABAD / PUNE	A	
			PROMAC	BANGALORE	A	
			L & T - EWL	KANCHEEPURAM	A	
			ROLLWELL	HINDUPUR	A	
			INDIANA CONVEYORS	PUNE	A	
9	PIPES FOR IDLERS IS 9295		MAIN CONT. APPRD SOURCES			SUBJECT TO VALID BIS LICENCE
10	BEARINGS FOR IDLERS		MAIN CONT. APPRD SOURCES	HOSUR	N	
11	PULLEYS		ELECON	V V NAGAR	A	
			PROMAC	BANGALORE	A	
			MBE	KUMARDHUBI	A	
			BENGAL TOOLS	KOLKATA	A	
			TNS HEAVY	CHENNAI	A	
			KALI	THIRUBUVANAM	A	
			TKII	HYDERABAD / PUNE	A	
			L & T - EWL	KANCHEEPURAM	A	
			V V N MFG	V V NAGAR	A	Upto 800 NB Dia
			R K INDUSTRIES	NEW DELHI	A	UP TO 800 MM DIA
			ROLLWELL	HINDUPUR	A	
			INDIANA CONVEYORS	PUNE	A	
12	RUBBER LAGGING FOR PULLEYS		RISHI INDUSTRIES	SONEPAT	A	
			WAHEGURU	KOLKATA	A	
			SUDEEP RUBBER	V V NAGAR	A	
			DEBDIP RUBBER	KOLKATA	A	
			CORI RUBBER	CHENNAI	A	
			PRADEEP RUBBER	CHAKULA	A	
			PRESIDENCY RUBBER	KOLKATA	A	
			THEJO ENGG	CHENNAI	A	
			CENTURY RUBBER	KOLKATA	A	
13	BEARING FOR PULLEYS		MAIN CONT. APPRD SOURCES			
14	HELICAL GEARBOX		SHANTI GEARS	COIMBATORE	A	Upto size 560
			ELECON	V V NAGAR	A	
			SIEMENS (FLENDER)	KHARAGPUR	A	
			PREMIUM TRANMISSION LTD	PUNE/FALTA	A	Up to size 710 / 450


 <b>PACKAGE: FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		INDICATIVE SUB VENDOR LIST					
SI No.	Item	QP/ Insp. Cat.	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS	
			SIEMENS (FLENDER)	GERMANY	A		
			NEW ALLENBURY WORKS	KOLKATA	A		
15	PLANETARY GEARBOX		ELECON	V V NAGAR	A		
			SIEMENS (FLENDER)	GERMANY	A		
			MOVENTAS	GERMANY	A		
			BREVINI	ITALY	A		
			SEW EURODRIVE GMBH & CO.	GERMANY	A		
			FLUIDOMAT	DEWAS	A	Scoop type upto SC-1330	
16	FLUID COUPLING (SCOOP AND TRACTION TYPE)		PTL	AURANGABAD	A	SCOOP TYPE UPTO PST 1150	
			ELECON	V V NAGAR	A	Scoop type upto model ESC 760.	
			VOITH	HYDERABAD	A	SCOOP TYPE UPTO SVNL 1330	
			MAIN CONTRACTOR APPROVED SOURCES				
17	GEARED COUPLING		MAIN CONTRACTOR APPROVED SOURCES				
18	FLEXIBLE COUPLINGS		MAIN CONTRACTOR APPROVED SOURCES				
19	FLAP GATE, R&P GATE AND ROD GATE*		TKII	PUNE	A		
			MINING & MATERIAL HANDLING	KOLKATA	A		
			UNITED TECHNOMAC	PUNE	A		
			MBE	KUMARDHUBI	A		
			PREPEC	HOWRAH	A		
			HMTC	KOLKATA	A		
	ELECON	V V NAGAR	A				
20	VENTILATION SYSTEM		MAIN CONTRACTOR APPROVED SOURCES			FAN FROM NTPC APPROVED SOURCES	
21	VENTILATION FANS		MARATHON ELECTRIC MOTOR(I) LTD	KOLKATA	A		
			DUVENT	BANGALORE	A		
			S K SYSTEM	SONIPAT	A		
			ALMONARD	CHENNAI	A		
			TCF NADI	CHENNAI	A		
			HOWDEN SOLYVENT	CHENNAI	A		


 <b>PACKAGE: FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		INDICATIVE SUB VENDOR LIST				
SI No.	Item	QP/ Insp. Cat.	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS
			KHAITAN	KOLKATA	A	
			C B DOCTOR	AHMEDABAD	A	
22	DUST EXTRACTION SYSTEM		MAIN CONTRACTOR APPROVED SOURCES			BOIs(Fan, Pump, Strainer, Gate valve, NRV, Butterfly valve, Control panel, Actuator, Pressure Gauge and Temperature Gauge) from NTPC approved source
23	HORIZONTAL CENTRIFUGAL PUMP		KIRLOSKAR BROS LTD.	KIRLOSKARWADI	A	
			WILO MATHER & PLATT	PUNE / KOLHAPUR	A	
			SAM TURBO	COIMBATORE	A	UP TO 1500 CUM/HR
			FLOWMORE	GHAZIABAD	A	
			BEST AND CROMPTON	CHENNAI	A	
			JYOTI	VADODARA	A	
			WPIL	GHAZIABAD	A	
			KISHORE PUMPS	PUNE	A	UP TO 500 CUM/HR
			GRUNDFOS PUMPS INDIA PVT LTD	CHENNAI	A	HORIZONTAL UP TO 30 KW (FOR APPLICATIONS WHERE NPSH IS NOT REQUIRED)
			SINTECH PRECISION	GHAZIABAD	A	UP TO 315 KW
			KSB	PUNE / NASHIK	A	
24	SUMP PUMP		FLOWSERVE INDIA CONTROLS PVT LTD	COIMBATORE	A	HOIZONTAL CENTRIFUGAL PUMP UP TO 75 KW
			SAM TURBO	COIMBATORE	A	
			KISHORE PUMPS	PUNE	A	
			MCNALLY SAYAJI	BANGALORE	A	up to 80 M3/hr capacity and head up to 25 MWC
			SU MOTORS	MUMBAI	A	
			AQUA MACHINERY	AHMEDABAD	A	
			FLOWMORE PUMP	GHAZIABAD	A	
25	CI GATE/GLOBE/CHECK VALVES (MAIN CONTRACTOR APPROVED SOURCE UP TO CLASS 300 & SIZE 600 NB)		DARLING PUMP	INDORE	A	
			LEADER	JALANDHAR	A	GATE 300NB AND PN16,GLOBE 150 NB AND PN16 & 450NB PN10,CHECK 600NB CLASS #150
			A V VALVES	AGRA	A	UPTO 500 NB PN16
			H SARKER	HOWRAH	A	
			BANKIM	HOWRAH	A	
			KBL	KONDHAPURI	A	SWING CHECK UP TO 600 MM
	HAWA ENGINEERS	AHMEDABAD	A			


 <b>PACKAGE: FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		INDICATIVE SUB VENDOR LIST				
SI No.	Item	QP/ Insp. Cat.	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS
			WEIR BDK	HUBLI	A	Conventional CCS Gate / Globe / Check Valves up to 600MM and Class # 1500, CSS Gate/ Globe/ Check Valves up to 200MM and Class # 600, up to 500MM and class #300 , FCS Gate / Globe / Check Valves up to 50MM and Class # 2500.
26	CS/ FS GATE/GLOBE/CHECK VALVES(MAIN CONTRACTOR APPROVED SOURCE UP TO CLASS 300 & SIZE 600 NB)		LEADER	JALANDHAR	A	CS GATE 600MM CLASS#600, SS GLOBE
			OSWAL INDUSTRIES	AHMEDABAD	A	ONLY FOR CCS VALVES UPTO 300 NB
			FOURESS	AURANGABAD	A	
			FOURESS	THANE	A	CS 600 NB CL 150, 500 NB CLASS 300, 400NB CLASS 600 AND 50NB CLASS 800
			BHEL IVP	GOINDWAL	A	GATE UP TO 600NB CLASS 150, 500 NB CLASS 300, 300 NB CLASS 600. GLOBE 250 NB CLASS 400, CHECK 500 NB CLASS 150, 300 CLASS 300,150NB CLASS 600.
			HITECH ENGG PVT LTD	AHEMDABAD	A	250 NB CLASS 150, 50 NB CLASS 800.
			STEEL STRONG	RABALE	A	GATE VALVE- CS UPTO 600NB, SS UPTO 300NB; GLOBE VALVE- CS/SS UPTO 300NB; CHECK VALVE- CS UPTO 600NB, SS UPTO 250NB
			KSB PUMPS LTD	COIMBATORE	A	300NB CLASS 2500.
			HAWA ENGINEERS	AHMEDABAD	A	CS UPTO 450NB, CLASS #300, 500NB CLASS 150 AND SS 300NB CLASS 300, FCS / FSS 50 NB CLASS 800.
			NITON VALVES INDIA PVT LTD	NAVI MUMBAI / AURANGABAD	A	CS GATE 900 NB CLASS 600, GLOBE 400 CLASS 300, CHECK 300 NB CLASS 600.
	L&T VALVES LIMITED	COIMBATORE	A	650 MM CLASS 600, 50 NB CLASS 800.		
			WEIR BDK	HUBLI	A	Conventional CCS Gate / Globe / Check Valves up to 600MM and Class # 1500, CSS Gate/ Globe/ Check Valves up to 200MM and Class # 600, up to 500MM and class #300 , FCS Gate / Globe / Check Valves up to 50MM and Class # 2500.





 <b>PACKAGE: FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		INDICATIVE SUB VENDOR LIST					
SI No.	Item	QP/ Insp. Cat.	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS	
27	BALL VALVES (MAIN CONTRACTOR APPROVED SOURCE UP TO CLASS 800 AND SIZE 100 NB)		WEIR BDK	HUBLI	A	SS Ball valves up to 500MM and class #600, CS Ball Valves up to 250 MM and class# 900, CS/ SS Ball valves up to 100 MM and class # 1500.	
			MICRO FINISH VALVES PVT. LTD.	HUBLI	A	400NB CLASS#600 AND UP TO 600NB CLASS#300	
			FLOW CHEM INDUSTRIES	KALOL	A	100NB CLASS#600,200NB CLASS#300, 50 NB CLASS#800	
			BRAY CONTROLS (ZHEJIANG) CO. LTD	CHINA	A	UP TO 100 NB CLASS#300	
			L&T VALVES LIMITED	COIMBATORE	A	UPTO 150NB, CLASS #150/300, AND UPTO 50NB, CLASS #800	
			PRECISSION ENGG CO VALVES PVT LTD	NASIK	A	FCS UP TO 50NB CLASS 800, CCS UP TO 400NB CLASS 150.	
			BELGAUM AQUA VALVE PVT LTD	BELGAON	A	FCS UP TO 50NB CLASS 800, CCS UP TO 200NB CLASS 150.	
			G M ENGINEERING PRIVATE LTD	RAJKOT	A	UP TO 400 NB AND CLASS #600	
			HAWA ENGINEERS	AHMEDABAD	A	UPTO 100NB, CLASS #150	
28	GUN METAL VALVES		LEADER ENGG	JULLUNDHAR	A		
			BOMBAY METAL	MUMBAI	A		
			SANT VALVES	JULLUNDHAR	A		
29	CHAIN PULLEY BLOCK		TRACTEL TIRFOR	PALWAL	A	UPTO 20 TON	
			LIFTING EQUIPMENT	DELHI	A	UPTO 12 TON	
			ARMSEL	BANGALORE	A	UPTO 5 TON	
			CENTURY CRANE ENGINEERS PVT. LTD	BALLABHGARH	A	UPTO 7.5 TON	
			HERCULES HOIST	RAIGAD	A	UPTO 15 TON	
30	EOT CRANE / ELECTRIC HOIST (upto 25 Tons for both)		REVA INDUSTRIES	FARIDABAD	A		
			EDDY CRANE	PUNE	A	UPTO 10 TON	
			CONSOLIDATED HOIST	SATARA /PUNE *	A	*PUNE FOR ELECTRIC HOIST UPTO 15 TONS	
			ELECTROTHERAPHY	RISHRA	A	UPTO 15 TON FOR ELECTRIC HOIST ONLY	
			HERCULES HOIST	RAIGAD	A	UPTO 15 TON FOR ELECTRIC HOIST ONLY	
			TUBRO FERGUSSON	KOLKATA	A	UPTO 5 TON FOR ELECTRIC HOIST	
			PRAYAS ENGG (PBL)	V V NAGAR	A	UPTO 10 TON FOR ELECTRIC HOIST ONLY	

 <b>PACKAGE: FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		INDICATIVE SUB VENDOR LIST				
SI No.	Item	QP/ Insp. Cat.	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS
			ALPHA SERVICES	ALWAR	A	SINGLE GIRDER EOT CRANE & ELECTRIC HOIST UPTO 15 TON ONLY. GEARBOX FROM NTPC APPROVED SOURCES FOR EOT CRANE.
			CENTURY CRANE ENGINEERS PVT. LTD	BALLABHGARH	A	
			ARMSEL	BANGALORE	A	UPTO 10 TON EOT & UPTO 15 T ELECTRIC HOIST
			TRACTEL TIRFOR	PALWAL	A	UPTO 15 TON FOR ELECTRIC HOIST AND UPTO 10 TON FOR EOT
			MILLARS INDIA	KARAMSAD	A	
			AVON CRANES	GURGAON	A	
			GRIP ENGINEERS	HYDERABAD	A	GEARBOX FROM NTPC APPROVED SOURCES FOR EOT CRANE.
			GRIP ENGINEERS	FARIDABAD	A	UPTO 20 TON ELECTRIC HOIST ONLY
31	ALLOY STEEL/CARBON STEEL FORGINGS		INDIAN FORGING AND STAMPING	JAMSHEDPUR	A	
			HINDUSTAN FORGE	MUMBAI	A	
			BAY FORGE	CHENNAI	A	
			VIKRANT FORGINGS	KOLKATA	A	
			SAIL	DURGAPUR	A	
			BHARAT FORGE	PUNE	A	
			TAYO ROLLS	JAMSHEDPUR	A	
			PUNJAB HAMMER	MANDI GOVINDGARH	A	
			FORGING INDIA	KOLKATA	A	
			PAHLAD RAI FORGINGS	KANPUR	A	
			HEC	RANCHI	A	
			VISHNU FORGINGS	NASIK	A	
32	CS AND ALLOY STEEL CASTINGS		PRAYAS CASTINGS	V V NAGAR	A	
			STEELCAST	BHAVNAGAR	A	
			KOLHAPUR STEEL	KOLHAPUR	A	
			AQUA ALLOYS	KOLHAPUR	A	
			MARTOPEARL ALLOYS	HYDERABAD	A	
			UP STEEL	MUZAFFAR NAGAR	A	NOT FOR Mn STEEL CASTING
			GS ALLOYS	VIJAYWADA	A	NOT FOR Mn STEEL CASTING
			VOSSLOH BEEKAY CASTINGS	BHILAI	A	UPTO 250 KG. NOT FOR Mn STEEL CASTING
			RAIPUR CASTINGS	BILASPUR	A	UPTO 250 KG.


SI No.	Item	QP/ Insp. Cat.	INDICATIVE SUB VENDOR LIST			APPROVAL STATUS	REMARKS
			ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING			
	 PACKAGE: FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE						
33	MISC. FABRICATED ITEMS, TECHNOLOGICAL STRUCTURE		MAIN CONTRACTOR APPROVED SOURCES				PHYSICAL ASSESSMENT SHALL BE DONE BY THE MAIN CONTRACTOR BASED ON CRITERIA/CHECKLIST PROVIDED BY NTPC
34	BELT CLEANER & SKIRT BOARD SEALING (BACKING PLATE, RUBBER BLOCKS), FESTOON TROLLEY		MAIN CONT. APPROVED SOURCES				
35	SCRAPPER,SHEAVES,TAKEUP TROLLEY,TAKEUP COMPONENTS (THIMBLE,BULL DOG GRIP,TURN BUCKLE,COUNTER WEIGHTS), SCREW TAKEUP, RAIL, MANUAL RAIL CLAMP		MAIN CONTRACTOR APPRD SOURCES				
36	WIRE ROPE		BOMBAY WIRE ROPES	MUMBAI	A		
			BHARAT WIRE ROPE	MUMBAI	A		
			USHA MARTIN	RANCHI	A		
37	PAC		VOLTAS	THANE/SILVASSA	A		
			CARRIER AIRCON	GURGAON	A		
			BLUESTAR	SILVASSA	A		
38	SPLIT/WINDOW AC		MAIN CONTRACTOR APPRD SOURCES				
39	QUICK RELEASE COUPLING, SHRINK DISC COUPLINGS, SLIP RING , CLUTCH COUPLING, COMPRESSION COUPLINGS		MAIN CONTRACTOR APPRD SOURCES				
40	AIR RELEASE VALVE, FLOAT VALVES		MAIN CONTRACTOR APPRD SOURCES				
41	DUST SUPPRESSION SYSTEM (PLAIN WATER & DRY FOG)		MAIN CONTRACTOR APPRD SOURCES				BOIs (Pump,Strainer,Pipes, Nozzle, Gate,Globe,Check valve, Butterfly valve, Actuator,Motors,Control Panel, Pressure Reducing valve ,Solenoid valve, Pressure Gauge and Temperature Gauge, Pressure switch, Level switch, Flow switch, Transmitter ) from NTPC approved sources
42	BELT VULCANISER		NILOS	CHENNAI	A		
			THEJO ENGG	CHENNAI	A		
43	CAST IRON CASTING		MAIN CONT. APPRD SOURCES				
44	PLUMMER BLOCK		MAIN CONT. APPRD SOURCES				

 <b>PACKAGE: FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		INDICATIVE SUB VENDOR LIST					
SI No.	Item	QP/ Insp. Cat.	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS	
45	SAFETY RELIEF VALVE		LEADER	JULLANDHAR	A		
			SPIRAX MARSHALL	PUNE	A		
			FISHER SANMAR	CHENNAI	A		
46	STRAINERS		MAIN CONTRACTOR APPRD SOURCES				
47	BUTTER FLY VALVE (MAIN CONTRACTOR APPROVED SOURCE UP TO CLASS 150 & SIZE 600 NB)		INTERVALVE POONAWALA LTD	PUNE	A	SGI / CI / D2 1400MM PN10, SGI / CI 1000MM PN16,CS/SS 500MM PN16, SS 400MM CLASS#300, UPTO 2800NB, PN 6	
			WEIR BDK	HUBLI	A	CI/ DI butterfly valve up to 1000MM and PN16 AND up to 1800MM and PN10,CCS UP TO 1050MM CLASS 150 AND up to 1800MM and PN16 SS - UP TO 400NB PN-16 ,FABRICATED 800MM CLASS#150.	
			PENTAIR VALVES	HALOL	A	FOR SS UP TO 500 NB PN-10, CI- UP TO 900NB PN-10, UP TO 500NB PN-16, 450MM CLASS#300., UPTO 2800NB, PN6.	
			CRANE FLOW PROCESS	SATARA	A	CI & SS UPTO 500 NB PN16, 600 NB PN10	
			FLOWSERVE INDIA CONTROLS	CHENNAI	A	UPTO 600 NB, CI ONLY PN 16/ CLASS 150	
			FOURES S ENGINEERING (INDIA) LIMITED	BANGALORE	A	CAST SGI/CI/ MS FABRICATED- UP TO 1200 PN-10, UP TO 350 PN-16 ,2400 MM PN6/CLASS150 SS - UP TO 300NB PN-10, UPTO 2700NB CLASS # 75	
			KBL	KONDHAPURI	A	CAST SGI/CI/CS 1400 MM PN16 , SS 300 MM PN16 , 1800MM CLASS 150, MS FABRICATED 900 NB PN40,2800NB, PN6.	
			R & D MULTIPLE	VALSAD	A	CAST SGI/CI/MS FABRICATED- UP TO 1800 MM PN-10/CLASS # 75, ,1100MM PN25,1400MM CLASS#150 , UPTO 2800NB CLASS # 75	
			ADVANCE	GAGRET	A	SOFT SEATED, CONCENTRIC BFV OF CI/ CS/ SS OF SIZE UPTO 250MM AND PRESSURE RATING UPTO CLASS #150.	

 <b>PACKAGE: FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		INDICATIVE SUB VENDOR LIST					
SI No.	Item	QP/ Insp. Cat.	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS	
			ADVANCE	GREATER NOIDA	A	METAL SEATED, TRIPLE ECCENTRIC, SS BFV OF SIZE UPTO 100NB, AND PRESSURE RATING UPTO CLASS #300.	
			BRAY CONTROLS INDIA PVT LTD	VADODARA	A	UP TO 400NB CLASS 150 / PN16	
			BRAY CONTROLS (ZHEJIANG) CO. LTD	CHINA	A	UP TO 400 NB CLASS#600	
			L&T	KANCHIPURAM	A	UPTO 400NB, CLASS #150	
			INSTRUMENTATION LTD.	PALAKKAD	A	UPTO 2200NB CLASS # 75	
			HAWA ENGINEERS	AHMEDABAD	A	CI/ CS & FABRICATED UPTO 1200MM, CLASS #150, SS UPTO 250MM, CLASS#150	
48	MS FITTINGS (BLACK / GI) AS PER IS 1239 PART-2		MAIN CONTRACTOR APPRD SOURCES				
49	MS ERW PIPES AS PER IS 1239 / IS 3589 ( UPTO 600 NB)		SAIL	ROURKELA	A		
			MAHARASHTRA SEAMLESS	RAIGAD	A	200 NB TO 500 NB ERW PIPES AS PER IS 3589	
			INDUS TUBES	G.B.NAGAR	A	UPTO 300 NB AS PER IS 1239/3589	
			SURYA ROSHNI	BAHADURGARH	A	UPTO 400 NB ERW PIPES AS PER IS 1239/3589	
			JINDAL	GHAZIABAD	A	UPTO 350 NB ERW PIPES AS PER IS 1239/3589	
			JINDAL	JANGALPUR	A	UPTO 500 NB FOR BLACK PIPE	
			JINDAL INDUSTRIES LTD.	HISSAR	A	UP TO 300 NB ERW BLACK PIPE AS PER IS 1239/3589	
			APL APOLLO TUBES LTD.	SIKANDRABAD	A	MS pipes ( Black & GI) as per IS 1239 & MS pipes ( Black & GI) as per IS 3589 up to 250 NB size, 8 mm thickness and Grade up to Fe 410.	
			LLYODS LINE PIPES LTD.	THANE	A	MS pipes ( Black & GI) as per IS 1239 & MS pipes ( Black ) as per IS 3589 up to 350 NB size, 8 mm thickness and Grade up to Fe 410.	
			DADU PIPES	SIKANDRABAD	A	UPTO 300 NB ERW BLACK PIPES	


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SI No.	Item	QP/ Insp. Cat.	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS	
			TATA	JAMSHEDPUR	A	UPTO 150 NB ERW PIPES AS PER IS 1239	
			RATNAMANI	KUTCH	A	ERW PIPES AS PER IS 3589 UPTO 400 NB	
			WELPSUN	ANJAR	A	UPTO 400 NB ERW PIPES AS PER IS 1239/3589	
50	FORGED/FORMED FITTINGS		GUJARAT INFRA PIPES	BARODA	A		
			EBY	UMBAI	A		
			N.L.HAZRA	KOLKATA	A		
			MS FITTINGS	KOLKATA	A		
			TRUE FORGE	FARIDABAD	A		
			TUBE PRODUCTS	BARODA	A		
			PIPEFIT ENGINEERS	BARODA	A		
			SIDDARTH & GAUTAM	FARIDABAD	A		
51	MATERIAL FOR DUCTING, DUCTING SUPPORT, GRILLS, LOUVRE, DAMPERS, PRE & FINE FILTERS (no of filters < 100 each), EARTHING MATERIAL (MS ROUND BAR)		MAIN CONTRACTOR APPRD SOURCES				
52	CI PRESSURE RELEIF/REDUCING VALVE		DARLING MUESCO	AHMEDABAD	A		
			LEADER	JULLUNDHAR	A		
			FISCHER SANMAR	PUNE	A		
			SPIRAX MARSHALL	PUNE	A		
			FAINGER LESSER	AURANGABAD	A		
53	HYDRAULIC POWER PACK		EATON POWER	PUNE	A		
			BOSCH-REXROTH	AHMEDABAD	A		
			HAGGLUNDS	SWEDEN	A		
			MAHA HYDRAULICS	CHENNAI	A		
			L & T HYDRAULICS	BANGALORE	A	EXCEPT FOR STACKER RECLAIMER	
54	HYDRAULIC CYLINDER		VELJAN	HYDERABAD	A		
			WIPRO	BANGALORE	A		
			EATON POWER	PUNE	A		
			L & T HYDRAULICS	BANGALORE	A		

SI No.	Item	QP/ Insp. Cat.	INDICATIVE SUB VENDOR LIST		APPROVAL STATUS	REMARKS
			ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING		
			BOSCH-REXROTH	AHMEDABAD	A	
55	HYDRAULIC MOTOR		POCLAIN HYDRAULICS	FRANCE	A	
			HAGGLUNDS	SWEDEN	A	
			PARKER CALZONI	ITALY	A	
			MAHA HYDRAULICS	CHENNAI	A	UP TO 100 LITRE CAPACITY
			KAWASAKI	UK	A	
56	HYDRAULIC PIPE & PIPE FITTING		MAIN CONTRACTOR APPRD SOURCES			
57	SCREW TYPE AIR COMPRESSORS		ELGI	COIMBATORE	A	UPTO MODEL E 160. OIL FLOODED/LUBRICATED SCREW COMPRESSORS
			ATLAS COPCO	BELGIUM.	A	ASSEMBLY & TESTING AT AC - PUNE
			INGERSOL RAND INDIA	AHMEDABAD	A	UPTO MODEL SH 300 (36 NM3/MIN) . AIR ENDS FROM GHH RAND - GERMANY & OTHER COMPONENTS FROM IR'S GLOBAL SOURCES ASSEMBLY & TESTING AT INGERSOL- AHMEDABAD
			KOBELCO	JAPAN	A	OIL FREE SCREW COMPRESSORS, ASSEMBLING AND TESTING AT KPC PUNE
			AERZENER	GERMANY	A	OIL FREE SCREW UPTO MODEL VML-95
			ELGI	COIMBATORE	A	UPTO 2830 CFM, AIR ENDS FROM HITACHI-JAPAN. ASSEMBLY AND TESTING AT ELGI COIMBATORE.
58	BLOWER		SWAM	NOIDA	A	
			KAY INTERNATIONAL	SONEPAT	A	
			EVEREST	NEW DELHI / BAHADURGARH	A	
			KULKARNI POWER TOOLS	SHIROL	A	
59	PNEUMATIC CYLINDER		NUCON	HYDERABAD	A	UPTO 350 NB
			ROTEX	MUMBAI	A	UPTO 600 NB

 <b>PACKAGE: FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		INDICATIVE SUB VENDOR LIST					
SI No.	Item	QP/ Insp. Cat.	ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING	APPROVAL STATUS	REMARKS	
			SCHRADER DUNCAN	PUNE	A	UPTO 350 NB	
			VAAS INDUSTRIES	CHENNAI	A	UPTO 300 NB	
			ORBINOX	COIMBATORE	A	UPTO 300 NB	
60	REFRIGERANT TYPE DRIER		SUMMITS HYGRONICS	COIMBATORE	A	Upto 11893 m3/hr	
			TRIDENT	COIMBATORE	A	Upto 10000 m3/hr	
			MELCON	GREATER NOIDA	A	Upto 7250 m3/hr	
			DELAIR	GURGAON	A	Upto 7500 m3/hr	
			ATLAS COPCO	BELGIUM	A	Upto model FD 1200	
61	DESSICANT TYPE AIR DRYER		DELAIR	GURGAON	A		
			INDCON	DELHI	A		
			MELCON	GREATER NOIDA	A		
			SUMMIT	COIMBATORE	A		
			TRIDENT	COIMBATORE	A		
62	AIR RECEIVER(MAIN CONTRACTOR APPROVED SOURCE FOR < 10 KSC PRESSURE)		UNITED ENGINEERS	NASHIK	A		
			TEMASME VESELEX	NOIDA	A		
			INTEGRATED ENGINEERS	MUMBAI	A		
			ABACUS HEAT TRANSFER	FARIDABAD	A		
			PARKAIRE	DELHI	A		
			GEM	COIMBATORE	A		
63	ROTARY FEEDER		INDURE	SAHIBABAD	A		
			DCIPS	KOLKATA	A		
			MELCO	FARIDABAD	A		
			MCNALLY SAYAJI	ASANSOL/KUMARDHUBI	A		
			MACAWBER BEEKAY	KESHWANA	A		
			EXPONENTIAL ENGINEERING	PUNE	A		



SI No.	Item	QP/ Insp. Cat.	INDICATIVE SUB VENDOR LIST			APPROVAL STATUS	REMARKS
			ACCEPTABLE SUPPLIER AS PER DATABASE	PLACE OF MANUFACTURING			
64	PLAIN WATER SPRAY NOZZLE/SPRINKLERS FOR DS SYSTEM		SPRAYING SYSTEM	BANGALORE	A		
			F.HARLEY	KOLKATA	A		
			EAGLE AGRO	RAJKOT	A		
65	SHOP FABRICATED STRUCTURE		INDIANA GRATINGS PVT. LTD.	PUNE	A		
			JINDAL STEEL & POWER LTD.	RAIGARH	A		
			BABY ENGG. PVT. LTD.	TRICHY	A		
			REGIONAL ENGG. WORKS	TRICHY	A		
			AJANTHA FABS	MATHUR	A		
			CAPACITE STRUCTURES LTD.	THANE	A		
			MIURA INFRASTRUCTURE PVT. LTD.	BHILAI	A		
			SHIVAM HITECH STEELS PVT. LTD	BHILAI	A		
			TECHNOFAB MANUFACTURING LTD.	CHENNAI	A		
			JSW SEVERFIELD STRUCTURES LTD(JSSL)	BELLARY	A		
			ALLIANCE INTEGRATED METALIKS LTD(AIML)	RAJPURA	A		
			ATMASTCO PVT LTD	DURGAPUR	A		
			APEX BUILDSYS LTD	NAGPUR	A		
			COREFAB PROJECTS PVT LTD	BHILAI	A		
			KOTHARI CHEMICALS	BHILAI	A		
	FEDDERS LLOYD CORPORATION LTD	SIKANDRABAD	A				
	ARCELOR MITTAL DHAMM PROCESSING PVT LTD	RANIPET	A				
	ARTSON ENGINEERING	NASIK	A				

	<b>PACKAGE: FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>		<b>INDICATIVE SUB VENDOR LIST</b>				
<b>SI No.</b>	<b>Item</b>	<b>QP/ Insp. Cat.</b>	<b>ACCEPTABLE SUPPLIER AS PER DATABASE</b>	<b>PLACE OF MANUFACTURING</b>	<b>APPROVAL STATUS</b>	<b>REMARKS</b>	
			ARTSON ENGINEERING	NAGPUR	A		



## SUB-SECTION-V-QM3

# EQUIPMENT COOLING WATER SYSTEM

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



EQUIPMENT COOLING WATER SYSTEM													
TEST / CHECKS		Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Assembly Fit Up	Visual & Dimensional Check	UT	RT	Hydraulic / Water Fill	Balancing	Type Test	Performance Test	Other Test
ITEM / COMPONENTS													
<b>A</b>	<b>PLATE TYPE HEAT EXCHANGER</b>		Y	Y <sup>3</sup>	Y	Y			Y				
A.1	Heat Transfer Plates	Y <sup>1</sup>		Y <sup>2</sup>		Y							Y <sup>7</sup>
A.2	Gaskets	Y				Y							
A.3	Cover Plates (Front & Rear)	Y <sup>1</sup>				Y	Y <sup>5</sup>						
A.4	Tie Rods	Y <sup>1</sup>		Y <sup>4</sup>			Y <sup>6</sup>						
<b>B</b>	<b>HORIZONTAL CENTRIFUGAL PUMP</b>				Y	Y						Y <sup>10</sup>	
B.1	Casing	Y <sup>1</sup>		Y <sup>4</sup>		Y		Y <sup>8</sup>					
B.2	Impeller	Y <sup>1</sup>		Y <sup>4</sup>		Y			Y <sub>9</sub>				
B.3	Shaft	Y <sup>1</sup>		Y		Y	Y <sup>6</sup>		Y <sub>9</sub>				

**NOTES**

- 1 One per heat / HT batch
- 2 DP Test shall be conducted for 10% of the lot of HT plates. However, in case of any defect, entire lot shall be tested and only defect free plates shall be accepted.
- 3 100% DP Test shall be conducted on butt welds and 10% DPT on fillet weld after final run.
- 4 100% DPT shall be carried out on machined surfaces.
- 5 UT shall be done on plates with thickness >40 mm and for pressure parts plates 25 mm or above.
- 6 UT shall be done on shaft / tie rod with diameter above 40 mm.
- 7 After pressing each HT plate shall be subjected to either of the following tests, as per Manufacturer Practice
  - a) Light Box Test
  - b) Vacuum Test
  - c) Air Chamber Test
- 8 All pressure retaining parts shall be hydrostatically tested at 200% of pump rated head or 150% of shut – off head, whichever is higher, for at least 30 minutes. No leakage is allowed.
- 9 Static and Dynamic Balancing shall be carried out on complete rotor assembly.
- 10 All pumps shall be tested at rated speed, for head, flow capacity, efficiency and power consumption for the entire operating range i.e. from shut off head to maximum flow. A minimum of 7 readings shall be taken to plot the curve, with one reading at design flow. Testing standard shall be HIS (Hydraulic Institute Standard) of USA.  
Performance test shall be carried out with contract motor, wherever Liquidated Damages are to be ascertained based on performance test at shop.
11. For pipes, fittings, valves & RE joints refer QA chapters of LP Piping



**QUALITY ASSURANCE**

**PIPES, FITTINGS, BENDS, VALVES, COATING-WRAPPING, STRAINERS, EXPANSION JOINTS, TANKS, FASTENERS, LINING ETC.**

Tests/Check	Items / Components	Material Test	DPT/MPI / RT	Ultrasonic Test	WPS/ WQS/PQR	Hydraulic / Water Fill Test	Pneumatic Test	Assembly Fit up	Dimensions	Functional/operational Test	Other Tests	All Tests as per relevant Std	REMARKS
1	Pipes & Pipe Fittings	Y <sup>a</sup>	Y <sup>b</sup>			Y <sup>1</sup>			Y			Y	
2	Diaphragm Valves	Y <sup>a</sup>				Y <sup>5</sup>			Y		Y <sup>6</sup>		
3A	Cast Butterfly Valves (Low Pressure)					Y		Y	Y	Y	Y <sup>7</sup>		
	Body	Y <sup>a</sup>	Y <sup>b</sup>										
	Disc	Y <sup>a</sup>	Y <sup>b</sup>										
	Shaft	Y <sup>a</sup>	Y	Y <sup>c</sup>									
3B	Fabricated Butterfly Valves	<b>REFER NOTE 14</b>											
4	Gate/ Globe/Swing Check / Ball Valves	Y <sup>a</sup>	Y <sup>b</sup>	Y <sup>c</sup>		Y <sup>5</sup>	Y	Y	Y	Y	Y <sup>8</sup>		
5	Dual Plate Check Valves	Y <sup>a</sup>	Y <sup>b</sup>	Y <sup>c</sup>		Y	Y	Y	Y	Y	Y <sup>4</sup>		
6	Rolled & Welded Pipes and Mitre Bends	Y <sup>a</sup>	Y <sup>3</sup>		Y	Y <sup>3</sup>			Y		Y <sup>3&amp;15</sup>	Y	
7	Coating & Wrapping of Pipes	Y <sup>2</sup>									Y <sup>2</sup>		
8	Tanks & Vessels	Y <sup>a</sup>	Y <sup>b</sup>		Y	Y			Y		Y <sup>16</sup>		
9	Strainers	Y <sup>a</sup>	Y <sup>b</sup>		Y #	Y					Y <sup>11</sup>		#F or Fabricated Strainer
10	Rubber Expansion Joints	Y <sup>a</sup>				Y <sup>12</sup>		Y	Y		Y <sup>13</sup>		
11	Internal Lining of Pipes	Y <sup>a</sup>							Y		Y <sup>9</sup>		
12	Site Welding		Y <sup>10</sup>		Y	Y							
<b>NOTES (MEANING OF SUPERSRIPTS)</b>													
a	One per heat/heat treatment batch/lot.												
b	On machined surfaces only for castings and on butt welds.												
c	For shaft/spindles > or = 40 mm												
1	100% Hydraulic test shall be carried out. Weld joints not subjected to hydraulic test shall be subjected to 100% RT.												
2	Spark Test, Adhesion Test and Material Test for primer and enameled & Coal Tar Tapes as per AWWA-C-203-91/ IS-10221/IS 15337 as applicable.												
3	Followings are the testing requirements for fabrication of pipes at site												
<b>TESTS</b>					<b>TESTS</b>								
WPS, PQR, Welder Qualification Test					WPS, PQR, Welder Qualification Test								
DPT on root run					DPT on root run								



**QUALITY ASSURANCE**

	DPT after back gauging	DPT after back gauging
	RT / UT by TIME OF FLIGHT DEFRACTION (TOFD) Technique	RT / UT by TIME OF FLIGHT DEFRACTION (TOFD) Technique
	DPT on finished butt weld joints	DPT on finished butt weld joints
	Hydraulic Test	Hydraulic Test
4	Dry Cycle Test on Dual Plate Check valve spring for one lakh Cycles shall be carried out as a type test. If Dry Cycle test carried out earlier for same material & diameter, Test report shall be reviewed by owner/owner's representative.	
5	Seat Leakage Test for Actuator Operated Valves, shall be done with by closing the valves with actuator.	
6	Tests on rubber parts shall be conducted per batch of rubber mix for tensile, Elongation, hardness, adhesion, spark test, bleed resistance test. In addition, type test for 50,000 cycles of each type of diaphragm shall also be conducted.	
7	Hydraulic Test of Body, Seat and disc-strength shall be carried out in accordance with governing design standard. Actuator operated valves shall be checked for Seat Leakage by closing the valves with actuator. For Proof of Design Test refer respective chapters of engineering portion in the technical specification.	
8	Blue matching, wear travel for gates, valves, pneumatic seat leakage, and reduced pressure test for check valves shall be done as per relevant standard. Maximum allowable vacuum loss is 0.5 mm of Hg abs. for valves to be tested for vacuum operation for internal pressure 25 mm of Hg abs. for a period of 15 minutes. Fire safe test for ball valve shall be done wherever specified. In case of already carried out, the test report shall be submitted for review by owner/owner's representative. Functional checks of the valves for smooth opening and closing shall also be done. Valves shall be offered for hydro test in unpainted condition. Anti-corrosive protection shall be tested as per applicable code.	
9	Tensile, Elongation, Hardness, Specific Gravity, Lining Thickness, Humidity Check, Pipe temperature check, Adhesion Test and Holiday Detection Test etc as per applicable standard shall be done for all lining material and application.	
10	10% of welds (Root and finished welds) shall be subjected to DPT. ( 100% DPT for compressed air line and boiler & deaerator fill line.).	
11	Pressure drop across the strainer for each type and size as a special test shall be carried out. In case of already carried out, the test report shall be submitted for review by owner/owner's representative.	
12	During Hydraulic & Vacuum test at 30 mm Hg absolute in 3 different positions, the change in Circumference of the Arch should not be more than 1.5%. Permanent Set, after 24 hours of the test, should not exceed 0.5% of Arch.	
13	Tests on rubber for tensile, elongation, hardness, hydraulic stability check as per ASTM D 471, ozone resistance test as per ASTM D 1149 aging test and adhesion strength of rubber to fabric, rubber to metal adhesion shall be carried out.	
14	In addition of all tests as indicated for Cast Butterfly valve being applicable for fabricated butterfly valves, following test shall be done for Fabricated Butterfly Valve: <ol style="list-style-type: none"> <li>UT as per ASTM A-435 on plate material for body and disc shall be carried out for plate thickness 25mm and above.</li> <li>100% RT and DPT as per ASTM, Section-VIII, Division-I, on butt joints of thickness 20mm &amp; above of body and disc. 10% DPT on other welds shall be done.</li> <li>Post weld heat treatment as per ASME, Section-VIII, Division-I on butt joints of body and disc.</li> <li>Welders and WPS shall be qualified as per ASME- section IX</li> </ol>	
15	Maximum number of segments in segmental flanges shall be four (04) only. All butt weld joints in the segmental flanges shall be examined by RT/UT. Segmental flanges exceeding 37.5 mm thickness shall be stress-relieved as per norms of ASME Section VIII after welding	
16	For pressure vessel welds, RT shall be done as per design code requirements.	

<b>PROJECT : RGTPP HISAR (2X600 MW)</b> <b>PACKAGE: FGD</b> <b>SUPPLIER :</b> <b>BID DOC. NO:-</b> <b>31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL)</b> <b>SUB SYSTEM: <u>EQUIPMENT COOLING WATER SYSTEM</u></b>			<b>DOC. No.</b>
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<b>SN</b>	<b>ITEM</b>	<b>ACCEPTABLE SUPPLIER AS PER DATA BASE</b>	<b>PLACE</b>	<b>SUB-SUPPLIER APPROVAL STATUS</b>	<b>REMARKS</b>

1	BUTTERFLY VALVES (SIZE > 600 NB OR PRESSURE CLASS >150)	INTERVALVE POONAWALA LTD	PUNE	A	SGI / CI / D2 1400MM PN10, SGI / CI 1000MM PN16,CS/SS 500MM PN16, SS 400MM CLASS#300, MS FABRICATED UPTO 2800NB, PN 6
		WEIR BDK	HUBLI	A	CI/ DI BUTTERFLY VALVE UP TO 1000MM AND PN16 AND UP TO 1800MM AND PN10,CCS UP TO 1050MM CLASS 150 AND UP TO 1800MM AND PN16 SS - UP TO 400NB PN-16 ,FABRICATED 800MM CLASS#150.
		PENTAIR VALVES	HALOL	A	FOR SS UP TO 500 NB PN-10, CI- UP TO 900NB PN-10, UP TO 500NB PN-16, 450MM CLASS#300, MS FABRICATED UPTO 2800NB, PN6.
		FOURES S ENGINEERING (INDIA) LIMITED	BANGALORE	A	CAST SGI/CI/ MS FABRICATED- UP TO 1200 PN-10, UP TO 350 PN-16 ,2400 MM PN6/CLASS150 SS - UP TO 300NB PN-10, MS FABRICATED UPTO 2700NB CLASS # 75
		KBL	KONDHAPURI	A	CAST SGI/CI/CS 1400 MM PN16 , SS 300 MM PN16 , 1800MM CLASS 150, MS FABRICATED 900 NB PN40,2800NB, PN6.
		R & D MULTIPLE	VALSAD	A	CAST SGI/CI/MS FABRICATED- UP TO 1800 MM PN-10/CLASS # 75, ,1100MM PN25,1400MM

<b>PROJECT : RGTPP HISAR (2X600 MW)</b> <b>PACKAGE: FGD</b> <b>SUPPLIER :</b> <b>BID DOC. NO:-</b> <b>31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL)</b> <b>SUB SYSTEM: <u>EQUIPMENT COOLING WATER SYSTEM</u></b>			DOC. No.
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					CLASS#150 , MS FABRICATED UPTO 2800NB CLASS # 75
		ADVANCE	GREATER NOIDA	A	METAL SEATED, TRIPLE ECCENTRIC, SS BFV OF SIZE UPTO 100NB, AND PRESSURE RATING UPTO CLASS #300.
		BRAY CONTROLS (ZHEJIANG) CO. LTD	CHINA	A	UP TO 400 NB CLASS#600
		INSTRUMENTATION LTD.	PALAKKAD		UPTO 2200NB CLASS # 75
		HAWA ENGINEERS	AHMEDABAD	A	CI/ CS & FABRICATED UPTO 1200MM, CLASS #150, SS UPTO 250MM, CLASS#150
2	BUTTERFLY VALVES (SIZE UP TO 600 NB & PRESSURE CLASS UP TO 150)	MAIN CONTRACTOR APPROVED SOURCES		A	
3	CONVENTIONAL GATE/GLOBE VALVE/ CHECK VALVE(SIZE >600 NB OR RATING PR CLASS > 300)	LEADER	JALANDHAR	A	CS GATE 600MM CLASS#600, SS GLOBE 600MM CLASS#600, CS CHECK 600MM AND CLASS#600
		HAWA ENGINEERS	AHMEDABAD	A	FCS / FSS 50 NB CLASS 800.
		FOURESS	THANE	A	400NB CLASS 600 AND 50NB CLASS 800.
		BHEL IVP	GOINDWAL	A	GATE UP TO 300 NB CLASS 600. GLOBE 250 NB CLASS 400, CHECK 150NB CLASS 600.
		HITECH ENGG PVT LTD	AHEMDABAD	A	50 NB CLASS 800.
		KSB PUMPS LTD	COIMBATORE	A	300NB CLASS 2500.
		NITON VALVES INDIA PVT LTD	NAVI MUMBAI / AURANGABAD		CS GATE 900 NB CLASS 600, CHECK 300 NB CLASS 600.
		L&T VALVES LIMITED	COIMBATORE	A	650 MM CLASS 600, 50 NB CLASS 800.



<b>PROJECT : RGTPP HISAR (2X600 MW)</b> <b>PACKAGE: FGD</b> <b>SUPPLIER :</b> <b>BID DOC. NO:-</b> <b>31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL)</b> <b>SUB SYSTEM: <u>EQUIPMENT COOLING WATER SYSTEM</u></b>			DOC. No.
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		WEIR BDK	HUBLI	A	CONVENTIONAL CCS GATE / GLOBE / CHECK VALVES UP TO 600MM AND CLASS # 1500, CSS GATE/ GLOBE/ CHECK VALVES UP TO 200MM AND CLASS # 600, FCS GATE / GLOBE / CHECK VALVES UP TO 50MM AND CLASS # 2500.
4	CONVENTIONAL GATE/GLOBE VALVE/ CHECK VALVE (SIZE UP TO 600 NB & RATING PR CLASS UP TO 300)	MAIN CONTRACTOR APPROVED SOURCES		A	
5	FITTINGS- (MS/GI/CS/SS) & (FORGED/ FORMED)	MAIN CONTRACTOR APPROVED SOURCES		A	
6	HORIZONTAL /VERTICAL CENTRIFUGAL PUMPS	KIRLOSKAR BROS LTD.	KIRLOSKARW ADI	A	
		WILO MATHER & PLATT	PUNE	A	
		WILO MATHER & PLATT	KOLHAPUR	A	
		SAM TURBO	COIMBATORE	A	UP TO 1500 CUM/HR
		FLOWMORE	GHAZIABAD	A	
		BEST AND CROMPTON	CHENNAI	A	
		JYOTI	VADODARA	A	
		WPIL	GHAZIABAD	A	
		KISHORE PUMPS	PUNE	A	UPTO 500M3/HR RUBBERLINED PUMPS ALSO
		GRUNDFOS PUMPS INDIA PVT LTD	CHENNAI	A	HORIZONTAL UP TO 30 KW AND VERTICAL UP TO 45 KW (FOR APPLICATIONS WHERE NPSH IS NOT REQUIRED)
		SINTECH PRECISION	GHAZIABAD	A	HORIZONTAL UP TO 400 KW MOTOR RATING AND VERTICAL UP TO 30 KW MOTOR RATING
		KSB	PUNE	A	
KSB	NASHIK	A			

<b>PROJECT : RGTPP HISAR (2X600 MW)</b> <b>PACKAGE: FGD</b> <b>SUPPLIER :</b> <b>BID DOC. NO:-</b> <b>31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL)</b> <b>SUB SYSTEM: <u>EQUIPMENT COOLING WATER SYSTEM</u></b>			DOC. No.
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		FLOWSERVE INDIA CONTROLS PVT LTD	COIMBATORE	A	HOIZONTAL CENTRIFUGAL PUMP UP TO 75 KW
		SU MOTOR	MUMBAI	A	HORIZONATL UPTO 500M3/HR RUBBERLINED PUMPS AND VERTICAL CENTRIFUGAL PUMPS UP TO 100CMH
7	MS PIPE (BLACK/GI) (IS 1239 / IS 3589) ( UPTO 1000 NB)	MAIN CONTRACTOR APPROVED SOURCES		A	(BIS MARKED, MANUFACTURERS WITH VALID BIS LICENSE)
8	PIPE-CS SEAMLESS ASTM A 106	ISMT	AHMADNAGAR	A	UPTO 150NB
		ISMT	BARAMATI	A	UPTO 200 NB
		REMI	BHARUCH	A	UPTO 177.8 MM OD, HOT FINISHED
		MAHARASHTRA SEEMLESS	RAIGAD	A	CS SEAMLESS PIPES UPTO 350 NB
9	PIPES & FITTINGS-CI & DI	MAIN CONTRACTOR APPROVED SOURCES		A	
10	PIPE-SS ASTM A 312 UP TO 100 NB	REMI	TARAPUR	A	ERW UPTO 400 NB
		RATNAMANI	MEHSANA	A	ERW UPTO 500 NB, SEAMLESS UPTO 50 NB ONLY
		RATNAMANI	KUTCH	A	ERW UPTO 400 NB, SEAMLESS UPTO 50 NB ONLY, ARC WELDED UP TO 450NB
		SUMITOMO	JAPAN	A	
		SOSTA	GERMANY	A	
		OUTO KOMPU	SWEDEN	A	
		PRAKASH STEELAGE	VALSAD	A	ONLY FOR SEAMLESS UPTO 50NB AND ERW UP TO 400NB
		BHANDARI FOILS & TUBES LIMITED	DEWAS	A	ERW UP TO 300NB
APEX	BEHRORE	A	ERW UPTO 400 NB,		

<b>PROJECT : RGTPP HISAR (2X600 MW)</b> <b>PACKAGE: FGD</b> <b>SUPPLIER :</b> <b>BID DOC. NO:-</b> <b>31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL)</b> <b>SUB SYSTEM: <u>EQUIPMENT COOLING WATER SYSTEM</u></b>			DOC. No.
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11	PIPING FABRICATION AND FABRICATED FITTINGS-LP UP TO 300PSI	MAIN CONTRACTOR APPROVED SOURCES		A	SEAMLESS UPTO 50 NB.
12	PLATE HEAT EXCHANGER	TRANTER INDIA(FORMERLY INDWEEP)	PUNE	A	HT PLATES & GASKETS FROM TRANTER SWIDEN/USA.HT PLATES FROM HISKA JAPAN
		KELVION INDIA PVT LTD ( FORMLY GEA ECOFLEX INDIA)	PUNE	A	
		ALPHA LAVAL	SATARA	A	HT PLATES & GASKETS FROM ALPHA LAVAL SWIDEN
		IDMC	ANAND	A	HT PLATES & GASKETS FROM SONDEX DENMARK
		HISAKA WORKS LTD	JAPAN	A	
		SONDEX INDIA	VADODARA	A	HT PLATES FROM SONDEX DENMARK
13	RUBBER EXPANSION JOINT(<1600NB)	MAIN CONTRACTOR APPROVED SOURCES		A	HT PLATES & GASKETS FROM TRANTER SWIDEN/USA.HT PLATES FROMHISKA JAPAN
14	RUBBER EXPANSION JOINT(≥1600NB)	CORI ENGINEERS PVT LTD	CHENNAI	A	UPTO 2800 MM
		SRM EXOFLEX PVT LTD	KOLKATA	A	UPTO 2600 MM
15	STRAINERS/FILTERS	MAIN CONTRACTOR APPROVED SOURCES		A	
16	PUMP -SUBMERSIBLE / SUMP -UP TO 30KW	MAIN CONTRACTOR APPROVED SOURCES		A	
17	FQP RECEIPT INSPECTION & ERECTION	MAIN CONTRACTOR			

NOTE: VENDOR CONTROL MAY BE REVISED BASED ON OWNER'S INPUT/REQUIREMENT.

**LEGENDS: SUB-SUPPLIER STATUS CATEGORY**

**A** – INDICATES ACCEPTABLE SUB-SUPPLIERS TO NTPC ALONG WITH CONDITION OF APPROVAL, IF ANY.

OWNER

QA&I CONSULTANT

MAIN CONTRACTOR

FORMAT NO.: QS-01-QAI-P-01/F3-R0	1/1	ENGG. DIV./QA&I
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## SUB-SECTION-V-QM4

# AIR CONDITIONING & VENTILATION SYSTEM

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**

	<b>QUALITY ASSURANCE</b>	
	<b>AIR CONDITIONING &amp; VENTILLATION SYSTEM PACKAGE</b>	

<b>CLAUSE NO</b>	<b>QA MODULE FOR AIR CONDITIONING AND VENTILATION SYSTEM</b>
1.00.00	<b>CHILLING UNIT/CONDENSING UNIT</b>
1.01.00	<b>REFRIGERANT COMPRESSOR (SCREW/SCROLL)</b>
1.01.01	Hydraulic/Pneumatic test of castings of casings shall be carried out. No leakage shall be permitted.
1.01.02	DPT of screw, impeller, shaft, vanes, casing etc. after machining shall be carried out.
1.01.03	All rotating parts of screw and centrifugal compressor shall be dynamically balanced to ISO 1940 Gr. 6.3.
1.01.04	Leak tightness & vacuum check for chilling units / compressor in assembled condition shall be carried out. No leakage shall be permitted.
1.01.05	Performance test of assembled compressor and Chiller assembly shall be done to check for following :
1.01.05.01	No load air run (free run) test of all types of compressor to check FAD (Free air delivery), Noise, Vibration & Temp. rise of bearing & body.
1.01.05.02	Functional run test for Chiller assembly shall be carried out.
1.02.00	<b>CONDENSER &amp; EVAPORATOR</b>
1.02.01	DPT shall be carried out on welds if applicable
1.02.02	10% RT of butt weld joint on shell shall be carried out if applicable.
1.02.03	Dimensional check including tube hole dia, ligament, pitch etc. shall be carried out.
1.02.04	Mock-up test of tubes to tube sheet expansion shall be carried out. In case such test is already carried out for similar tube/tube sheet thickness and materials, records for the same shall be furnished for review and acceptance of owner / owner's representatives.
1.02.05	Hydraulic/Pneumatic test of Shell Side and Tube Side of condenser and evaporator as applicable shall be carried out. 'No leakage' shall be permitted.
2.00.00	<b>FANS</b>
2.01.00	20% DPT of welding on fan hub, blades, casing and impeller as applicable shall be carried out.
2.02.00	DPT of fan shafts shall be carried out after machining.
2.03.00	UT of fan shafts (diameter equal to or above 40mm) shall be carried out.
2.04.00	Rotating components of all fans shall be dynamically balanced to ISO-1940 Gr. 6.3
2.05.00	All Fans shall be subjected to run test for 4 hrs. or till temperature stabilization is reached. Vibration, Noise level, Temp. rise and current drawn shall be measured during the run test.
2.06.00	One fan of each type and size will be performance tested as per corresponding BIS /AMCA for Air flow, Static Pressure, Speed, Efficiency, Power Consumption, Noise, Vibration and Temp. Rise.
3.00.00	<b>AIR HANDLING UNIT</b>
3.01.00	For Fans refer tests as mentioned at 2.00.00

<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATIONS SECTION VI, PART- B BID DOC. NO: 31/CE/PLG/RGTPP/FGD-250</b>	<b>SUB-SECTION-V-QM 4 AC &amp; VENTILLATION SYSTEM (MECHANICAL)</b>	<b>Page 1 of 4</b>
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	<b>QUALITY ASSURANCE</b>	
	<b>AIR CONDITIONING &amp; VENTILLATION SYSTEM PACKAGE</b>	

3.02.00	One per type of assembled AHU (AHU casing and fan assembly) shall be subjected to free run test. Noise, Vibration and Temp. Rise of bearing shall be measured during run test.
3.03.00	All cooling coil shall be pneumatically tested and no leakage shall be permitted.
4.00.00	<b>CENTRIFUGAL PUMP</b>
4.01.00	UT on pump shaft (dia equal to or above 40 mm) and MPI/DPT on pump shaft and impeller after machining shall be carried out.
4.02.00	All rotating components of the pumps shall be dynamically balanced to ISO-1940 Gr. 6.3
4.03.00	A standard hydrostatic test shall be conducted on the pump casing with water at 1.5 times the shut off pressure on the head characteristics curve or twice the rated pressure whichever is higher, for a minimum duration of 30 minutes.
4.04.00	Standard Running Test
4.05.01	All pumps shall be tested in the manufacturer's works preferably with contract motor for capacity, efficiency, head and brake horse power. Pump shall be given running test over the entire operating range covering from the shut-off head to the maximum flow. The duration of test shall be minimum one (1) hr. A minimum of seven readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standard (HIS) and/or as per applicable Indian Standard or equivalent. Acceptance norms shall be as per approved datasheet & HIS standard only.
4.05.02	Noise and vibration shall be measured at shop for reference purpose only.
4.05.03	Pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and/or excessive vibration are observed during the shop test.
4.05.04	NPSH test shall be conducted with water as the medium, if required as per approved data sheets.
5.00.00	<b>LOW PRESSURE AIR DISTRIBUTION SYSTEM</b>
5.01.00	Functional test for fire damper along with solenoid shall be done.
5.02.00	Prototype tests report of fire damper (duly approved/accepted by owner / owner's representatives.) for each type and size as per UL-555 for fire rating shall be furnished.
5.03.00	Site Test- After completion, all ducting system shall be checked/tested for air leakages/tightness (smoke test) at site.
6.00.00	<b>INSULATION</b>
6.01.00	Insulation material shall be tested for all mandatory tests only as per relevant code/standard.
6.02.00	Thermal conductivity tests (for thermal insulation only) shall be done once in 12 months for insulation material manufactured during 12 months period for the same density and thickness of material as applicable as per IS:3346 or equivalent standard.

<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATIONS SECTION VI, PART- B BID DOC. NO: 31/CE/PLG/RGTPP/FGD-250</b>	<b>SUB-SECTION-V-QM 4 AC &amp; VENTILLATION SYSTEM (MECHANICAL)</b>	<b>Page 2 of 4</b>
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	<b>QUALITY ASSURANCE</b>	
	<b>AIR CONDITIONING &amp; VENTILLATION SYSTEM PACKAGE</b>	

6.03.00	XLPE/Nitrile Rubber: Thermal conductivity tests (for thermal insulation only) shall be done as per relevant code for the same density and thickness of material and validity of test shall be as per relevant standard.
7.00.00	<b>Packaged COOLING TOWER</b>
7.01.00	UT of fan shaft and drive shaft (dia equal to or above 40mm) shall be carried out.
7.02.00	DPT of fan hub and shafts shall be carried out after machining.
7.03.00	Color of fills shall be as per approved data sheet.
7.04.00	Fan assembly shall be statically/dynamically balanced.
7.05.00	Cooling Towers being supplied to site in assembled condition shall be subjected to run test at shop to measure FAD, Noise & Vibration. For Cooling Towers being supplied in knocked-down condition, these tests shall be done at site.
8.00.00	<b>AIR FILTERS</b>
8.01.00	Pre/Fine filters shall be tested for initial and final pressure drop Vs flow and average synthetic dust weight arrestance as per the requirement of BS 6540/ASHARE-52-76/EN779. HEPA (Absolute) filters shall be tested as per applicable code.
9.00.00	<b>PIPES &amp; FITTINGS</b>
9.01.00	All pipes and fittings shall be tested as per applicable codes / standard.
9.02.00	Site test- Pipes shall be tested at site hydraulically/pneumatically as per application requirement.
10.00.00	<b>VALVES &amp; SPECIALTIES</b>
10.01.00	Visual and dimensional check of valves as per relevant codes and approved drawing.
10.02.00	All the water line valves shall be hydraulically tested for body, seat and back seat (wherever provided) as per the relevant standard to which these valves are supplied irrespective of the working pressure for which these valves are selected. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.
10.03.00	Refrigerant line valves shall be pneumatically tested for body and seat leakage test.
10.04.00	Valves shall be offered for hydro test and pneumatic test in unpainted condition.
10.05.00	Functional check of the valves for smooth opening and closing shall be done.
10.06.00	Performance test to check pressure drop Vs flow shall be carried out for one valve of each type, size and rating for 'Balancing Valve'/Globe Valves with orifice.
11.00.00	<b>SPLIT/CASSETTE / WINDOW AC/ PAC/PEC</b>
11.01.00	Split/Cassette/ Window AC will be accepted on the basis of Manufacturer Standard Guarantee and Warrantee certificate.
11.02.00	PAC/PEC: Each Unit shall be subjected to production routine Test excluding performance test carried out as per relevant standard.
11.03.00	Performance test of PAC/PEC shall be carried out as per relevant standard on one unit of each type and rating at site.

<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATIONS SECTION VI, PART- B BID DOC. NO: 31/CE/PLG/RGTPP/FGD-250</b>	<b>SUB-SECTION-V-QM 4 AC &amp; VENTILLATION SYSTEM (MECHANICAL)</b>	<b>Page 3 of 4</b>
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	<b>QUALITY ASSURANCE</b>  <b>AIR CONDITIONING &amp; VENTILLATION SYSTEM PACKAGE</b>	
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12.00.00	<b>Air Washer and Unitary Air Filter (UAF)</b>
12.01.00	Random 10% DPT on weld joints shall be carried out.
12.02.00	Hydraulic test of pressure parts at 1.5 times the design or 2 times of working pressure whichever is higher. Pressure and water fill test of tanks shall be carried out.
12.03.00	Trial assembly of Air washer/UAF for one of each size shall be done in shop.
12.04.00	Performance test to check pressure drop Vs flow shall be carried out for one Nozzle of each type, size and rating.

<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATIONS SECTION VI, PART- B BID DOC. NO: 31/CE/PLG/RGTPP/FGD-250</b>	<b>SUB-SECTION-V-QM 4 AC &amp; VENTILLATION SYSTEM (MECHANICAL)</b>	<b>Page 4 of 4</b>
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<b>PROJECT : RGTPP HISAR (2X600 MW)</b> <b>PACKAGE: FGD</b> <b>SUPPLIER :</b> <b>BID DOC. NO:-</b> <b>31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL)</b> <b>SUB SYSTEM: <u>AC &amp; VENTILATION</u></b>			DOC. No.
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1	AIR HANDLING UNITS	MAIN CONTRACTOR APPROVED SOURCES		A	
2	AIR /PRESSURE RELEASE/SAFETY/VACUUM RELIEF VALVE/FLOAT VALVE	MAIN CONTRACTOR APPROVED SOURCES		A	
3	AIR WASHER & UNITARY AIR FILTER/ VOLUME CONTROL DAMPERS/ GRILLES/ DIFFUSERS/ PAN HUMIDIFIER/ EXPANSION TANK/ LOUVERS/FABRICATED DUCTS/PROPELLER FAN	MAIN CONTRACTOR APPROVED SOURCES		A	
4	AXIAL FAN (< 5KW)	MAIN CONTRACTOR APPROVED SOURCES		A	
5	AXIAL FAN (≥ 5KW)	KHAITAN	KOLKATA	A	UP TO 31000 CMH
		MARATHON ELECTRIC MOTOR(I) LTD	KOLKATA	A	UP TO 50000 CMH
		KRUGER VENTILATION INDUSTRIES PTE LTD	SINGAPORE	A	UP TO 20000 CMH
		NADI AIRTECHNICS PVT LTD	CHENNAI	A	UP TO 15000 CMH
		CB DOCTOR VENTILATOR PVT LTD	AHMEDABAD	A	UP TO 50000 CMH
		HOWDEN SOLYVENT FLAKT INDIA PVT LTD,	CHENNAI	A	UP TO 125000 CMH
		C DOCTOR &CO PVT LTD	SIRAKOLE, 24 PARGANES ( SOUTH)	A	UP TO 50000 CMH
		KRUGER VENTILATION INDUSTRIES (I) PVT LTD	THANE	A	UP TO 6000 CMH
		NADI AIR TECHNICS PVT LTD	CHENNAI	A	UP TO 15000 CMH
		ADVANCE VENTILATION PVT LTD	SONEPAT	A	UP TO 40000 CMH
		SOLYVENT FLAKT	KOLKATA	A	UP TO 60000 CMH
SK SYSTEMS PVT LTD	SONEPAT, HARYANA	A	UP TO 50000 CMH		
	ALMONAROD (P) LIMITED	CHENNAI	A	UP TO 14000 CMH	
6	BALANCING VALVES	MAIN CONTRACTOR APPROVED SOURCES		A	
7	BUTTERFLY VALVES (SIZE > 600 NB OR PRESSURE CLASS >150)	INTERVALVE POONAWALA LTD	PUNE	A	SGI / CI / D2 1400MM PN10, SGI / CI 1000MM PN16,CS/SS 500MM PN16, SS 400MM CLASS#300, MS FABRICATED UPTO 2800NB, PN 6
		WEIR BDK	HUBLI	A	CI/ DI BUTTERFLY VALVE UP TO 1000MM AND PN16

<b>PROJECT : RGTPP HISAR (2X600 MW)</b> <b>PACKAGE: FGD</b> <b>SUPPLIER :</b> <b>BID DOC. NO:-</b> <b>31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL)</b> <b>SUB SYSTEM: <u>AC &amp; VENTILATION</u></b>			<b>DOC. No.</b>
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					AND UP TO 1800MM AND PN10,CCS UP TO 1050MM CLASS 150 AND UP TO 1800MM AND PN16 SS - UP TO 400NB PN-16 ,FABRICATED 800MM CLASS#150.
		PENTAIR VALVES	HALOL	A	FOR SS UP TO 500 NB PN-10, CI- UP TO 900NB PN-10, UP TO 500NB PN-16, 450MM CLASS#300, MS FABRICATED UPTO 2800NB, PN6.
		FOURES S ENGINEERING (INDIA) LIMITED	BANGALORE	A	CAST SGI/CI/ MS FABRICATED- UP TO 1200 PN-10, UP TO 350 PN-16 ,2400 MM PN6/CLASS150 SS - UP TO 300NB PN-10, MS FABRICATED UPTO 2700NB CLASS # 75
		KBL	KONDHAPURI	A	CAST SGI/CI/CS 1400 MM PN16 , SS 300 MM PN16 , 1800MM CLASS 150, MS FABRICATED 900 NB PN40,2800NB, PN6.
		R & D MULTIPLE	VALSAD	A	CAST SGI/CI/MS FABRICATED- UP TO 1800 MM PN-10/CLASS # 75, ,1100MM PN25,1400MM CLASS#150 , MS FABRICATED UPTO 2800NB CLASS # 75
		ADVANCE	GREATER NOIDA	A	METAL SEATED, TRIPLE ECCENTRIC, SS BFV OF SIZE UPTO 100NB, AND PRESSURE RATING UPTO CLASS #300.

<b>PROJECT : RGTPP HISAR (2X600 MW)</b> <b>PACKAGE: FGD</b> <b>SUPPLIER :</b> <b>BID DOC. NO:-</b> <b>31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL)</b> <b>SUB SYSTEM: <u>AC &amp; VENTILATION</u></b>			DOC. No.
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		BRAY CONTROLS (ZHEJIANG) CO. LTD	CHINA	A	UP TO 400 NB CLASS#600
		INSTRUMENTATION LTD.	PALAKKAD	A	UPTO 2200NB CLASS # 75
		HAWA ENGINEERS	AHMEDABAD	A	CI/ CS & FABRICATED UPTO 1200MM, CLASS #150, SS UPTO 250MM, CLASS#150
8	BUTTERFLY VALVES (SIZE UP TO 600 NB & PRESSURE CLASS UP TO 150)	MAIN CONTRACTOR APPROVED SOURCES		A	
9	CASSETTE /SPLIT / WINDOW AC/ PRECISION /PACKAGED AIR CONDITIONER/	MAIN CONTRACTOR APPROVED SOURCES		A	
10	CENTRIFUGAL FAN/AIR BLOWERS/ LOBE TYPE ROTARY BLOWER(< 5KW)	MAIN CONTRACTOR APPROVED SOURCES		A	
11	CENTRIFUGAL FAN (≥ 5KW)	KRUGER VENTILATION INDUSTRIES PTE LTD	SINGAPORE	A	UP TO 150000 CMH
		MARATHON ELECTRIC MOTOR(I) LTD	KOLKATA	A	UP TO 50000 CMH
		HOWDEN SOLYVENT FLAKT INDIA PVT LTD,	CHENNAI	A	UP TO 200000 CMH
		ALMONAROD (P) LIMITED	CHENNAI	A	UP TO 60000 CMH
		PATEL AIRFLOW	VATVA,AHM EDABAD	A	UP TO 250000 CMH
		CB DOCTOR VENTILATOR PVT LTD	AHMEDABAD	A	UP TO 150000 CMH
		WOLTER VENTILATORS INDIA (P) LTD	BHIWADI, DIST-ALWAR	A	UP TO 150000 CMH
		C DOCTOR &CO PVT LTD	SIRAKOLE, 24 PARGANES ( SOUTH)	A	UP TO 250000 CMH
		KRUGER VENTILATION INDUSTRIES (1) PVT LTD	THANE	A	UP TO 90000 CMH
		SOLYVENT FLAKT	KOLKATA	A	UP TO 200000 CMH
ADVANCE VENTILATION PVT LTD	SONEPAT	A	UP TO 200000 CMH		
SK SYSTEMS PVT LTD	SONEPAT, HARYANA	A	UP TO 250000 CMH		
12	CONDENSING UNIT/ PACKAGED COOLING TOWER	MAIN CONTRACTOR APPROVED SOURCES		A	
13	CONVENTIONAL GATE/GLOBE VALVE/ CHECK	LEADER	JALANDHAR	A	CS GATE 600MM CLASS#600,

<b>PROJECT : RGTPP HISAR (2X600 MW)</b> <b>PACKAGE: FGD</b> <b>SUPPLIER :</b> <b>BID DOC. NO:-</b> <b>31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL)</b> <b>SUB SYSTEM: <u>AC &amp; VENTILATION</u></b>			<b>DOC. No.</b>
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	VALVE (SIZE >600 NB OR RATING PR CLASS > 300)				SS GLOBE 600MM CLASS#600, CS CHECK 600MM AND CLASS#600
		HAWA ENGINEERS	AHMEDABAD	A	FCS / FSS 50 NB CLASS 800.
		FOURESS	THANE	A	400NB CLASS 600 AND 50NB CLASS 800.
		BHEL IVP	GOINDWAL	A	GATE UP TO 300 NB CLASS 600. GLOBE 250 NB CLASS 400, CHECK 150NB CLASS 600.
		HITECH ENGG PVT LTD	AHEMDABAD	A	50 NB CLASS 800.
		KSB PUMPS LTD	COIMBATORE	A	300NB CLASS 2500.
		NITON VALVES INDIA PVT LTD	NAVI MUMBAI / AURANGABAD		CS GATE 900 NB CLASS 600, CHECK 300 NB CLASS 600.
		L&T VALVES LIMITED	COIMBATORE		650 MM CLASS 600, 50 NB CLASS 800.
		WEIR BDK	HUBLI	A	CONVENTIONAL CCS GATE / GLOBE / CHECK VALVES UP TO 600MM AND CLASS # 1500, CSS GATE/ GLOBE/ CHECK VALVES UP TO 200MM AND CLASS # 600, FCS GATE / GLOBE / CHECK VALVES UP TO 50MM AND CLASS # 2500.
14	CONVENTIONAL GATE/GLOBE VALVE/ CHECK VALVE (SIZE UP TO 600 NB & RATING PR CLASS UP TO 300)	MAIN CONTRACTOR APPROVED SOURCES		A	
15	FILTERS(PRE/FINE/HEPA)	MAIN CONTRACTOR APPROVED SOURCES		A	
16	FIRE DAMPER (MOTORIZED) WITH SINGLE PHASE ACTUATOR	MAIN CONTRACTOR APPROVED SOURCES		A	
17	FITTINGS- (MS/GI/CS/SS) AND (FORGED/	MAIN CONTRACTOR APPROVED SOURCES		A	

<b>PROJECT : RGTPP HISAR (2X600 MW)</b> <b>PACKAGE: FGD</b> <b>SUPPLIER :</b> <b>BID DOC. NO:-</b> <b>31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL)</b> <b>SUB SYSTEM: <u>AC &amp; VENTILATION</u></b>			DOC. No.
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	FORMED)				
18	GI SHEETS/PVC ELIMINATOR PLATES	MAIN CONTRACTOR APPROVED SOURCES		A	
19	GM GATE / GLOBE/ CHECK VALVES	MAIN CONTRACTOR APPROVED SOURCES		A	
20	HORIZONTAL /VERTICAL CENTRIFUGAL PUMPS	KIRLOSKAR BROS LTD.	KIRLOSKARW ADI	A	
		WILO MATHER & PLATT	PUNE	A	
		WILO MATHER & PLATT	KOLHAPUR	A	
		SAM TURBO	COIMBATORE	A	UP TO 1500 CUM/HR
		FLOWMORE	GHAZIABAD	A	
		BEST AND CROMPTON	CHENNAI	A	
		JYOTI	VADODARA	A	
		WPIL	GHAZIABAD	A	
		KISHORE PUMPS	PUNE	A	UPTO 500M3/HR RUBBERLINED PUMPS ALSO
		GRUNDFOS PUMPS INDIA PVT LTD	CHENNAI	A	HORIZONTAL UP TO 30 KW AND VERTICAL UP TO 45 KW (FOR APPLICATIONS WHERE NPSH IS NOT REQUIRED)
		SINTECH PRECISION	GHAZIABAD	A	HORIZONTAL UP TO 400 KW MOTOR RATING AND VERTICAL UP TO 30 KW MOTOR RATING
		KSB	PUNE	A	
		KSB	NASHIK	A	
	FLOWSERVE INDIA CONTROLS PVT LTD	COIMBATORE	A	HOIZONTAL CENTRIFUGAL PUMP UP TO 75 KW	
	SU MOTOR	MUMBAI	A	HORIZONATL UPTO 500M3/HR RUBBERLINED PUMPS AND VERTICAL CENTRIFUGAL PUMPS UP TO 100CMH	
21	MS PIPE (BLACK/GI) (IS 1239 / IS 3589) ( UPTO 1000 NB)	MAIN CONTRACTOR APPROVED SOURCES		A	(BIS MARKED, MANUFACTURERS WITH VALID BIS LICENSE)

<b>PROJECT : RGTPP HISAR (2X600 MW)</b> <b>PACKAGE: FGD</b> <b>SUPPLIER :</b> <b>BID DOC. NO:-</b> <b>31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL)</b> <b>SUB SYSTEM: <u>AC &amp; VENTILATION</u></b>			<b>DOC. No.</b>
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22	PIPE-CS SEAMLESS ASTM A 106	ISMT	AHMADNAGAR	A	UPTO 150NB &
		ISMT	BARAMATI	A	UPTO 200 NB
		REMI	BHARUCH	A	UPTO 177.8 MM OD, HOT FINISHED
		MAHARASHTRA SEEMLESS	RAIGAD	A	CS SEAMLESS PIPES UPTO 350 NB
23	PIPES & FITTINGS-CI & DI	MAIN CONTRACTOR APPROVED SOURCES			
24	PIPE-SS ASTM A 312 UP TO 100 NB	REMI	TARAPUR	A	ERW UPTO 400 NB
		RATNAMANI	MEHSANA	A	ERW UPTO 500 NB, SEAMLESS UPTO 50 NB ONLY
		RATNAMANI	KUTCH	A	ERW UPTO 400 NB, SEAMLESS UPTO 50 NB ONLY, ARC WELDED UP TO 450NB
		SUMITOMO	JAPAN	A	
		SOSTA	GERMANY	A	
		OUTO KOMPU	SWEDEN	A	
		PRAKASH STEELAGE	VALSAD	A	ONLY FOR SEAMLESS UPTO 50NB AND ERW UP TO 400NB
		BHANDARI FOILS & TUBES LIMITED	DEWAS	A	ERW UP TO 300NB
		APEX	BEHRORE	A	ERW UPTO 400 NB, SEAMLESS UPTO 50 NB.
25	PIPING FABRICATION AND FABRICATED FITTINGS-LP UP TO 300PSI	MAIN CONTRACTOR APPROVED SOURCES			A
26	PRDS SYSTEM	MAZDA	AHMEDABAD	A	
		FORBES MARSHALL	PUNE	A	
27	SCREW CHILLER	YORK INTERNATIONAL	TEXAS,USA	A	
		CARRIER ASIA LTD	SANGHAI,CHI	A	

<b>PROJECT : RGTPP HISAR (2X600 MW)</b> <b>PACKAGE: FGD</b> <b>SUPPLIER :</b> <b>BID DOC. NO:-</b> <b>31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL)</b> <b>SUB SYSTEM: <u>AC &amp; VENTILATION</u></b>			<b>DOC. No.</b>
					<b>Revision No. : 00</b>
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<b>SN</b>	<b>ITEM</b>	<b>ACCEPTABLE SUPPLIER AS PER DATA BASE</b>	<b>PLACE</b>	<b>SUB-SUPPLIER APPROVAL STATUS</b>	<b>REMARKS</b>

		KIRLOSKAR CHILLER	NA SASWAD, TALUKA- PURANDER, PUNE	A	
		DUNHAM-BUSH INDUSTRIES SPN BHD	MALAYSIA	A	
		BLUE STAR ( COMPRESSOR FROM HANBEL-TAIWAN)	WADA	A	
		TRANE COMPANY	COLORADO USA	A	
28	STRAINERS/NOZZLES	MAIN CONTRACTOR APPROVED SOURCES		A	
29	THERMAL INSULATION, ROCKWOOL/GLASS WOOL, NITRILE RUBBER	MAIN CONTRACTOR APPROVED SOURCES		A	
30	VALVES-2/3 WAY MIXING VALVES	MAIN CONTRACTOR APPROVED SOURCES		A	
31	FQP RECEIPT INSPECTION & ERECTION	MAIN CONTRACTOR			

NOTE: VENDOR CONTROL MAY BE REVISED BASED ON OWNER'S INPUT/REQUIREMENT.

LEGENDS:

**SUB-SUPPLIERSTATUS CATEGORY**

A – INDICATES ACCEPTABLE SUB-SUPPLIERS TO NTPC ALONG WITH CONDITION OF APPROVAL, IF ANY.

OWNER

QA&I CONSULTANT

MAIN CONTRACTOR




SUB-SECTION-V-QM5


COMPRESSOR AIR SYSTEM

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



CLAUSE NO.	 <b>QUALITY ASSURANCE</b>				
<p><b>1.00.00</b></p> <p>1.01.00</p> <p>1.01.01</p> <p>1.02.00</p>	<p><b><u>AIR COMPRESSOR SYSTEM</u></b></p> <p><b>AIR COMPRESSORS:</b></p> <p>a) All pressure parts shall be hydraulically tested at not less than 150% of design pressure prior to painting and lining, if applicable. The test pressure will be maintained for 30 minutes.</p> <p>b) All other parts including inter-connecting piping shall be hydraulically tested wherever possible, as per relevant codes.</p> <p>c) Ultrasonic testing shall be carried out on all forgings and shafts (if dia.&gt; 40mm). MPI/DP test will be done on machined areas of the above components.</p> <p>e. Rotor shall be statically and dynamically balanced.</p> <p><b>PERFORMANCE TEST (SHOP TEST) :</b></p> <p>a) Performance test on the compressors shall be carried out in accordance relevant standard. The test shall also include demonstration of loading and unloading mechanism (Capacity control) and operation of safety valves.</p> <p>b) Power consumption at motor input terminal at rated capacity as well as at fully unloaded condition of all the compressor shall be measured.</p> <p>c) Vibration and noise level measurement will be done during shop performance test.</p> <p>d) Test shall be carried out on all compressors with contract drive motor where power consumption for compressors has been indicated as a guaranteed parameter</p> <p><b>AIR RECEIVER, HEAT EXCHANGERS, MOISTURE SEPERATORS, AIR DRYING PLANT:</b></p> <p>a) Each finished vessel shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes.</p> <p>b) NDT on weld joints shall be as per respective code requirements or the minimum as specified below:</p> <p>(i) 100 % DPT on root run of butt welds.</p> <p>(ii) 100% DPT on all finished butt welds and fillet welds</p> <p>(iii) 10% RT on butt welds which shall include all T- joints.</p> <p>c) Tube to Tube sheet joint of the heat exchangers shall be subject to Mock-up test as per the relevant standards.</p>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO: 31/CE/PLG/RGTPP/FGD-250</p>	<p>SUB-SECTION -V- QM5 COMPRESSED AIR SYSTEM</p>	<p>Page 1 of 2</p>

CLAUSE NO.	 <b>QUALITY ASSURANCE</b>		
1.04.00	<p>d) Reactivation blowers shall be tested for FAD, temp. rise noise &amp; vibration. Rotating parts shall be dynamically balanced.</p> <p>e) Completely assembled ADP shall be pneumatically tested at design pressure for a duration of 5 minutes. Functional and sequential operation testing of the completely assembled ADP shall be demonstrated at shop. Other accessories shall be tested as per relevant code and sections. Dew point measurement shall be done.</p> <p><b>E.O.T. CRANE:</b></p> <p>a) Chain pulley Blocks shall be tested as per IS: 3832.</p> <p>b) Following NDT requirements shall be met:</p> <p>(i) 100% RT of Butt welds in tension and 10% RT of butt welds in compression.</p> <p>(ii) DP at random on all weldments.</p> <p>Deflection, load, overload &amp; travel check on HOT crane assembly Shall be carried out as per IS: 3177.</p>		
1.05.00	<p><b>PIPINGS, VALVES, AND FITTINGS</b></p> <p>a. All pipes and fittings shall be tested as per applicable code.</p> <p>b. All valves shall be hydraulically tested for body, seat and back-seat (if applicable) as per relevant standard. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.</p> <p>c. Valves shall be offered for hydro test in unpainted condition.</p> <p>d. Functional checks of the valves for smooth opening and closing shall also be done.</p> <p>All bar stocks/ forgings, dia <math>\geq</math> 40 mm shall be Ultrasonic Tested irrespective of the type, size &amp; rating of the valve.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO: 31/CE/PLG/RGTPP/FGD-250</b>	<b>SUB-SECTION -V- QM5 COMPRESSED AIR SYSTEM</b>	<b>Page 2 of 2</b>

<b>PROJECT : RGTPP HISAR (2X600 MW)PACKAGE: FGD SUPPLIER : BID DOC. NO:- 31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL) SUB SYSTEM: <u>COMPRSED AIR SYSTEM</u></b>			DOC. No.
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1	AIR DRYER	SUMMITS HIGRONICS(I) LTD	COIMBATORE	A	
		ATLAS COPCO	BELGIUM	A	
		MELLCON ENGRS PVT LTD	GR NOIDA	A	
		DELAIR INDIA LTD	GURGAON	A	
		TRIDENT PNEUMATIC PVT LTD	COIMBATORE	A	
2	AIR RECEIVER(<10 BAR PRESSURE)	MAIN CONTRACTOR APPROVED SOURCES		A	
3	AIR /PRESSURE RELEASE/SAFETY/VACUUM RELIEF VALVE/FLOAT VALVE	MAIN CONTRACTOR APPROVED SOURCES		A	
4	BALANCING VALVES	MAIN CONTRACTOR APPROVED SOURCES		A	
5	BALL VALVE/PLUG VALVE-CCS/ CSS UP TO 100 MM & CLASS 800	MAIN CONTRACTOR APPROVED SOURCES		A	
6	BALL VALVE/PLUG VALVE-CCS/ CSS >100 MM OR CLASS >800	WEIR BDK	HUBLI	A	SS BALL VALVES UP TO 500MM AND CLASS #600, CS BALL VALVES UP TO 250 MM AND CLASS# 900, CS/ SS BALL VALVES UP TO 100 MM AND CLASS # 1500.
		MICRO FINISH VALVES PVT. LTD.	HUBLI	A	400NB CLASS#600 AND UP TO 600NB CLASS#300
		FLOW CHEM INDUSTRIES	KALOL	A	100NB CLASS#600,200NB CLASS#300, 50 NB CLASS#800
		L&T VALVES LIMITED	COIMBATORE	A	UPTO 150NB, CLASS #150/300, AND UPTO 50NB, CLASS #800
		PRECISION ENGG CO VALVES PVT LTD	NASIK		FCS UP TO 50NB CLASS 800, CCS UP TO 400NB CLASS 150.
		BELGAUM AQUA VALVE PVT LTD	BELGAON		FCS UP TO 50NB CLASS 800, CCS UP TO 200NB CLASS 150.
		G M ENGINEERING PRIVATE LTD	RAJKOT	A	UP TO 400 NB AND CLASS #600
7	BUTTERFLY VALVES (SIZE > 600 NB OR PRESSURE CLASS >150)	INTERVALVE POONAWALA LTD	PUNE	A	SGI / CI / D2 1400MM PN10, SGI / CI 1000MM PN16,CS/SS 500MM PN16, SS 400MM

<b>PROJECT : RGTPP HISAR (2X600 MW)PACKAGE: FGD SUPPLIER : BID DOC. NO:- 31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL) SUB SYSTEM: <u>COMPRSED AIR SYSTEM</u></b>			DOC. No.
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					CLASS#300, MS FABRICATED UPTO 2800NB, PN 6
		WEIR BDK	HUBLI	A	CI/ DI BUTTERFLY VALVE UP TO 1000MM AND PN16 AND UP TO 1800MM AND PN10,CCS UP TO 1050MM CLASS 150 AND UP TO 1800MM AND PN16 SS - UP TO 400NB PN-16 ,FABRICATED 800MM CLASS#150.
		PENTAIR VALVES	HALOL	A	FOR SS UP TO 500 NB PN-10, CI- UP TO 900NB PN-10, UP TO 500NB PN-16, 450MM CLASS#300, MS FABRICATED UPTO 2800NB, PN6.
		FOURES S ENGINEERING (INDIA) LIMITED	BANGALORE	A	CAST SGI/CI/ MS FABRICATED- UP TO 1200 PN-10, UP TO 350 PN-16 ,2400 MM PN6/CLASS150 SS - UP TO 300NB PN-10, MS FABRICATED UPTO 2700NB CLASS # 75
		KBL	KONDHAPURI	A	CAST SGI/CI/CS 1400 MM PN16 , SS 300 MM PN16 , 1800MM CLASS 150, MS FABRICATED 900 NB PN40,2800NB, PN6.
		R & D MULTIPLE	VALSAD	A	CAST SGI/CI/MS FABRICATED- UP TO 1800 MM PN-10/CLASS # 75, ,1100MM PN25,1400MM CLASS#150 , MS FABRICATED UPTO 2800NB CLASS # 75

<b>PROJECT : RGTPP HISAR (2X600 MW)PACKAGE: FGD SUPPLIER : BID DOC. NO:- 31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL) SUB SYSTEM: <u>COMPRSED AIR SYSTEM</u></b>			<b>DOC. No.</b>
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		ADVANCE	GREATER NOIDA	A	METAL SEATED, TRIPLE ECCENTRIC, SS BFV OF SIZE UPTO 100NB, AND PRESSURE RATING UPTO CLASS #300.
		BRAY CONTROLS (ZHEJIANG) CO. LTD	CHINA	A	UP TO 400 NB CLASS#600
		INSTRUMENTATION LTD.	PALAKKAD	A	UPTO 2200NB CLASS # 75
		HAWA ENGINEERS	AHMEDABAD	A	CI/ CS & FABRICATED UPTO 1200MM, CLASS #150, SS UPTO 250MM, CLASS#150
8	BUTTERFLY VALVES (SIZE UP TO 600 NB & PRESSURE CLASS UP TO 150)	MAIN CONTRACTOR APPROVED SOURCES		A	
9	CONVENTIONAL GATE/GLOBE VALVE/ CHECK VALVE (SIZE >600 NB OR RATING PR CLASS > 300)	LEADER	JALANDHAR	A	CS GATE 600MM CLASS#600, SS GLOBE 600MM CLASS#600, CS CHECK 600MM AND CLASS#600
		HAWA ENGINEERS	AHMEDABAD	A	FCS / FSS 50 NB CLASS 800.
		FOURESS	THANE	A	400NB CLASS 600 AND 50NB CLASS 800.
		BHEL IVP	GOINDWAL	A	GATE UP TO 300 NB CLASS 600. GLOBE 250 NB CLASS 400, CHECK 150NB CL 600.
		HITECH ENGG PVT LTD	AHEMDABAD	A	50 NB CLASS 800.
		KSB PUMPS LTD	COIMBATORE	A	300NB CLASS 2500.
		NITON VALVES INDIA PVT LTD	NAVI MUMBAI / AURANGABAD		CS GATE 900 NB CLASS 600, CHECK 300 NB CLASS 600.
		L&T VALVES LIMITED	COIMBATORE	A	650 MM CLASS 600, 50 NB CLASS 800.
		WEIR BDK	HUBLI	A	CONVENTIONAL CCS GATE / GLOBE / CHECK VALVES UP TO 600MM AND CLASS # 1500, CSS GATE/ GLOBE/ CHECK VALVES UP TO

<b>PROJECT : RGTPP HISAR (2X600 MW)PACKAGE: FGD SUPPLIER : BID DOC. NO:- 31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL) SUB SYSTEM: <u>COMPRSED AIR SYSTEM</u></b>			DOC. No.
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					200MM AND CLASS # 600, FCS GATE / GLOBE / CHECK VALVES UP TO 50MM AND CLASS # 2500.
10	CONVENTIONAL GATE/GLOBE VALVE/ CHECK VALVE (SIZE UP TO 600 NB & RATING PR CLASS UP TO 300)	MAIN CONTRACTOR APPROVED SOURCES		A	
11	CHAIN PULLEY BLOCK (> 5 TON & MAX UP TO 10 TON)	TRACTEL TIRFOR	KALYANI	A	
		LIFTING EQUIPMENT	DELHI	A	
		ARMSELL	BANGALORE	A	
		CENTURY CRANE ENGINEERS PVT. LTD	BALLABHGAR H	A	UP TO 7.5 T CAPACITY
12	ELECTRIC HOIST/EOT CRANE (> 5 TON & MAX UP TO 25 TON)	HERCULES HOIST	RAIGAD	A	
		REVA INDUSTRIES	FARIDABAD	A	
		EDDY CRANE	PUNE	A	UPTO 10 TON
		CONSOLIDATED HOIST	SATARA /PUNE *	A	*PUNE FOR ELECTRIC HOIST UPTO 15 TONS
		ELECTROTHERAPHY	RISHRA	A	UPTO 15 TON FOR ELECTRIC HOIST ONLY
		HERCULES HOIST	RAIGAD	A	UPTO 15 TON FOR ELECTRIC HOIST ONLY
		PRAYAS ENGG (PBL)	V V NAGAR	A	UPTO 22 TON FOR ELECTRIC HOIST ONLY
		ALPHA SERVICES	ALWAR	A	SINGLE GIRDER EOT CRANE & ELECTRIC HOIST UPTO 15 TON ONLY. GEARBOX FROM NTPC APPROVED SOURCES FOR EOT CRANE.
		CENTURY CRANE ENGINEERS PVT. LTD	BALLABHGAR H	A	
ARMSEL	BANGALORE	A	UPTO 10 TON EOT & UPTO 15 T ELECTRIC HOIST		
	TRACTEL TIRFOR	PALWAL	A	UPTO 15 TON FOR ELECTRIC HOIST AND UPTO 10 TON	

<b>PROJECT : RGTPP HISAR (2X600 MW)PACKAGE: FGD SUPPLIER : BID DOC. NO:- 31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL) SUB SYSTEM: <u>COMPRSED AIR SYSTEM</u></b>			DOC. No.
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		MILLARS INDIA	KARAMSAD	A	FOR EOT
		AVON CRANES	GURGAON	A	
		GRIP ENGINEERS	AHMEDABAD	A	UPTO 20 TON FOR ELECTRIC HOIST ONLY
		GRIP ENGINEERS	HYDERABAD	A	GEARBOX FROM OWNER APPROVED SOURCES FOR EOT CRANE.
13	ELECTRIC HOIST/EOT CRANE/CHAIN PULLEY BLOCK (UP TO 5 TON)	MAIN CONTRACTOR APPROVED SOURCES		A	
14	FASTENERS	MAIN CONTRACTOR APPROVED SOURCES		A	
15	FITTINGS- (MS/GI/CS/SS) & (FORGED/ FORMED)	MAIN CONTRACTOR APPROVED SOURCES		A	
16	FILTERS/COOLERS/DE-HUMIDIFIER /ABSORBER VESSEL	MAIN CONTRACTOR APPROVED SOURCES		A	
17	GM GATE / GLOBE/ CHECK VALVES	MAIN CONTRACTOR APPROVED SOURCES		A	
18	MS PIPE (BLACK/GI) (IS 1239 / IS 3589) ( UPTO 1000 NB)	MAIN CONTRACTOR APPROVED SOURCES		A	(BIS MARKED, MANUFACTURERS WITH VALID BIS LICENSE)
19	OIL FREE COMPRESSOR	ELGI EQUIPMENTS	COIMBATORE	A	UP TO 74M3/MINUTE ( AIR ENDS FROM HITACHI JAPAN), 45 M3/MINUTE FORM OWN
		ATLAS COPCO	PUNE.( (SCREW ASSEMBLY FROM ATLOS COPCO , BELGIUM)	A	UP TOZR 630-MODEL CAPACITY 75 NM3/MINUTE
		INGERSOLL RAND	AHEMDABAD	A	UP TO 36 M3/MINUTE
20	PIPE-CS SEAMLESS ASTM A 106	ISMT	AHMADNAGAR	A	UPTO 150NB &
		ISMT	BARAMATI	A	UPTO 200 NB
		REMI	BHARUCH	A	UPTO 177.8 MM OD, HOT FINISHED
		MAHARASHTRA SEEMLESS	RAIGAD	A	CS SEAMLESS PIPES UPTO 350 NB

<b>PROJECT : RGTPP HISAR (2X600 MW)PACKAGE: FGD SUPPLIER : BID DOC. NO:- 31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL) SUB SYSTEM: <u>COMPRSED AIR SYSTEM</u></b>			DOC. No.
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21	PIPES & FITTINGS-CI	MAIN CONTRACTOR APPROVED SOURCES		A	
22	PIPE-SS ASTM A 312 UP TO 100 NB	REMI	TARAPUR	A	ERW UPTO 400 NB
		RATNAMANI	MEHSANA	A	ERW UPTO 500 NB, SEAMLESS UPTO 50 NB ONLY
		RATNAMANI	KUTCH	A	ERW UPTO 400 NB, SEAMLESS UPTO 50 NB ONLY, ARC WELDED UP TO 450NB
		SUMITOMO	JAPAN	A	
		SOSTA	GERMANY	A	
		OUTO KOMPU	SWEDEN	A	
		PRAKASH STEELAGE	VALSAD	A	ONLY FOR SEAMLESS UPTO 50NB AND ERW UP TO 400NB
		BHANDARI FOILS & TUBES LIMITED	DEWAS	A	ERW UP TO 300NB
		APEX	BEHRORE	A	ERW UPTO 400 NB, SEAMLESS UPTO 50 NB.
23	PIPING FABRICATION AND FABRICATED FITTINGS-LP UP TO 300PSI	MAIN CONTRACTOR APPROVED SOURCES		A	
24	THERMAL INSULATION, ROCKWOOL/GLASS WOOL, NITRILE RUBBER	MAIN CONTRACTOR APPROVED SOURCES		A	
25	FQP RECEIPT INSPECTION & ERECTION	MAIN CONTRACTOR			

NOTE: VENDOR CONTROL MAY BE REVISED BASED ON OWNER'S INPUT/REQUIREMENT.

#### SUB-SUPPLIERSTATUS CATEGORY

A – INDICATES ACCEPTABLE SUB-SUPPLIERS TO NTPC ALONG WITH CONDITION OF APPROVAL, IF ANY.



<b>PROJECT : RGTPP HISAR (2X600 MW)PACKAGE: FGD SUPPLIER : BID DOC. NO:- 31/CE/PLG/RGTPP/FGD-250</b>		<b>INDICATIVE VENDOR LIST(MECHANICAL) SUB SYSTEM: <u>COMPRSED AIR SYSTEM</u></b>			DOC. No.
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OWNER

QA& CONSULTANT

MAIN CONTRACTOR



(ELECTRICAL)

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



## SUB-SECTION-V-QE1

### MOTORS

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



**MOTOR**

TESTS/CHECKS TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating Physical Inspection /General	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS 2148/IEC60034/IEC 60079-I/ IS-12615	vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y				Y										
Shaft	Y	Y	Y	Y	Y	Y			Y										
Magnetic Material	Y	Y	Y	Y			Y			Y		Y							
Rotor Copper/Aluminium	Y	Y	Y	Y			Y		Y										
Stator copper	Y	Y	Y	Y			Y		Y			Y							
SC Ring	Y	Y	Y	Y	Y		Y	Y	Y										
Insulating Material	Y		Y	Y			Y					Y							
Tubes, for Cooler	Y	Y	Y	Y	Y				Y		Y								
Sleeve Bearing	Y	Y	Y	Y	Y				Y		Y								
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y											
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y											
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y			Y	Y										

CLAUSE NO.



QUALITY ASSURANCE

Wound stator	Y	Y					Y	Y											
Wound Exciter	Y	Y					Y	Y											
Rotor complete	Y	Y					Y						Y	Y					
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y												
Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y																
Complete Motor	Y	Y	Y												Y	Y	Y	Y1	Y

**Note:** 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalization. However, No QP for LT motor upto 50KW.  
 2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard  
 3. Makes of major bought out items for HT motors will be subject to HPGCL/Consultant approval.  
 4. Y1 = for HT Motor / Machines only.



## SUB-SECTION-V-QE2

# MEDIUM VOLTAGE BUS DUCTS

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



**Medium Voltage BUS DUCT**

Attributes / Characteristics  Items/Components Sub Systems	Visual & Dimensional Checks	Electrical / Mechanical / Chemical Properties	WPS & PQR	NDT (RT / DP / MPI / UT)	Painting Quality & Adhesion Test	Galvanising Test as per IS: 2629 / 2633 / 6745	Electrical clearance & Creepage distance	Functional/Operational check	Make / Type Rating / Model / TC / Embossing/Printing of make & batch /General Physical Inspection	Trial Assembly at works.	Routine Test as per relevant standard / Specification
Enclosure / Cubicle	Y	Y		Y	Y		Y				Y
Bus bar Conductor / Flexible Connector & Dis-connector Link	Y	Y		Y							
Galvanised Steel Structure & Plate (Steel as per IS:2062)	Y					Y					
Epoxy / Seal-off Bushing & Epoxy / Porcelain Post / Support Insulator	Y	Y					Y	Y			Y
Welding of enclosure & conductor	Y		Y	Y							
Gasket, Silica gel Breather, Elastomer Spring Head		Y						Y	Y		
Complete Bus Duct & Cubicles IS:8084	Y				Y		Y			Y	Y

**Note:**

- 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
- 2) All major Bought Out Items will be subject to HPGCL/Consultant approval.



SUB-SECTION-V-QE3

LT POWER CABLES

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**





LT Power Cables

Attributes / Characteristics  Item / Components / Sub System Assembly	Make, Type & T.C as per relevant standard	Dimension/surface finish	Mechanical properties	Chemical Composition	Spark Test(as applicable)	Electrical properties	Hot Set Test/ Eccentricity & Ovality	Lay length & Sequence	Armour coverage, cross over, looseness, gap between two wires	Sequential marking/ Batch marking/ surface finish/ cable length	T.S & elongation before & after ageing on outer sheath & insulation	Thermal stability	Anti termite coating on wooden drums	Constructional requirements feature as per Technical specification	Routine & Acceptance Tests as per relevant standard & specification	FRLS Tests
Aluminum (IS-8130)	Y	Y	Y	Y		Y										
XLPE Compound (IS-7098)	Y		Y			Y	Y				Y					
PVC insulation Compound (IS: 5831)	Y		Y			Y					Y	Y				
FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810( Part 58), IEC-60754 Part-1)	Y		Y								Y	Y				Y
Extrusion & curing /Manufacturing of Core ( PVC / XLPE)		Y			Y	Y						Y				
Core Laying							Y									
Armour wire/strip	Y	Y	Y													
Inner sheath	Y	Y														
Armouring		Y						Y								
Outer Sheathing		Y								Y						
<b>Power Cable (Finished)</b> (IS-5831, ASTM-D2843, IS10810( Part 58), IEC-60754 Part-1, IEC 60332 part III cat B)							Y	Y		Y	Y	Y		Y	Y	Y
Wooden drum(IS-10418) /Steel Drum		Y											Y	Y		

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought out items will be subject to HPGCL/Consultant approval.



<b>ROUTINE TESTS</b>	<b>Following routine tests shall be carried out on each drum of finished cables for all types (PVC / XLPE insulated) &amp; sizes.</b>	
1)	Conductor Resistance test	
2)	High voltage test	
<b>ACCEPTANCE TESTS</b>	<b>Following Acceptance tests shall be carried out on each size of each type (PVC / XLPE insulated) of cables, in the offered lot.</b>	
<b>A) For Conductor (as per sampling plan mentioned in IS: 1554 / 7098)</b>		
	1)	Annealing test (Copper)
	2)	Tensile Test ( Aluminum)
	3)	Wrapping Test ( Aluminum)
	4)	Resistance test
<b>B) For Armour Wires / Formed Wires ( If applicable ) (as per sampling plan mentioned in IS: 1554 / 7098)</b>		
	1.	Measurement of Dimensions
	2.	Tensile Tests
	3.	Elongation Test
	4.	Torsion Test For Round wires only
	5.	Wrapping Test
	6.	Resistance Test
	7.	Mass of Zinc coating test For G S wires / Formed wires only
	8.	Uniformity of Zinc coating For G S wires / Formed wires only
	9.	Adhesion test For G S wires / Formed wires only
	10.	Freedom from surface defects
<b>C ) For PVC / XLPE insulation &amp; PVC Sheath (as per sampling plan mentioned in IS: 1554 / 7098)</b>		
	1)	Test for thickness
	2)	Tensile strength & Elongation before ageing (for tests after ageing see "D")
	3)	Hot set test (For XLPE insulation)



<b>D) Ageing test:</b>				
	<b>Criteria</b>	<b>Condition</b>	<b>Test Requirements</b>	<b>Remarks</b>
<b>PVC insulation &amp; outer sheath:</b>	Samples as per relevant IS, from each size of cables in the offered lot, shall be tested for tensile strength & elongation (before ageing). <b>Tensile &amp; elongation testing shall preferably be done with a computerized machine.</b> The values will be compared with corresponding values mentioned in the Type Test report accepted by HPGCL/Consultant. These values of Tensile Strength & Elongation (before ageing) should be within +/- 15% of the corresponding values of Type Test report. (Please note that test values should be more than the minimum values indicated in relevant standard).	All sizes which meet the criteria	The size which has maximum negative deviation from type test report values will be put on accelerated ageing test. The samples shall be aged in air oven at temperature of 130°C +/- 2°C for 5 hours and tested for TS & elongation. Acceptance norms shall be as per IS.	In case the size does not meet the requirement in accelerated ageing test <b>then all sizes (which had met the criteria) will be put on ageing test as per IS.</b>
		Sizes which do not meet the criteria	Every size will be put on ageing test as per IS.	----
<b>XLPE insulation</b>	Samples as per relevant IS, from each size of cables in the offered lot, will be put on ageing test as per IS.			

**E) Following tests will be carried out on completed cables as per IS on each size of each type (PVC / XLPE insulated)**

	1)	Insulation resistance test ( Volume resistivity method )
	2)	High voltage test

**F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes & types)**

	1)	Thermal stability test on PVC insulation and outer sheath
	2)	Oxygen index test on outer sheath



	3)	Smoke density rating test on outer sheath
	4)	Acid gas generation test on outer sheath
<b>G) Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cables as per following sampling plan:</b>		
		<p>This test will be carried out using composite sampling i.e. irrespective of size; cables of one particular type (i.e. armoured PVC insulated, unarmoured PVC insulated, armoured XLPE insulated, unarmoured XLPE insulated) will be bunched together, as per calculations in line with the IEC. All sizes of PVC &amp; XLPE insulated, armoured &amp; unarmoured cables shall be covered.</p> <p>For one particular type, cables with OD less than or equal to 30 mm shall be clubbed together in touching formation while cables with OD greater than 30 mm shall be clubbed together leaving a gap equal to OD of cable having least diameter. Cable OD shall be taken as nominal overall diameter as per bidding documents.</p>
<b>H) Following tests shall be carried on one length of each size of each type (PVC / XLPE insulated) of offered lot:</b>		
	1)	Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, drum / Batch (outer sheath extrusion batch )number marking on sheath
	2)	Measurement of Eccentricity & Ovality



SUB-SECTION-V-QE4

CONTROL CABLES

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



Control Cables

Attributes / Characteristics  Item / Components / Sub System Assembly	Make, Type & T.C as per relevant standard	Dimension/surface finish	Mechanical properties	Chemical Composition	Spark Test(as applicable)	Electrical properties	Lay length & Sequence	Armour coverage, cross over, looseness, gap between two wires	Sequential marking/ Batch marking/ surface finish/ cable length	T.S & elongation before & after ageing on outer sheath & insulation	Thermal stability	Anti termite coating on wooden drums	Constructional requirements as per Tech specification	Routine & Acceptance Tests as per relevant standard & specification	FRLS Tests
Copper (IS-8130)	Y	Y	Y	Y		Y									
PVC insulation Compound (IS: 5831)	Y		Y			Y			Y	Y					
FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810( Part 58), IEC-60754 Part-1)	Y		Y						Y	Y					Y
Extrusion & curing /Manufacturing of Core		Y			Y					Y					
Core Laying						Y									
Armour wire/strip	Y	Y	Y												
Inner sheath	Y	Y													
Armouring		Y					Y								
Outer Sheathing		Y						Y							
<b>Finished Cable</b> (IS-5831, ASTM-D2843, IS10810( Part 58), IEC-60754 Part-1, IEC 60332 part III cat B)						Y	Y	Y	Y	Y		Y	Y	Y	Y
Wooden drum(IS-10418) /Steel Drum		Y										Y	Y		

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought out items will be subject to HPGCL/Consultant approval.



<b>ROUTINE TESTS</b>	<b>Following routine tests shall be carried out on each drum of finished cables for all sizes.</b>	
1)	Conductor Resistance test	
2)	High voltage test	
<b>ACCEPTANCE TESTS</b>	<b>Following Acceptance tests shall be carried out on each size of cables, in the offered lot.</b>	
<b>A) For Conductor (as per sampling plan mentioned in IS: 1554)</b>		
	1)	Annealing test (Copper)
	2)	Resistance test
<b>B) For Armour Wires / Formed Wires ( If applicable ) (as per sampling plan mentioned in IS: 1554)</b>		
	1.	Measurement of Dimensions
	2.	Tensile Tests
	3.	Elongation Test
	4.	Torsion Test For Round wires only
	5.	Wrapping Test
	6.	Resistance Test
	7.	Mass of Zinc coating test For G S wires / Formed wires only
	8.	Uniformity of Zinc coating For G S wires / Formed wires only
	9.	Adhesion test For G S wires / Formed wires only
	10.	Freedom from surface defects
<b>C) For PVC insulation &amp; PVC Sheath (as per sampling plan mentioned in IS: 1554)</b>		
	1)	Test for thickness
	2)	Tensile strength & Elongation before ageing (for tests after ageing see "D")



**D) Ageing test:**

	Criteria	Condition	Test Requirements	Remarks
<b>PVC insulation &amp; outer sheath:</b>	Samples as per relevant IS, from each size of cables in the offered lot, shall be tested for tensile strength & elongation (before ageing). <b>Tensile &amp; elongation testing shall preferably be done with a computerized machine.</b> The values will be compared with corresponding values mentioned in the Type Test report accepted by HPGCL/ Consultant. These values of Tensile Strength & Elongation (before ageing) should be within +/- 15% of the corresponding values of Type Test report. (Please note that test values should be more than the minimum values indicated in relevant standard).	All sizes which meet the criteria	The size which has maximum negative deviation from type test report values will be put on accelerated ageing test. The samples shall be aged in air oven at temperature of 130°C +/- 2°C for 5 hours and tested for TS & elongation. Acceptance norms shall be as per IS.	In case the size does not meet the requirement in accelerated ageing test <b>then all sizes (which had met the criteria) will be put on ageing test as per IS.</b>
		Sizes which do not meet the criteria	Every size will be put on ageing test as per IS.	----

**E) Following tests will be carried out on completed cables as per IS on each size:**

	1)	Insulation resistance test ( Volume resistivity method )
	2)	High voltage test

**F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes):**

	1)	Thermal stability test on PVC insulation and outer sheath
	2)	Oxygen index test on outer sheath
	3)	Smoke density rating test on outer sheath
	4)	Acid gas generation test on outer sheath

**G) Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cable will be carried out as per following sampling plan:**

		This test will be carried out using composite sampling i.e. irrespective of size; cables of one particular type (i.e. armoured, unarmoured) will be bunched together, as per calculations in
--	--	--





		line with the IEC. All sizes of armoured & unarmoured cables shall be covered.
<b>H) Following tests shall be carried on one length of each size (armoured &amp; unarmoured) of offered lot:</b>		
	1)	Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, drum / outer sheath extrusion's batch number marking
	2)	Measurement of Eccentricity & Ovality



SUB-SECTION-V-QE5

CABLING EARTHING & LIGHTNING PROTECTION

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



**CABLING, EARTHING, LIGHTNING PROTECTION**

ATTRIBUTES / CHARACTERISTICS  ITEMS/COMPONENTS / SUB SYSTEMS	Dimension	Paint shade, paint thickness, adhesion	Pre-treatment of sheet	IP protection	Proof load*	Surface finish	Deflection test*	HV & IR	Galvanise Test (If Applicable)	Functional	Bought out items/Bill of material	Routine tests as per relevant standard & specification	Acceptance tests as per relevant standard & specification	Constructional feature as per Tech specification
Wall Mounted-Lighting Panel (IS-513, IS:5, IS:2629, 2633, 6745)	Y	Y	Y	Y		Y		Y		Y	Y	Y	Y	Y
Switch box/junction box/ Receptacles Panel (IS-513, IS:5, IS:2629, 2633, 6745)	Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y
Cable glands(BS-6121)	Y													Y
Cable lug	Y													Y
Lighting wire (IS-694)	Y											Y		
Flexible conduits	Y											Y		Y
Conduits (Galvanise & Epoxy) IS-9537 & IS-2629, 2633, 6745	Y		Y						Y			Y		Y
RCC Hume Pipe (IS-458)												Y		
Cable termination & straight through joint (IS 13573)	Y											Y		Y
Cable Trays, bends, tees, crosses, Flexible supports system & accessories IS-513, 2629,2633,6745	Y		Y		Y	Y	Y		Y			Y	Y	Y
Trefoil clamp	Y													Y
GI flats for earthing & lighting protection (IS 2062, 2629, 6745,2633)	Y		Y						Y			Y		Y
GI wire (IS-280)	Y											Y		
Fire Sealing System ( BS -476)												Y	Y	Y

.Note:1.This is an indicative list of tests /checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.  
 2.\* Deflection Test on cable trays and Proof Load test on cable trays support system will be as per details given in the technical specification & approved MQP. The above acceptance tests shall be done only on one sample from each size of offered lot. This test is not applicable on bends, tees & crosses.  
 3. Make of all items will be subject to HPGCL/Consultant approval.



## SUB-SECTION-V-QE6

### HT CABLES

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



MV (3.3 kV / 6.6. kV / 11 kV / 33 kV) Cables

Attributes / Characteristics  Item / Components / Sub System Assembly	Make, Type & T.C as per relevant standard	Dimension/surface finish	Mechanical properties	Chemical Composition	Spark Test(as applicable)	Electrical properties	Hot Set Test/ Eccentricity & Ovality	Lay length & Sequence	Armour coverage, cross over, looseness, gap between two wires	Sequential marking/ Batch marking/ surface finish/ cable length	T.S & elongation before & after ageing on outer sheath &	Thermal stability on outer sheath	Metallic ( Cu ) Screening ( If applicable)	Anti termite coating on wooden drums	Constructional requirements feature as per Tech specification	Routine & Acceptance Test as per relevant standard & specification	FRLS Test	
Aluminum (IS-8130)	Y	Y	Y	Y		Y												
Semiconducting Compound	Y		Y			Y												
XLPE Compound (IS-7098 Part-II)	Y		Y			Y					Y							
FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810( Part 58) ,IEC-60754 Part-1)	Y		Y								Y	Y						Y
Triple Extrusion & curing /Manufacturing of Core		Y			Y	Y												
Copper Tape	Y	Y	Y			Y												
Polyster tape	Y	Y																
Core Laying								Y										
Armour wire/strip	Y	Y	Y															
Copper tapping	Y	Y											Y					
Inner sheath	Y	Y																
Armouring		Y						Y										
Outer Sheathing		Y								Y								
<b>Power Cable (Finished)</b>								Y	Y	Y	Y	Y			Y	Y	Y	Y
Wooden drum(IS-10418) /Steel Drum		Y												Y	Y			

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.



2. Make of all major Bought out items will be subject to HPGCL/Consultant approval.

<b>ROUTINE TESTS</b>	<b>Following routine tests shall be carried out on each drum of finished cables for all types &amp; sizes.</b>	
1)	Conductor Resistance test	
2)	High voltage test	
3)	Partial discharge test <b>(for Screened cables only)</b>	
<b>ACCEPTANCE TESTS</b>	<b>Following Acceptance tests shall be carried out on each size of each type (voltage rating) of cables, in the offered lot.</b>	
<b>A) For Conductor (as per sampling plan mentioned in IS: 7098 Part II)</b>		
	1)	Annealing test (Copper)
	2)	Tensile Test ( Aluminum)
	3)	Wrapping Test ( Aluminum)
	4)	Resistance test
<b>B) For copper tape / Wires (as per sampling plan mentioned in IS: 7098 Part II)</b>		
	1)	Measurement of Dimensions
	2)	Conductivity check
<b>B) For Armour Wires / Formed Wires ( If applicable ) (as per sampling plan mentioned in IS: 7098 Part II)</b>		
	1.	Measurement of Dimensions
	2.	Tensile Tests
	3.	Elongation Test
	4.	Torsion Test For Round wires only
	5.	Wrapping Test
	6.	Resistance Test
	7.	Mass of Zinc coating test For G S wires / Formed wires only
	8.	Uniformity of Zinc coating For G S wires / Formed wires only
	9.	Adhesion test For G S wires / Formed wires only
	10.	Freedom from surface defects



**C) For XLPE insulation & PVC Sheath (as per sampling plan mentioned in IS: 7098 Part II)**

	1)	Test for thickness
	2)	Tensile strength & Elongation before ageing (for tests after ageing see "D")
	3)	Hot set test (For XLPE insulation)

**D) Ageing test:**

	Criteria	Condition	Test Requirements	Remarks
<b>PVC outer sheath :</b>	Samples as per relevant IS, from each size of each type (voltage rating) of cables in the offered lot, shall be tested for tensile strength & elongation (before ageing). <b>Tensile &amp; elongation testing shall preferably be done with a computerized machine.</b> The values will be compared with corresponding values mentioned in the Type Test report accepted by HPGCL/Consultant. These values of Tensile Strength & Elongation (before ageing) should be within +/- 15% of the corresponding values of Type Test report. (Please note that test values should be more than the minimum values indicated in relevant standard).	All sizes which meet the criteria	For PVC: The size which has maximum negative deviation from type test report values will be put on accelerated ageing test. The samples shall be aged in air oven at temperature of 130°C +/- 2°C for 5 hours and tested for TS & elongation. Acceptance norms shall be as per IS.	In case the size does not meet the requirement in accelerated ageing test <b>then all sizes (which had met the criteria) will be put on ageing test as per IS.</b>
		Sizes which do not meet the criteria	Every size will be put on ageing test as per IS.	----
<b>XLPE Insulation</b>	Samples as per relevant IS, from each size of each type (voltage rating) of cables in the offered lot, will be put on ageing test as per IS.			

**E) Following tests will be carried out on completed cables as per IS on each size of each type**

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**QUALITY ASSURANCE**

	1)	Insulation resistance test ( Volume resistivity method )
	2)	High voltage test
	3)	Partial discharge test ( for Screened cables only )
<b>F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes &amp; types)</b>		
	1)	Thermal stability test on outer sheath
	2)	Oxygen index test on outer sheath
	3)	Smoke density rating test on outer sheath
	4)	Acid gas generation test on outer sheath
	5)	Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cable
<b>G) Following tests shall be carried on one length of each size of each type of offered lot:</b>		
	1)	Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, marking of drum no. / Batch number of outer sheath extrusion
	2)	Measurement of Eccentricity & Ovality





SUB-SECTION-V-QE7

ELECTRIC ACTUATORS WITH INTEGRAL  
STARTERS

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



**ELECTRICAL ACTUATOR WITH INTEGRAL STARTER**

Test/Attributes Characteristics													
ITEM/ COPONENT/ SUB SYSTEM ASSEMBLY/ TESTING	RPM ®	No Load Current ®	IR & HV Test®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position indicator	EPT output ®	Grease leakage ®	Local/ Remote ( Open-Stop-Close) Operation® Safety check (Single phasing, Phase correction, Tripping etc.) (A)
<b>ELECTRICAL ACTUATOR WITH INTEGRAL STARTER(IS_9334)</b>													
Motor	Y	Y	Y	Y	Y								
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note: 1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practices and procedure adopted along with relevant supporting documents.

® - Routine Test                      (A) - Acceptance Test                      Y - Test applicable



## SUB-SECTION-V-QE8

### HT SWITCHGEAR

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



**QA TABLE FOR HT SWITCHGEAR**

ATTRIBUTES / CHARACTERISTICS →	Make, Type, Model, Rating & TC	Electrical Properties	Mechanical properties	Chemical Properties	Dimensions & Finish	Constructional, Functional & Operational Features as per Tech Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint shade, thickness, adhesion &	Functional Checks	HV & IR Test	Degree of Protection Routine test as per Tech spec.	CB Operation timing check	All Routine Tests as per relevant
ITEMS, COMPONENTS, SUB-SYSTEM ASSEMBLY ↓														
CRCA steel sheet/ Aluzinc*/ Zinalum*/ Galvalum*	Y		Y	Y	Y		Y							
Aluminum Bus bar material ( IS : 5082 )	Y	Y	Y	Y	Y		Y							
Copper Bus bar material ( IS : 613 )	Y	Y	Y	Y	Y		Y							
Bus bar Support Insulator	Y	Y	Y		Y		Y			Y				
HT Circuit Breaker (IEC-62271-100)	Y				Y	Y	Y		Y			Y	Y	
HT Contactors ( IS : 9046 / IEC 60470)	Y				Y	Y	Y		Y				Y	
Protection & Auxilliary Relays	Y				Y	Y	Y		Y				Y	
HT CT's & PT's ( IS : 2705 / 3156 )	Y				Y		Y						Y	
HT Fuses ( IS : 9385 )	Y				Y	Y	Y							
Surge Arrester ( IEC : 99 –4 )	Y				Y		Y						Y	
LT Contactors ( IS : 13947)	Y				Y	Y	Y		Y					
Control & Selector Switches ( IS : 6875 )	Y				Y	Y	Y		Y					
Indicating Meters ( IS : 1248)	Y				Y	Y	Y		Y				Y	
Indicating Lamps ( IS : 13947)	Y				Y	Y	Y		Y					
Push Buttons ( IS : 4794)	Y				Y	Y	Y		Y					

CLAUSE NO.



**QUALITY ASSURANCE & INSPECTION**

Control Transformer ( IS : 12021 )	Y				Y	Y	Y			Y				Y
LT Fuses ( IS : 13703)	Y				Y	Y	Y							
Energy Meters ( IS : 722 )	Y				Y	Y	Y			Y				Y
Transducers ( IEC : 60688)	Y				Y	Y	Y			Y				Y
Diodes	Y	Y				Y	Y			Y				
Terminal Blocks	Y	Y				Y	Y							
Synthetic Rubber Gasket ( IS : 11149 / 3400 )	Y	Y			Y		Y							
Breaker Handling Trolley	Y				Y	Y			Y	Y				
HT Switchgear Panel IEC-62271-200)	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
  2. Make of all major Bought Out Items will be subject to HPGCL/Consultant approval.
  3. Temperature rise test reports for diode plates with actual heat sink will be verified.
- \*. CRCA Galvanized steel with metal coating composed of Al (55%), Zn (43.4%) & Si (1.6%),



## SUB-SECTION-V-QE9

### LT SWITCHGEAR

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



LT SWITCHGEAR

( MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)

ATTRIBUTES / CHARACTERISTICS ↓ ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLY	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per Tech Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per Tech spec	All Routine tests as per Tech spec. & IS
Sheet Steel (IS : 513)	Y	Y		Y	Y		Y							
Aluminum Bus bar Material (IS : 5082)	Y	Y	Y	Y	Y		Y							
Copper Bus bar Material (IS : 613)	Y	Y	Y	Y	Y		Y							
Support Insulator	Y	Y	Y	Y			Y							
Air Circuit Breaker ( IS: 13947)	Y	Y				Y	Y		Y	Y				Y
Energy Meters ( IS : 13010, 13779 )	Y	Y				Y	Y		Y					Y
Power & Aux. Contactors (IS : 13947 )	Y	Y				Y	Y		Y					
Protection & Aux. Relays (IS : 3231) (IEC 60255 / IEC 61850)	Y	Y				Y	Y		Y					Y

CLAUSE NO.



**QUALITY ASSURANCE & INSPECTION**

Control & Selector Switches ( IS : 13947)	Y	Y				Y	Y			Y				
CT's & PT's ( IS 2705 / 3156)	Y	Y					Y							Y
MCCB ( IS : 13947 )	Y	Y					Y			Y				
Indicating Meters ( IS : 1248 )	Y	Y				Y	Y			Y				Y
Indicating Lamps ( IS : 13947 )	Y	Y				Y	Y			Y				
Air Break Switches ( IS : 13947 )	Y	Y				Y	Y			Y				
Control Terminal Blocks	Y	Y				Y	Y							

**LT SWITCHGEAR**

**( MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)**

ATTRIBUTES / CHARACTERISTICS →	ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLY ↓	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per Tech Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per Tech spec	All Routine tests as per Tech spec. & IS
Fuse ( IS 13703)		Y	Y				Y	Y							
Control Transformer ( IS : 12021)		Y	Y				Y	Y			Y				Y
Push Buttons ( IS : 4794 )		Y	Y				Y	Y			Y				
Transducer ( IEC : 60688)		Y	Y				Y	Y			Y				Y



CLAUSE NO.



**QUALITY ASSURANCE & INSPECTION**

MCB ( IS : 8828)	Y	Y				Y	Y			Y			
Breaker Handling Trolley	Y	Y				Y			Y	Y			Y
Synthetic Rubber Gasket ( IS : 11149 )	Y	Y		Y	Y		Y						
LT SWITCHGEAR ( IS : 8623 )	Y	Y				Y	Y	Y	Y	Y		Y	Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Makes of all major Bought Out Items will be subject to HPGCL/Consultant approval.

**LT BUSDUCT**

ATTRIBUTES CHARACTERISTICS →	Dimension & Surface Finish	Make, Type, Rating & TC	Electrical Properties	Mechanical Properties	Chemical Properties	Item to conform to relevant IS	WPS Approval, Welder Qualification	Weld Quality Check ( DP test & x-ray	Paint Shade, Thickness, Adhesion &	Tightness by Torque measurement	Electrical Clearances	Galvanizing Test as per IS 2629/ 2633/	IR – HV – IR Test	Phase Sequence Check	Degree of Protection routine test as per Tech spec.
ITEM, COMPONENTS, SUB SYSTEM ASSEMBLY ↓															
Aluminum Sheets / Plates / Strips / Flexibles / tubes ( IS : 5082 / 737 )	Y	Y		Y	Y	Y	Y	Y							
CRCA Flats / ISMC ( IS 2062 )	Y	Y		Y	Y	Y									
Neoprene / Synthetic Rubber Gaskets ( IS 11149 / 3400 )	Y	Y		Y	Y										

CLAUSE NO.



**QUALITY ASSURANCE & INSPECTION**

Rubber Bellows (IS : 3400)	Y	Y		Y	Y										
Support Insulator ( BS : 2782, IEC : 660, IS : 10912 )	Y	Y	Y	Y											
Galvanized Structure & GI Earthing Flat (IS : 2629 / 2633 / 4749 )	Y	Y				Y						Y			
Space Heater & Thermostat		Y	Y									Y			
LT Busduct (IS : 8623 PART 2)	Y	Y				Y	Y	Y	Y	Y	Y		Y	Y	Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Makes of all major Bought Out Items will be subject to HPGCL/Consultant approval.



SUB-SECTION-V-QE10

DIESEL GENERATORS

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



DIESEL GENERATOR SET

SQE\_18

DIESEL ENGINE

TESTS/CHECKS ITEMS/COMPONENTS	Material Test	DP/MPI	UT( On forging and piston Bonding)	Balancing	Hydraulic/water fill test	Assy./fit up	Dimension	Functional/Operation test	Performance test as per BS-5514/or equivalent IS/ISO- Standard including Governing Test for 3 hours at full load and one hr at 10% overload	Fuel consumption, rated power measurement, rated speed	All other tests( if applicable) as per Spec./ relevant standard
Crank shaft	Y	Y	Y	Y							
Cylinder blocks/heads	Y				Y						
Liner/ Radiator	Y				Y						
Rotating/moving parts other than crank shaft	Y	Y									
Piston	Y	Y	Y								
Diesel Engine						Y	Y	Y	Y	Y	Y

Note: 1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents in line in case required as per agreement with HPGCL.  
 2. Make of all major BOIs will be subject to HPGCL/Consultant approval.

CLAUSE NO.



QUALITY ASSURANCE

ALTERNATOR

TESTS/CHECKS	ALTERNATOR																	
	Visual	Dimensional	Make/Type/Rating/TC/General Physical Inspection	Mech/Chem. Properties	NDT /DP/MP/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	All tests as per IS--4722	vibration	Over speed	Tan delta, shaft voltage & polarisation index test
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y					Y									
Shaft	Y	Y	Y	Y	Y	Y			Y									
Magnetic Material	Y	Y	Y	Y	Y		Y			Y		Y						
Rotor Copper/Aluminium	Y	Y	Y	Y		Y	Y		Y			Y						
Stator copper	Y	Y	Y	Y			Y		Y			Y						
SC Ring	Y	Y	Y	Y	Y	Y	Y	Y	Y									
Insulating Material	Y		Y	Y			Y					Y						
Tubes for Cooler	Y	Y	Y	Y	Y				Y		Y							
Sleeve Bearing	Y	Y	Y	Y	Y				Y		Y							
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y										
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y										
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y				Y									



**ALTERNATOR**

TESTS/CHECKS ITEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating/TC/General Physical Inspection	Mech/Chem. Properties	NDT /DP/MP/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	All Routine tests as per IS-4722	vibration	Over speed	Tan delta, shaft voltage & polarisation index test
Wound stator	Y	Y					Y	Y										
Wound Exciter	Y	Y					Y	Y										
Rotor complete	Y	Y					Y						Y	Y				
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y											
Accessories, RTD, BT, CT, AVR. Brushes, Diodes, Space heater, antifriction bearing, cable glands, lugs, gaskets etc.	Y	Y	Y															
Alternator ( IS 4722)	Y	Y	Y												Y	Y	Y	Y1

Note:1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and Procedure along with relevant supporting documents during QP finalisation.  
 2. Make of all major BOIs will be subject to HPGCL/Consultant approval.  
 Y1= for HT Machines only.



**FINAL ASSEMBLY**

TESTS/CHECKS ITEMS/COMPONENTS	Material Test	Dimension	WPS/PQR/Welding	NDT/DP/MPI/UT	Check completeness	Hydraulic/Leak/Pressure test	Functional Tests	All routine test as per Spec/ IS	No load test for 5 min & partial load for one hour of the DG set assembly	Clearances & Alignment
Base frame	Y	Y	Y	Y	Y					
Fuel Tank	Y	Y	Y	Y	Y	Y				
Battery								Y		
Battery Charger								Y		
Control Panel								Y		
Assembled DG Set		Y			Y		Y		Y	Y

**NOTES:**

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents during finalisation of QP.
2. Make of all major Bought Out Items will be subject to HPGCL/Consultant approval.



SUB-SECTION-V-QE11

AUXILIARY TRANSFORMERS

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



CLAUSE NO.



**QUALITY ASSURANCE**

**AUXILIARY / LT TRANSFORMER**

Attributes / Characteristics Items/Components Sub Systems	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical Inspection.	Functional check	WPS & PQR	Routine Test as per relevant standard / Specification
Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y					Y	
Conservator / Radiator / Cooler / Pipes	Y	Y					Y						
Copper Conductor (IS:191)	Y	Y	Y		Y								
Insulating Material	Y	Y	Y	Y	Y	Y							
CRGO Lamination & Built Core	Y	Y	Y		Y	Y				Y			
Bushing / Insulator ( IS:2544 / 5621)	Y	Y								Y			Y
Gasket	Y	Y			Y	Y		Y		Y			Y
Transformer Oil (IEC296)			Y										Y
OLTC / Off-Circuit Tap Changer	Y									Y			Y
Core Coil Assembly & Pre-tanking	Y								Y	Y			
Marshalling Box	Y									Y	Y		Y
WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Valves	Y									Y	Y		
Welding (ASME Sect-IX)	Y						Y					Y	

CLAUSE NO.



**QUALITY ASSURANCE**

Complete Transformer (IS:2026/ IEC-60076)	Y													Y
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Note: 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.  
2) All major Bought Out Items will be subject to HPGCL/Consultant approval.



SUB-SECTION-V-QE12

ELEVATOR

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



QUALITY ASSURANCE

Passenger/ Service Elevators

TEST /CHECK  ITEM	Material Test	DPI/MPI	Ultrasonic Test	Dimensions/Physical	Functional/ Operational Test/ Run Test	Performance Test	Other Tests	All routine tests as per applicable standard	Plain shade, thickness & adhesion	Assembly/fit up
Shaft/ /Gears/Pinion/Pulley/ Sheave	Y	Y	Y	Y						
Spring	Y	Y	Y	Y				Y		
Plates	Y			Y						
Wire rope				Y			Y5			
Safety device								Y		
Geared Machine					Y					
VVVF Drive					Y			Y		
Power, Control & Trailing Cables								Y4		
Control Panel				Y					Y	
ARD System					Y			Y		
Electrical motor								Y		
Controller assembly with VVVF drive					Y		Y3			
Complete Elevator				Y	Y1	Y1	Y2			Y

Y1 –Test to Be Done At Site

Y2 - Load/Overload Test to Be Done At Site as Applicable.

Y3 – Burn in test on electronic card

Y4 – Routine tests including FRLS tests as per Tech. Spec.

Y5- Test report as per relevant std.

NOTE: 1. This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the applicable practices and procedures followed along with relevant supporting documents during QAP finalization.

2. Makes of all bought out items shall be subject to HPGCL/Consultant approval



## SUB-SECTION-V-QE13

### VFD MODULE

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



**VFD MODULE SQE\_28**

<b>ATTRIBUTES / CHARACTERISTICS</b>  <b>ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY</b>	Visual & Dimensional checks	Make / Type / Rating etc.	Final Inspectio n as ISS / IEC	Remarks
HT Breaker (IEC 56)	Y	Y	Y	
DC Reactor	Y	Y		For details refer table for DC Reactor
Transformer	Y	Y		For details refer table for Transformer
Motor	Y	Y		For details refer separate table for Motor
VFD Panel	Y	Y		For details refer table for VFD

Note : 1) This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed alongwith relevant supporting documents during QP finalisation.

2) Make of all major Bought Out Items will be subject to 31/CE/PLG/RGTPP/FGD-250 approval.



**DC REACTOR**

ATTRIBUTES / CHARACTERISTICS  ITEMS/COMPONENTS, SUB SYSTEM ASSEMBLY	Visual	Dimensional	Mech. & Chem. Property	Electrical Characteristics	Pretreatment by Seven Tank	Painting by Stove Enameling	Final Inspection as per IS-2026	Welding/NDT
Winding Material (Aluminium)	Y	Y	Y	Y				
Insulation Material	Y	Y		Y				
Sheet Steel	Y	Y	Y					
Winding	Y	Y		Y				
Fabrication of Enclosures	Y	Y			Y	Y		Y
Assembly	Y	Y						
Routine Tests	Y	Y					Y	

Note : 1) This is an indicative list of tests/checks. The manufacturer to furnish a detailed Quality Plan indicating their practice & procedure along with relevant supporting documents during QP finalisation for all items.

2) All major Bought Out Items will be subject to HPGCL/Consultant approval.



**TRANSFORMER (OIL FILLED)**

Attributes / Characteristics Items/Components Sub Systems	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical Inspection.	WPS & PQR	Routine Test as per relevant test	Routine Test
Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y						
Conservator / Radiator / Cooler / Pipes	Y	Y					Y						
Copper Conductor (IS:191)	Y	Y	Y		Y								
Insulating Material	Y	Y	Y	Y	Y	Y							
CRGO Lamination & Built Core	Y	Y	Y		Y	Y							
Bushing / Insulator ( IS:2544 / 5621)	Y	Y							Y		Y		
Gasket	Y				Y	Y		Y			Y		
Transformer Oil ( IS:335 / IEC296)											Y		
Off-Circuit Tap Changer	Y								Y				
Core Coil Assembly & Pre-tanking	Y								Y				
Marshalling Box	Y	Y					Y				Y		
WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Globe & Gate Valve,	Y								Y				
Welding (ASME Sect-IX)	Y									Y			
Complete Transformer (IS:2026/ IEC-60076)	Y											Y	

Note: 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.  
2) All major Bought Out Items will be subject to HPGCL/Consultant approval.





**DRY TYPE TRANSFORMER**

Attributes / Characteristics  Items/Components Sub Systems	Visual & Dimensional check	Mechanical properties	Electrical strength	Thermal Properties	Chemical Properties	NDT / DP / MPI	Voltage Ratio, Vector Group & Polarity	Make / Type / Rating / Model /TC / General Physical Inspection	WPS & PQR	Routine Test as per relevant standard	Measurement of capacitance & tan delta between winding	Routine Test
Enclosure door, H.V. & L.V. Cable Box / Flange Throat	Y	Y						Y				
Copper Conductor	Y	Y	Y		Y							
Insulating Material	Y			Y	Y							
CRGO Lamination & Built Core	Y											
Bushing /Insulator ( IS:2544 / 5621)	Y							Y		Y		
Gasket	Y							Y		Y		
Off-Circuit Tap Changer	Y							Y				
Core Coil Assembly	Y						Y					
Marshalling Box	Y									Y		
WTI, Thermister, Terminal Connector	Y							Y				
Welding									Y			
Complete Transformer (IS:11171 / IEC 60076)	Y										Y	Y

Notes: 1) This is an indicative List of test/checks. The manufacturer is to furnish a detailed Quality Plan indicating his practice and procedure along with relevant supporting documents during QP finalization for all item.

2. All major Bought out Items will be subject to HPGCL/Consultant approval.

**VFD PANEL**

<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.: 31/CE/PLG/RGTPP/FGD-250</p>	<p>SUB-SECTION-V-QE13 VFD MODULE</p>	<p>PAGE 4 OF 5</p>
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Attributes Characteristics  Item Components Sub System Assembly	Electrical Properties	Mechanical Properties	Chemical Properties	Dimensions / Finish	Type/ Rating/Functional check	HV/IR	Routine test as per relevant std.	Constructional Features	IS:6005 ,Seven tank process	Paint finish/ shade/thickness	Mountings / BOM/ Make, Completeness	Interlock Functional & Operation Testing / Simulation check	Degree of Protection Test	Final testing as per Relevant
	Sheet Steel (IS-513)		Y	Y	Y									
Aluminum / Copper Bus-bar(IS-5082/IS-613/IS-1987)	Y	Y	Y	Y										
Support Insulator (BS-2782/IEC-660/IS-10912)	Y	Y	Y	Y										
Control / Selector Switch(IS-6875)					Y	Y	Y							
Contactora/ MCB(IS-13947)					Y	Y	Y							
O/L Protection relays(IS-3231)					Y		Y							
C.T /V.T/ Indicating Meter(IS-2705/3156/1248)					Y	Y	Y							
Fuse/ Fuse carrier(IS-13703)					Y	Y	Y							
Terminals/lugs/pvc wires(IS-13947//IS-694)	Y			Y	Y	Y	Y							
Timers(IS-3231)					Y	Y	Y							
Push Button/ Lamp/ (IS-6875)					Y	Y	Y							
Control Transformer (IS-12021)					Y	Y	Y							
Mimic, Annunciater					Y		Y							
GASKET(IS-11149)		Y	Y	Y	Y		Y							
Fabrication								Y						
Pretreatment & Painting									Y	Y				
VFD panel										Y	Y	Y	Y	Y

NOTE:

1. This is an indicative list of Test/ Checks. The manufacturer to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. All major Bought Out Items will be subject to HPGCL/Consultant approval.



SUB-SECTION-V-QE14

STATION LIGHTING

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



STATION LIGHTING

SQE\_17

Item Components Sub System Assembly  Attributes Characteristics	Make, Type , Rating/ TC	Dimension	Pre-Treatment of sheat	Paint Shade Thickness Adhesion & Finish	Galvanization Tests	IP Test	Bought Out Items/ Bill of Material	HV & IR	Functional Check as per spec.	Constructional Feature as per Tech spec.	Routine Test as per relevant std and spec	Acceptance Test as per relevant std and spec	Item to conform to relevant standard
Luminaries (IS-10322 Part-5 Sec.1 ( non –LED type)	Y					Y		Y			Y	Y	Y
Electronic Ballast	Y										Y	Y	Y
Lighting Wire (IS-694)	Y										Y		
Fans (IS-374)	Y										Y		
Pole (IS-2713)	Y			Y						Y	Y	Y	
Lamps (IS-9800, IS-9974)	Y										Y	Y	
Lighting Mast (with raise & lower lantern type)	Y	Y			Y					Y	Y	Y	
Wall Mounted Lighting Panel (IS-513, IS-5)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Switch Box/ Junction Box/Receptacles/ Local Push Button Station / Lighting Panel (IS-513, 2629, 2633, 4759, 6745)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Cable Gland (BS-6121)	Y	Y									Y		
Cable Lug (IS-8309)	Y	Y									Y		
Flexible Conduit	Y										Y		
Lighting Transformer (IS-11171)	Y									Y	Y		
Epoxy & Galvanised Conduit (IS-9537, 2629, 2633, 4759, 6745)	Y	Y									Y		Y

**LED Luminaire quality requirements:**

- 1) LED modules to conform to IS: 16103 part 2. Manufacturer to issue a certificate of compliance for the same.
- 2) Control gear to conform to IS 15885 part 2 section 13. Manufacturer to issue a certificate of compliance for the same.
- 3) LED luminaire to conform to IS 16107 part 2 section 1. Manufacturer to issue a certificate of compliance for the same.
- 4) LED luminaire marking to be as per IS 16107 part 2 section 1. Manufacturer to issue a certificate of compliance for the same.
- 5) Acceptance tests as per IS 16107 part 2 section 1 to be carried out on LED luminaire except long duration tests i.e. a) Chromaticity coordinates & correlated color temperature (CCT); b) Color rendering index (CRI). Manufacturer will submit a COC for above tests i.e. CCT & CRI
- 6) LED driver make, model, type & rating may be as per recommendations of LED module manufacturer.

**Notes:**

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought Out Items will be subject to HPGCL/Consultant approval.



SUB-SECTION-V-QE15

SWITCHYARD

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**

CLAUSE NO.



**QUALITY ASSURANCE**

**SWITCHYARD**

**SQE\_20**

Attributes / Characteristics Items/Components Sub Systems	Make, model, Type & Rating, Test Certificate	Routine & Acceptance Test as per IS / IEC	Functional requirements as per Tech Specification
Circuit Breaker (IEC:62271-100)	Y	Y	Y
Isolator (IEC:62271-102)	Y	Y	Y
Current Transformer (IEC:60044/BS:3938/IS2705/ IEC: 61869)	Y	Y	Y
Capacitor Voltage Transformer (IEC:186A / 358/IS3156/IEC60044/ IEC: 61869)	Y	Y	Y
Surge Arrestor (AIS) (IEC:99-4/IS:3070)	Y	Y	Y
Sub Station Automation system (IEC 61850)/ Control & Relay Panel	Y	Y	Y
Protection Relays	Y	Y	Y
Energy meter	Y	Y	Y
Wave Trap (IEC:353 / IS:8792 / 8793)	Y	Y	Y
Bus Post Insulator (IEC:168 / 815 / IS:2544)	Y	Y	Y
Disc, Pin & String Insulator (IEC:383 / IS:731)	Y	Y	Y
Long Rod Insulator (IEC:433)	Y	Y	Y
Aluminium Tube (IS:5082 / 2673 / 2678)	Y	Y	Y
Conductor (IS:398)	Y	Y	Y
Hardware fittings for Insulator (IS:2486 / BS:3288)	Y	Y	Y
Hollow insulator (IEC:233/ IS:5621)	Y	Y	Y
Spacers, Clamps & Connector (IS:10162 / 5561/ 617)	Y	Y	Y
Galvanised Steel Structures (IS:2062/2629/4759/6745)	Y	Y	Y
Vibration Damper (IS:9708)	Y	Y	Y
Sag Compensating Spring DIN:2089/2096 IS:3195 / 7906	Y	Y	Y
SF6 Gas filling & evacuating plant	Y	Y	Y
SF6 Gas Leak Detector	Y	Y	Y
Leakage Current Analyser	Y	Y	Y
Nitrogen Gas Filling Device	Y	Y	Y



**QUALITY ASSURANCE**

Attributes / Characteristics  Items/Components Sub Systems	Make, Type Rating, and Model, Test Certificates	Routine & Acceptance Test as per relevant IS/IEC	Functional requirement s as per Tech Specification
Event Logger	Y	Y	Y
Operation Analyser	Y	Y	Y
Disturbance Recorder	Y	Y	Y
Synchronising Trolley	Y	Y	Y
Relay Test Kit	Y	Y	Y

Notes : 1) This is an indicative list of test/checks. The manufacture is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents during QP finalisation for all items.  
2) All major Bought Out Items will be subject to HPGCL/Consultant approval.





SUB-SECTION-V-QE16

POWER TRANSFORMER

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



Oil Filled Transformer

Attributes / Characteristics  Items/Components Sub Systems	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT (DPT / RT / UT)	Functional check	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical	Isolation test on core/clamp/tank	WPS & PQR	Routine Test as per relevant standard / Specs-Vacuum & Pressure Test
Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y				Y		Y	
Conservator / Radiator / Cooler / Pipes	Y	Y					Y				Y			
Copper Conductor (IS:191)	Y	Y	Y		Y									
Insulating Material	Y	Y	Y	Y	Y	Y								
CRGO Lamination & Built Core	Y	Y	Y		Y	Y					Y			
Porcelain Bushing / Insulator ( IS:2544 / 5621)	Y	Y												Y
RIP - OIP Bushing (IS 12676, IEC 60137)	Y	Y	Y								Y			Y
Gasket (IS 2712)	Y	Y			Y	Y		Y						
Air Cell	Y													Y
Transformer Oil								Y						Y
On Load / Off-Circuit Tap Changer (IEC :214)	Y	Y	Y											Y Y
Core Coil Assembly & Pre-tanking	Y									Y		Y		
Marshalling Box	Y							Y						Y
WTI, OTI, MOG, Bucholz Relay, PRD, Thermistor, Breather, Terminal Connector, Bushing CT, Fan & Pumps with Drives, Valves								Y			Y			
Testing & Maintenance equipment											Y			
Welding (ASME Sect-IX)							Y						Y	



Attributes / Characteristics  Items/Components Sub Systems	Oil Leakage Test	Jacking test followed by DP Test on load bearing Member	DGA of Oil for main tank and OLTC Chamber	Measurement of capacitance and tan delta	Di-Electric tests	Routine Test as per relevant standard / Specs	Nitrogen / Dry Air Dew Point Measurement before final packing on transformer at receipt at site.	Paint Shade Thickness and Adhesion & finish.
Complete Transformer ( IS:2026 / IEC: 60076)	Y	Y	Y	Y	Y	Y	Y	Y

**Note:**

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and procedure along with relevant supporting documents during QP finalization for all the items.
2. All major Bought Out Items will be subject to HPGCL/Consultant approval.
3. Read Mechanical strength as mechanical endurance for OLTC/OCTC



## SUB-SECTION-V-QE17

### DC SYSTEM

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



DC SYSTEM

SQE\_19

LEAD ACID BATTERY

<p>ATTRIBUTES / CHARACTERISTICS →</p> <p>↓</p> <p>ITEMS, COMPONENTS, SUB SYSTEM ASSEMBLY</p>	Dimensions & Finish	Conformance to relevant part drg. & Manufacturer's standards	Chemical composition	Lead Coating Thickness (min. 25 microns, IS: 6848 App.F) & Adhesion	Conformance to CPWD Spec. for Teak Wood	Paint Process checks, Paint Shade, Thickness, Adhesion & Finish	Constructional requirements as per Tech Spec.	Routine & acceptance tests as per relevant standard
Container & Lids ( IS : 1146)	Y	Y						
Vent Plugs	Y	Y						
Sealing Compound ( IS : 3116 )		Y	Y					
Positive & Negative Plates		Y	Y					
Separators ( IS : 6071 )	Y	Y						
Electrolyte ( Water / Sulphuric Acid ) ( IS : 1069 / 266 )		Y	Y					
Inter-cell Connectors & Fasteners	Y	Y		Y				
Battery Stand	Y	Y			Y	Y		
Cell Insulators	Y	Y						
Stack Assembly	Y	Y						
Lead Acid Battery ( IS : 1652 )	Y						Y	Y

Note: This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.



Ni- Cd BATTERY								
ATTRIBUTES CHARACTERISTICS / ITEMS, COMPONENTS, SUB ASSEMBLY SYSTEM	Dimensions & Finish	Impact Strength	Conformance to relevant part drg. & Manufacturer's standards	Resistance to Alkali	Chemical composition	Nickel Plating thickness	Paint Shade, Thickness, Adhesion & Finish	Routine & acceptance tests as per relevant standard
Container & Lids	Y	Y	Y	Y				
Vent Plugs	Y		Y	Y				
Perforated Steel Strips	Y		Y	Y		Y		
Active Material for Positive & Negative Plates			Y		Y			
Separators	Y		Y	Y				
Electrolyte			Y		Y			
Inter-cell Connectors & Fasteners	Y		Y	Y		Y		
Battery Stand	Y			Y			Y	
Cell Insulators	Y		Y	Y				
Stack Assembly	Y		Y					
Ni-Cd Battery ( IS : 10918)	Y							Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Makes of all major Bought Out Items will be subject to HPGCL/Consultant approval.



**BATTERY CHARGER**

Attributes Characteristics →	/	Items / Components / Sub-assembly ↓	Make, Model, Type, Rating & Finish	Verification of Routine test reports as per relevant IS	Sheet Steel Pretreatment & Painting process	Conform to relevant Standard & spec	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features as per HPGCL Temperature Rise Test	Ripple Content Test, Load Limiter & AVR Operation Test	Dynamic Response Test	Operational & Functional Checks	HV & IR Test	Burn-In Test at 50°C for 48 hrs in energised ..... Alternating current measurement test	Degree of Protection Test as per NTCP Spec.
Rectifier Transformer and Reactors IS : 4540, 2026)	Y	Y		Y				Y				Y		
Electronic Components including Potentiometer ( Vernier Type)	Y			Y			Y							
Electronic Cards	Y			Y								Y		
PCB & racks for electronic cards	Y						Y							
Control & Selector Switches ( IS : 6875)	Y			Y							Y			
Indicating Meters (IS : 1248 )	Y			Y							Y			
Indicating Lamps (IS: 13947)	Y			Y							Y			
Air Break Switches / Fuses ( IS : 13947 / 13703 )	Y			Y							Y			
Control Terminal Blocks (IS : 13947)	Y			Y										
Control Transformer ( IS : 12021)	Y			Y							Y			
Push Buttons ( IS : 4794 )	Y			Y							Y			
MCB ( IS : 8828)	Y			Y							Y			
PVC insulated Copper control wires (IS : 694 )	Y			Y										
Sheet Steel ( IS : 513 )	Y		Y	Y										
Synthetic Rubber Gaskets	Y			Y										



**QUALITY ASSURANCE**

Annunciator	Y								Y		Y		
Battery Charger	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

**Notes:**

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Makes of all major Bought Out Items will be subject to HPGCL/Consultant approval.

<b>BATTERY CHARGER</b> (of capacity upto 24 V / 48 V , 150 A DC)										
Attributes Characteristics →	/	↓	↓	↓	↓	↓	↓	↓	↓	↓
Items / Components / Sub- assembly	Make, Model, Type, Rating	Dimensional check and Paint shade, thickness, adhesion &	Complete physical examination for constructional features as per approved drgs	Ripple Content Test, Load Limiter operation & AVR Operation	Operational & Functional Checks of aux. Devices like annunciator, switches, inductors etc.	HV & IR Test	Burn-In Test	Dynamic response test	AC input current measurement test	Temperature rise test
Battery Charger	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
<p><b>Note</b></p> <ol style="list-style-type: none"> <li>1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.</li> <li>2. Makes of all major Bought Out Items will be subject to HPGCL/Consultant approval.</li> </ol>										





SYSTEM		DC HEALTH MONITORING									
		Make, Model, Type, Rating & Finish	Verification of Routine test reports as per relevant IS	Sheet Steel Pretreatment & Painting process	Conform to relevant Standard & spec	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features as per HPGCL Operational & Functional Checks	HV & IR Test	Burn-In Test at 50°C for 48 hrs in energized condition	Degree of Protection Test as per NTCP Spec.	
Attributes / Characteristics	Items / Components / Sub-assembly										
Enclosure		Y		Y	Y	Y					Y
Synthetic Rubber Gaskets		Y			Y						
Control & Selector Switches, Indicating Meters, Indicating Lamps		Y			Y			Y			
Control Terminal Blocks, Push Buttons, MCB		Y			Y			Y			
MCB		Y			Y			Y			
PVC insulated Copper control / signal cables		Y	Y		Y						
Transducers / detectors		Y	Y		Y			Y			
PCB & racks for electronic cards		Y									
Electronic Cards		Y						Y		Y	
Microprocessor Based Controller		Y						Y		Y	
SCADA		Y						Y			
Software		Y						Y			
DC Health Monitoring System		Y			Y	Y	Y	Y	Y	Y	Y
<p>Notes:</p> <p>3. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.</p> <p>4. Makes of all major Bought Out Items will be subject to HPGCL/ Consultant approval.</p>											



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1	Power Transformer (Oil Filled) - Tie Transformer	I				ABB	Vadodara	A		up to 765 kV Class						
						CG Power & Industrial Solutions Ltd	Mandideep	A		Up to 765 kV class						
						GE T&D India Limited	Vadodara	A		Up to 765 kV class including Shunt Reactor, Approval Conditions Apply						
						BHEL	Bhopal	A		up to 400 kV Class						
						GE T&D India Limited	Naini	A		up to 400 kV Class						
						TELK	Angamally, Kerala	A		up to 400 kV Class						
						Toshiba	Hyderabad	A		up to 400 kV Class						
						CG Power & Industrial Solutions Ltd	Kanurmarg	A		up to 400 kV Class						
						EMCO	Thane	A		up to 400 kV Class						
						Siemens	Mumbai	A		up to 400 kV Class						
						BHEL	Jhansi	A		Up to 220 kV Class						
						2	Oil Filled Transformer	I				GE T&D	ALLAHABAD	A		
												ABB	VADODARA	A		
SIEMENS	NAVI MUMBAI	A														
CG Power & Industrial Solutions Ltd	KANJUR MARG	A														
EMCO	THANE	A														
TELK	ANGAMALY (KERALA)	A														
BHEL	JHANSI	A														
TOSHIBA	HYDERABAD	A														
Schneider	Vadodara	A		Up to 50 MVA, 132 kV Class												
T & R	Ahmedabad	A		Up to 90 MVA, 132 kV Class												
Prime Meiden Ltd	Nellur	A		up to 63 MVA, 132 kV Class												
CG Power & Industrial Solutions Ltd	Malanpur	A		up to 7.5 MVA, 33 KV Class												
ECE	Sonepat	A		up to 4.0 MVA, 11 KV Class												
Andrew Yule	Chennai	A		up to 10.0 MVA, 33 KV Class												
EMCO	Jalgaon	A		Up to 16 MVA, 33 kV Class												
EMCO	Umala	A		up to 2.0 MVA, 33 KV Class												
Essenar	Medak	A		Up to 16 MVA, 66 kV Class												
Indotech Transformers	Chennai	A		Up to 16 MVA, 11 KV Class												
Kanohar	Meerut	A		Upto 16 MVA, 33 kV Class												
Kirloskar	Mysore	A		up to 16 MVA, 33 kV Class												
Kirloskar	Pune	A		up to 2.0 MVA, 33 KV Class												
Kotsons	Agra	A		up to 2.5 MVA, 11 KV Class , Approval Conditions Apply												
KRYFS Power Components Ltd	Silvassa	A		Up to 2.5 MVA, 33 kV Class												
Hammond Power Solutions	Hyderabad	A		up to 10.0 MVA, 33 KV Class												
Raychem RPG	Pune	A		Up to 5 MVA, 33 kV Class												
Sudhir Transformer	Bangalore	A		Up to 12.5 MVA, 33 KV Class												
SUDHIR POWER LTD	SILVASSA	A		Up to 12.5 MVA, 33 kV Class												



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						Technical Associate Ltd	Sitarganj	A		up to 16 MVA, 33 kV Class, Approval Conditions Apply
						Tesla, Unit-2	23-A, B-Sector, Industrial Area, Govindpura, Bhopal	A		up to 5.0 MVA, 33 KV Class
3	LT (415 V) Motors	See Note-2				CGL	Ahmednagar	A		
						MARATHON	KOLKATA	A		
						SIEMENS	MUMBAI	A		
						JYOTI	BARODA	A		
						BHARAT BIJLEE	NAVI MUMBAI	A		Upto 690 V, 500 KW for Inverter Duty & upto 415V, 200 KW for Non-Inverter Duty
						ABB	FARIDABAD	A		UPTO 55KW
						ABB	BANGALORE	A		55KW – 200KW
						NGEF	BANGALORE	A		UPTO 15KW
						KEC	BANGALORE	A		
						KEC	HUBLI	A		UPTO 90KW
4	GEARED MOTOR	II				LHP	SOLAPUR	A		UPTO 120KW
						PETL	AURANGABAD	A		Motor to be supplied from NTPC approved sources
						PBL	VV NAGAR	A		
						INTERNAL COMBUSTION	Aurangabad	A		
5	HT MOTOR	I				NEW ALLENBERRY WORKS	Kolkata	A		
						ABB	VADODARA	A		Upto 6.6kV, 2500kW & 11kV, 2000kW
						MARATHON	KOLKATA	A		Upto 11kV,1600kW
						CGL(D5 Industrial Area)	MANDIDEEP	A		Upto 6.6kV,1650kW & 11kV, 1350kW
						CGL(Plot 9)	MANDIDEEP	A		Upto 11kV, 4MW
						BHEL	BHOPAL	A		
						WEG	HOSUR	A		Uptoo 11kV, 7000kW
						SIEMENS	THANE	A		Upto 690 V, 500 KW
						KEC	BANGALORE	A		3.3 kV, 240 kW
						JYOTI	VADODARA	A		Upto 6.6kV,2250kW
6	VFD Motor	I				ABB	BANGALORE	A		Upto 690V, 250KW
						MARATHON ELECTRIC MOTORS	KOLKATA	A		Upto 690V, 100KW
						BHARAT BIJLEE	NAVI MUMBAI	A		UPTO 690V, 500 KW
						SIEMENS	THANE	A		Upto 690 V, 500 KW
						Powertech	Sonepat	A		upto 55 KW with following conditions: i) VFD from Schneider- France, upto 415V, 50KW, ii) Enclosure & bought out items shall be from NTPC acceptable makes & 3) Engineering support for integration will be provided by M/s Schneider / Authorized integrator of M/s Schneider



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7	LT VFD Panel	I				DANFOSS	Oragadam	A		(upto 690V, 1200kW), VFD drives with VFD sourced from Danfoss-Denmark/USA and Panel sourced from Rittal
						YASAKAWA	Japan	A		VFD from Yasakawa- Japan, Upto 415V, 132KW
						ROCKWELL AUTOMATION-AB	SAHIBABAD	A		VFD from Rockwell(Allen Bradley)- USA, (Upto 415 V, 600 KW)
						ABB	BANGALORE	A		VFD from ABB-Finland, Upto 690V, 750 KW
						SIEMENS	NASIK	A		VFD from SIEMENS- Germany, Upto 690V,900KW
						VACON	BANGALORE	A		VFD(NXP model) from VACON Finland, upto 400KW,415V and upto 900KW, 690V
8	MV Switchgear panel up to 33 KV	I				Siemens	Mumbai	A		
						BHEL	Bhopal	A		
						Megawin	Salem	A		
						Jyoti	Vadodara	A		
						ABB	Nasik	A		
						L&T	Ahmednagar	A		
	Areva	Kolkata	A		Upto 11 kV only					
9	Indoor LT Switchgear Panel	I				Switching Circuits	Kolkata	A		
						Tricolite	Sahibabad / Manesar	A		
						Hindustan Control & equipment Ltd	Kolkata	A		With fabrication & painting at unit II & MP Electrical Narendrapur
						Maktel	Vadodara	A		
						Jakson	Greater Noida	A		
						Vidyut Control	Gaziabad	A		
						Adlec Power	Rohad ( Jhajjar)	A		
						Pyrotech	Udaipur	A		
						L&T	Mumbai / Coimbatore	A		
						GE	Bangalore	A		
						Siemens	Mumbai	A		
						C&S Electric	Noida / Hardwar	A		
						Nitya Electrocontrols	Noida	A		
						Control & Schematics	Hyderabad	A		
Schneider	Nasik	A		ACB from Schneider, France						



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10	Numerical Relays for Switchgear (IEC 61850 Compliant)	* (with switch gear MQP)				SEL	Pullman, USA	A		
								A		
						ALSTOM T&D	Stafford, UK	A		P14X, P34X, P44X, P64X, P74X models only.
						ALSTOM T&D	Chennai	A		P14X, P34X, P44X, P64X, P74X models only.
						GE Multilin	Zamudio, Vizcaya, Spain/ Markham, Ontario, Canada	A	F 650 only	
						Schneider	UK, France	A	PX30 & PX40, VAMP 5X and VAMP 2XX models only.	
						ABB	Finland	A		
						ABB	Baroda	A	For 6XX Series	
						Siemens	Goa	A	7SR2X, 7SJ66X series only	
					Siemens	Germany	A	7SX Series only		
11	Wall mounted fixed type indoor/ outdoor LT Switchgear non compartmentalized Panel (Lighting panels / AC / DC Fuse boards / MCB boxes)	I				Control Devices	Kolkata	A		
						Jasper	Noida	A		
						Conquerent Control Systems	Manesar	A		
						Havells	Faridabad	A		
						Novateur Electrical & distribution systems	Murthal	A		
						Avaidd Technovator	Manesar	A		
						Additionally all vendors identified in serial no. 8 are also		A		
						Universal Cable Ltd.	Satna	A		
						NICCO	Shamnagar, Kolkata	A		
						Incab	Pune	A		
					Hindustan Vidyut Products	Faridabad	A			
					KEI Industries	Bhiwadi	A			
					Delton Cable Ltd	Faridabad	A		A)Unarmoured cable all sizes. B) Armoured cable up to 3.5 x 240 sq. Mm with GI strip armour and 1Cx70 sq mm with Al strip armour	
					Paramount Cable	Khushkhera	A			



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12	1.1 KV AC/DC Power cable (PVC & XLPE)	I				Polycab Wires Pvt. Ltd	Daman	A								
						Gemscabs Industries	Bhiwadi	A								
						Cords Cables	Bhiwadi	A								
						Havells India Ltd.	Alwar	A								
						Sri ram Cables	Bhiwadi	A								
						Thermocables	Hyderabad	A								
						Sbee Cables	Bangalore	A								
						Suyog Cables	Vadodara	A								
						Finolex	Pune	A								
						Scot Innovation wires and cables	Baddi	A								
						Indo Alusys	Bhiwadi	A								
						Radiant Cables	Hyderabad	A								
						Universal Cable Ltd.	Satna	A								
						NICCO	Shamnagar, Kolkata	A								
13	1.1 KV Control Cable	I				Incab	Pune	A								
						Polycab WiresPvt. Ltd	Daman	A								
						Hindustan Vidyut Products Ltd	Faridabad	A								
						KEI Industries	Bhiwadi	A								
						Delton Cable Ltd	Faridabad	A								
						Paramount Cable	Khushkhera	A								
						Gemscabs Industries	Bhiwadi	A								
						Cords Cables	Bhiwadi	A								
						SPM Cables	Hyderabad	A								
						Elkay Telelink	Faridabad	A								
						Havells India Ltd.	Alwar	A								
						R.R. Kabel	Silvasa	A								
						Thermocables	Hyderabad	A								
						Finolex	Pune	A								
						Sbee Cables	Bangalore	A								
						Suyog Cables	Vadodara	A								
						Scot Innovation wires & Cables	Baddi	A								
						Indo Alusys	Bhiwadi	A								
						Radiant Cables	Hyderabad	A								
						Apar Industries	Valsad	A								
						14	H.T. CABLE Grade- upto 33kV	I				Finolex	Pune	A		
												Gemscab	Bhiwadi	A		
Gupta Power	Kashipur	A														
Havells India Ltd.	Alwar	A														
Incab	Pune	A		upto 11kV only												
KEC International	Vadodara	A														
KEI Industries	Bhiwadi	A														
Krishna Electrical Industries Ltd	Gwalior	A		upto 11kV only												
NICCO	Shamnagar, Kolkata	A		upto 11kV only												
Paramount	Khushkhera	A														
Polycab Wires Pvt. Ltd	Daman	A														



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						Sri ram Cables	Bhiwadi	A		upto 11kV only
						Sterlite	Haridwar	A		
						Tirupati Plastomatics	Jaipur	A		upto 11kV only
						Torrent Cable Ltd	Nadaid	A		
						Universal Cable Ltd.	Satna	A		
15	Battery Charger ( 48V/110V/220V)	I				Chabbi India Ltdi Electricals	Jalgaon	A		
						HBL Power	Hyderabad	A		
						Dubas Engineering	Bangalore	A		
						Chloride Power	Kolkatta	A		
						Statcon	Hapur	A		
						Masstech	Jalgaon	A		
16	Battery	I				Exide	Kolkata	A*		* For lead acid plante type only
						Hoppekkee	Brilon, Germany	A*		* For lead acid plante type only
						HBL Power Systesm	Hyderabad	A#		# For Ni-cd type only
						Amcosaft	Bangalore	A#		# For Ni-cd type only
17	ELEVATOR	I				ECE	GHAZIABAD	A		
						TECHNO	AHMEDABAD	A		
						OTIS	MUMBAI	A		
						KONE	CHENNAI	A		
						OMEGA	AHMEDABAD	A		
						SAMIL ELTEC	KOREA	A		
18	DG Set	I				TIL	Ghaziabad	A		UP TO 1500KVA
						Powerica	Silvasa	A		UP TO 500KVA
						Jakson	Kathua	A		
						Sterling Generators Pvt Ltd	Silvasa	A		
						Supernova	Rajpur	A		
						Kohler	Singapore	A		
19	HV Busduct ( SPBD)	I				BHEL	Rudrapur	A		
						C&S	G.Noida/Haridwar	A		
						KGS Engg	Chennai	A		Upto 11KV only
						Powergear	Chennai/Bangalore	A		
20	GI CABLE TRAYS	II				Inar Profiles Ltd	Ankapally (Vizag)	A		
						Vatco	Mumbai	A		Galvanization at Sigma Mumbai
						Indiana cable trays	Mumbai	A		Galvanization at Karamtara galvaniser
						Industrial Perforation	Kolkata	A		
						Ratan Projects	Howrah	A		Galvanization at DMP Projects
						India Electric Syndicate	Kolkata	A		Galvanization at BMW Industries/B.P Projects
						Steelite engg.	Mumbai	A		
						Premier Power Products	Kolkata	A		Galvanising at Neha Galvaniser
						Indiana Gratings	Pune	A		Galvanization at Poona Galvanizer
						M.J. Engineering	Okhla/ Bhiwadi	A		



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						T.R.G	Chennai	A		Galvanization at TM Radhakrishna Chetty & Co
						Amtech	Pune	A		Galvanization at B.G. Shirke - Pune
						Rukmani	Raipur	A		Ladder type cable trays only
						Passive Infra	Hasangarh (Rohtak)	A		
						Unitech Fabricators & Engineers	Howrah/ Hoogly	A		
						Patny System	Hyderabad	A		
						Rabi Engg	Kolkata	A		Galvanizing from NTPC approved sources
						Indmarkformtech Pvt Ltd	Pune	A		Galvanizing at B.G. Shirke - Pune
21	CABLE TRAY FLEXIBLE SUPPORT SYSTEM	II				Vatco	Mumbai	A		Galvanizing at Sigma Mumbai
						Inar profiles	Enkapalli	A		
						Industrial perforations	Kolkata	A		
						Premier power products	Kolkata	A		Galvanising at Neha Galvaniser
						Steelite engg.	Mumbai	A		
						Indiana gratings	Pune	A		Galvanising at Poona Galvaniser
						Patny Systems	Hyderabad	A		
						Amtech	Pune	A		Galvanising at B.G. Shirke
22	LT Busduct	II				KGS Engg	Chennai	A		
						Spaceage	Gurgaon	A		
						C&S	Noida/Haridwar	A		
						BHEL	Rudrapur	A		
						Nitya Electrocontrols	G.Noida	A		
						Unilec	Gurgaon	A		
						REEP	Chennai	A		
23	Lighting Transformer (Epoxy Insulated)	III				Gujarat Plug In	Vadodara	A		SQP
						Prayog	Pune	A		SQP
						Indcoil	Mumbai	A		SQP
						Pragati	Thane	A		SQP
						Southern Elect	Chennai	A		SQP
						Pactil	Thane	A		SQP
						AE	Mumbai	A		SQP
						KPEL	Pune	A		SQP
24	Lighting Fixtures & Luminaries	III				Wipro	Pune	A		For Filament and LED
						Crompton	Mumbai	A		For Filament only
						Philips	Noida	A		For Filament and LED
						Bajaj	Mumbai	A		For Filament and LED
						Surya Roshni	Noida	A		For Filament and LED
						Goldwyn	Noida	A		For LED only
25	Welding Recepticles	III				SCHEINDER	Nasik	A		
						AJMERA	Mumbai	A		
						Best & Crompton	Chennai	A		
						BCH	Faridabad	A		
26	Cable Gland	III				Additionally Any make with VDE or CE or UL or CSA marking or BIS Any make with VDE or CE or UL or CSA marking or BIS approved with valid CML number.is acceptable				
27	Lugs	III				Dowells	Mumbai	A		
						Chetna	Nasik	A		
						3D	Umbergaon	A		
						Additionally Any make with VDE or CE or UL or CSA marking or BIS				
28	Emergency Light, Trefoil Clamps, Ceiling Fans	III				Main Contractor Approved Sources		A		
29	M.S. ROD, G.I. Flat, G.I. Wire, Earth Wire	III				Main Contractor Approved Sources		A		GALVANISING AT NTPC APPROVED SOURCES
						SIEMENS	Mumbai	A		





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30	Local Motor Starter Panels	III				L&T	Mumbai	A		
						Any other make with VDE or CE or UL or CSA marking or BIS approved with valid CML number is acceptable				
31	Limit Switches	III				KAKU BHILLAI	Chennai	A		Any other make with VDE or CE or UL or CSA marking or <i>BIS approved with valid CML number</i> .
						Jai Balaji	Chennai	A		
						AG System	Mumbai	A		
						Electromag	Mumbai	A		
						BCH	Faridabad	A		
32	HT Termination & Jointing Kits	III				3M	Pune	A		
						Raychem	Pune	A		
						3M India	Bangalore	A		
33	Fire sealing system - Type A Material supplier	III				GE Silicon	USA	A		
						Hiiti	Germany	A		
						DOW Corning	USA	A		
34	Fire sealing system - Type B Material supplier	III				LLOYDS	Delhi	A		
						Signum	Nagpur	A		
						Vijay System Engineers Pvt Ltd	Mumbai	A		
35	Executing Agency for Fire sealing system	I				LLOYDS	Delhi	A		
						Signum	Nagpur	A		
						Vijay System Engineers Pvt Ltd	Mumbai	A		
						3M India	Bangalore	A		



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36	CIRCUIT BREAKER	I				GE T&D	KANCHIPURAM	A		
						ABB	VADDARA	A		
						SIEMENS	AURANGABAD	A		
						CGL	NASHIK	A		
37	ISOLATOR	I				GR POWER	HYDERABAD	A		
						HIVELM	CHENNAI	A		
						S&S POWER	PONDICHERRY	A		
						SIEMENS	HYDERABAD	A		
						SWITCHGEAR & STRUCTURALS	HYDERABAD	A		
38	CURRENT TRANSFORMER	I				ABB	VADDARA	A		
						GE T&D	HOSUR	A		
						BHEL	JHANSI	A		
						CGL	NASHIK	A		
						MEHRU	BHIWADI	A		
39	CVT	I				ABB	VADDARA	A		
						GE T&D	HOSUR	A		
						BHEL	JHANSI	A		
						CGL	NASHIK	A		
40	SURGE ARRESTOR	I				CGL	NASIK	A		
						LAMCO	HYDERABAD	A		
						OBLUM	HYDERABAD	A		
						ADITYA BIRLA	HALOL	A		
41	POST INSULATOR	I				IEC	BHOPAL	A		
						SARVANA GLOBAL	CUDDALORE	A		
						MODERN INSULATOR	ABU ROAD	A		
						WSI	CHENNAI	A		
						ELCTROMECH TRANSTECH	KOLKATA	A		
42	CLAMPS & CONNECTORS & WELDING SLEEVES	II				EXALT	MUMBAI	A		
						KLEMMEN ENGG	CHENNAI	A		
						MEGHA ENGG	CHENNAI	A		
						MILIND	MUMBAI	A		
						PEE VEE ENGG	BANGALORE	A		
43	INSULATOR HARDWARE, CONDUCTOR ACCESSORIES & EARTHWIRE ACCESSORIES	II				ELECTROMECH TRANSTECH	KOLKATA	A		
						EMI TRANSMISSION	MUMBAI	A		
						IAC ELECTRICALS	KOLKATA	A		
						ITPL	MUMBAI	A		
						RASHTRA UDYOG	KOLKATA	A		
44	DISC INSULATOR/ PIN INSULATOR	I				ADITYA BIRLA	RISHRA (W.B.)	A		
						BHEL	BANGALORE	A		
						IEC	BHOPAL	A		
						IMPERIAL CERAMICS	BIKANER	A	UPTO 90 KN	
						MODERN INSULATOR	ABU ROAD	A		
						SARVANA	CUDDALORE	A		



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45	ACSR CONDUCTOR	I				WSI	CHENNAI	A		
						APAR INDUSTRIES	SILVASSA	A		
						CABCON	KOLKATA	A		
						DIAMOND	VADODARA	A		
						GALAXY	SANGLI	A		
						GUPTA POWER INFRA	BHUBANESWAR	A		
						HIRA CABLES	HIRAKUD	A		
						JSK	SILVASSA	A		
						LUMINO	KOLKATA	A		
						SARAVATHY	BANGALORE	A		
						SMITA	GHAZIABAD	A		
46	ALUMINIUM TUBE	I				ALOM EXTRUSIONS	KOLKATA	A		
						BANCO	VADODARA	A		
						CENTURY EXTRUSION	KOLKATA	A		
						HINDALCO	RENUKUT	A		
						HINDALCO	ALUPURAM	A		
						JINDAL ALUMINIUM	BANGALORE	A		
						SUDAL	NASIK	A		
47	SUB STATION AUTOMATION SYSTEM (BCU, GRP, ENERGY METER, NUMERICAL RELAYS, SWITCHYARD PROTECTION)	I				GE T&D	CHENNAI	A		
						ABB	PEENYA	A		
						SCHNEIDER	NOIDA	A		
						SIEMENS	KALWA	A		
					BHEL	BHOPAL	A*	* : Approved only for C&R Panel		
48	COMPONENTS FOR CONTROL & RELAY PANELS, PROTECTION PANELS, ISLANDING SCHEME & BAY CONTROL UNIT :	I							* : Control Measure of Items shall be same as in the Quality Plan of SAS.	
a	ENERGY METER	*				CONZERV	BANGALORE	A		
						ELSTER	MUMBAI	A		
						SEMS	UDAIPUR	A		
						L&T	MYSORE	A		
b	FIBRE OPTIC CABLE	*				AKSH OPTIFIBRE	BHIWARI	A		
						BIRLA ERICSSON	REWA	A		
						FINOLEX	PUNE	A		



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c	EVENT LOGGER	*				GE T&D	UK / FRANCE/CHENNAI	A		
						HATHWAY	UK	A		
d	GPS TIME SYNCHRONISATION EQUIPMENT	*				ARBITER	USA	A		
						HATHWAY	UK / USA	A		
						HOPF	GERMANY	A		
						SERTEL	CHENNAI	A		
e	RELAY TEST KIT	*				DOBLE ENGG	USA	A		
						MEGGER	UK	A		
						OMICRON	USA/AUSTRALIA	A		
						SCOPE T & M	PUNE	A		
f	DISTURBANCE RECORDER	*				ABB	FINLAND	A		
						GE T&D	USA	A		
						HATHWAY	UK	A		
						SIEMENS	GERMANY	A		
g	LARGE VIDEO SCREEN (LVS)	*				BARCO	NOIDA	A		
						DELTA	GURGAON	A		
						PLANAR	USA	A		
h	RELAYS for SWITCHYARD (NUMERICAL AND AUXILLARY)	*				ABB	SWEDEN/ BANGALORE	A		
						GE T&D	UK/CHENNAI	A		
						SCHNEIDER	UK	A		
						SIEMENS	GERMANY	A		
49	SF6 Gas Filling and Evacuating Plant, Gas Recycling & Purifying Plant, Gas Leakage Detector	III				AI QUALITEK	USA	A		
						DILO	GERMANY	A		
						ENERVAC	CANADA	A		
						VACCUUM PLANT INDUSTRIES	PUNE	A		



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50	OPERATIONAL ANALYSER WITH DCRM KIT	III				MEGGER	UK	A		
						OMICRON	USA	A		
						MEGGER	SWEDEN	A		
51	LEAKAGE CURRENT ANALYSER	III				DOBLE ENGG	USA	A		
						ISA	ITALY	A		
						SCOPE T & M	PUNE	A		
						TRANSINOR	NORWAY	A		
52	GS FLAT / 40MM DIA M.S.ROD / M.S EARTH RODS / U CLAMP / GI EARTH PIPE / GI PIPE / GI CONDUIT (INCLUDING BENDS) / PVC PIPES	III				MAIN CONTRACTOR APPROVED SOURCES				
53	GI EARTH WIRE / LIGHTING WIRE	III				MAIN CONTRACTOR APPROVED SOURCES				
54	LIGHTING POLE	III				BIS approved Vendors as per IS-2713				
55	BAY IDENTIFICATION TAGS, PHASE MARKERS & DANGER PLATES	III	*			MAIN CONTRACTOR APPROVED SOURCES				
56	PIANO SWITCHES	III	*			BIS APPROVED SOURCES				
57	WPS (Aluminium Tube)	I	W-010			MAIN CONTRACTOR APPROVED SOURCES				
58	WPS (Earthing Grid)	I	W-020			MAIN CONTRACTOR APPROVED SOURCES				
59	BELT WEIGHER	I				AVERY INDIA	BALLABHGARH	A		
						ELECON EPC	SAVALI	A		
						KISTLER MORSE	HYDERABAD	A	UP TO 2500 TPH	
						SCHENCK PROCESS	GURGAON	A		
60	WEIGH BRIDGE	I				AVERY INDIA	BALLABHGARH	A		
						RICELAKE	SRIPEREMBUDUR	A		
61	IN LINE MAGNETIC SEPARATOR / SUSPENDED MAGNET	I				ELECON EPC	SAVLI	A		
						MAGNETIC CORPORATION	BANGALORE	A		
						ELECTRO ZAVOD	KOLKATA	A		
						ELECTROMAG	MUMBAI	A		
62	METAL DETECTOR	II				ELECTROMAG	MUMBAI	A		
						THERMO RAMSEY	AUSTRALIA	A		
						ELECON EPC	SAVALI	A		
						SIVA SYSTEMS	GOA	A		
63	ELECTROMAGNETIC (EM) BRAKE	II				BCH	FARIDABAD	A		
						STORM CRAFT	MUMBAI	A		
						ELECTROMAG	MUMBAI	A		
						WITTON KRAMMER BROOK CROMPTON	UK	A	FOR WAGON TRIPPLER BRAKE ONLY	



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64	CABLE REELING DRUMS	III				BENGAL TECHNOCRAT	KOLKATA	A	With Demag Germany make stall torque motor	
						ELECTRO ZAVOD	KOLKATA	A	With Demag Germany make stall torque motor	
						ELECON	VV NAGAR	A		
						ELEKTROMAG	VAPI	A	With Demag Germany make stall torque motor	
65	EH THRUSTER BRAKE / RAIL CLAMP	II				WMI	MUMBAI	A		
						PINTCH BUBNEZER	GERMANY	A	FOR DISC TYPE ONLY	
						ELECTROMAG	MUMBAI	A		
66	PULL CORD / BELTSWAY INDICATION SYSTEM	II				JAYASHREE	PUNE	A		
						PROTO CONTROL	PUNE	A		
						AG SYSTEMS	MUMBAI	A		
67	ELECTRONIC SPEED SWITCH,ZSS,TILT SWITCH,MAGNETIC SWEITCH,PROXIMITY SWITCH	III				JAYASHREE	PUNE	A		
						PROTO CONTROL	PUNE	A		
						PG ELECTRONICS	MUMBAI	A		
						VIRTUAL INDUSTRIES	JAMSHEDPUR	A	For Magnetic Limit Switches only	



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68	HEAVY DUTY LIMIT SWITCHES	III				JAI BALAJEE	CHENNAI	A		
						JAYASHREE	PUNE	A		
						BCH	FARIDABAD	A		
						A.G.SYSTEM	MUMBAI	A		
						ELECTROMAG	MUMBAI	A		
69	PULL CORD/BELT SWAY SEITCHES,UNDER BELT SWITCH	III				JAYASHREE	PUNE	A		
						PROTO CONTROL	PUNE	A		
						AG SYSTEMS	MUMBAI	A		
70	GEARED MOTOR	II				INTERNATIONAL COMBUSION	ARURANGABAD	A		
						NAW	KOLKATA	A		
						PBL	V.V.NAGAR	A		
						SEW EURODRIVE	GERMANY	A	Up to 30 kw	
						SIEMENS	GERMANY	A	Up to 30 kw	
71	Lighting Wires / GI Conduit	III								
72	FOP for electrical works	I								
<b>LEGENDS :</b>										
<b>1. QP/INSPN CATEGORY</b> <b>CAT-I</b> :For these items the Quality Plans approved by HPGCL/Consultant & final acceptance will be on physical inspection witness by HPGCL/Consultant <b>CAT-II</b> :For these items the Quality Plans approved by HPGCL/Consultant. The final acceptance by HPGCL/Consultant shall be on basis of review of documents as per approved QP <b>CAT-III</b> :For these items Main supplier approves the Quality Plans.The final acceptance by HPGCL/Consultant shall be on basis of certificate of conformance by the main supplier. * : Control measure of item covered in quality plan of main item.										
<b>2. UNITS/WORKS</b> : Place of manufacturing Place of Main Supplier of multi units/works.										
<b>NOTES:</b>										
<b>Note 1:</b> Relevant certificates shall be submitted for HPGCL/Consultant approval.Approval conditions attached to above identified vendors, as applicable shall be adhered to. <b>Note 2: For LT Motors:</b> a) <u>Up to 50 KW:</u> Cat-III: Acceptance of Motor up to 50 KW is based on COC of the manufacturer & the Main Contractor confirming NTPC's technical specifications. b.i) <u>Above 50 KW and up to 75KW:</u> Cat-III : For manufacturers who have already supplied this range of motors to NTPC which have been commissioned and no adverse feedback has been reported from RIO/project-site AND for skid mounted motor supplied with the driven equipment. Acceptance based on review of Routine Test Inspection report as per IS-325 along with COC of the Manufacturer and Main Contractor confirming NTPC's technical specifications. b.ii) <u>Above 50 KW and up to 75KW:</u> Cat-I: For Other Manufacturers, as per NTPC approved Quality Plan c) <u>Above 75 KW:</u> Cat-I: as per NTPC approved Quality Plan										



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<b>Note 3: Category of inspection for Cable Trays &amp; Cable Tray Flexible Support System:</b>										
<b>For Total Contract Quantity per Size</b>						<b>Category of Inspection</b>				
For cable total quantity ≤ 2.5 KM						Cat-III - submission of TC & Certificate of Conformance by Main Contractor for the manufacturers having successfully supplied to any NTPC project-site through Corporate contracts for atleast 2 years				
For cable total quantity above 2.5 km & up to ≤ 10 km per size/type						Cat-II for the manufacturers having successfully supplied to any NTPC project-site through Corporate contracts for atleast 2 years				
For cable total quantity above 10 km per size/type						Cat-I				
<b>Note 4: Category of inspection for LT Cables:</b>										
<b>For Total Contract Quantity per Size</b>						<b>Category Of Inspection</b>				
For cable total quantity ≤ 2.5 KM						Cat-III - submission of TC & Certificate of Conformance by Main Contractor for the manufacturers having successfully supplied to any NTPC project-site through Corporate contracts for atleast 2 years				
For cable total quantity above 2.5 km & up to ≤ 10 km per size/type						Cat-II for the manufacturers having successfully supplied to any NTPC project-site through Corporate contracts for atleast 2 years				
For cable total quantity above 10 km per size/type						Cat-I				
<b>Note 5:</b> VDE / CE / UL / CSA Marking Certification preferably from Third Party Agency or BIS Approval Letter shall be submitted for NTPC's Verification /Information.										
<b>Note 6: NTPC approved Galvanizers:</b>										
1. M/s M J Engg,Delhi			8. M/s National Galvanizer, Kolkata			15. M/s Sigma, Mumbai				
2. M/s Jamna Metal,Delhi			9. M/s Unistar Galvanizer, Kolkata			16. M/s Radhakrishnan Shetty, Chennai				
3. M/s A.V. Engg, Kolkata			10. M/s B.P. Project. Kolkata			17. Karamtara Mumbai				
4. M/s Inar Profiles, Vishakapatnam			11. M/s Bajaj Pune			18. Poona Galvanizers Pune				
5. M/s Anand Udyog, Mumbai			12. M/s Electrocare Industries, Mumbai			19. Neha Galvanizer- Kolkata				
6. M/s Techno Engg,Chandigarh			13. M/s B.G. Shirke, Pune			20. Unitech Fabricators & Galvanizers- Hoogly				
7. M/S Steelite Engg, Mumbai			14. M/s Gurpreet Galvanizer, Hyderabad							





(CONTROL & INSTRUMENTATION SYSTEM)

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



SUB-SECTION-V-QC1

DDCIMS

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



**1.00.00**

**REQUIREMENTS OF AUTHORISATION-TO-SHIP-TEST (ATST) FOR DDCMIS**

1.01.00

- (a) Authorization-to-ship-test (ATST) or Factory Acceptance Test (FAT) (both terms have been used interchangeably) shall include all required tests to fully demonstrate to Employer's satisfaction that each equipment/sub-system/system as well as software modules furnished as per this specification as well as DDCMIS as a whole, fully meets the functional, parametric and other requirements of this specification and Employer's approved drawings/documents under all operating regimes. The procedure defined here is applicable for one DDCMIS system. Number of DDCMIS systems and their sub-systems shall be as defined in Part-A of technical specifications.
- (b) Contractor to note that ATST / FAT procedure given below in subsequent clauses are only indicative in order to help the Contractor in understanding the requirements and help him in submitting a detailed procedure based on these guidelines meeting all the specification requirements.
- (c) The results of the following activities shall be made available to the Employer's representative before start of ATST / FAT.
  - (i) Compliance check for Major Design Feature (including Customisation if any), as per Part-C, GTR or agreements regarding this.
  - (ii) Implementation check of various applications including those based on Consultant input, as per Part-C, GTR or agreements regarding this.
- (d) Generally, the ATST / FAT shall be carried out with the equipment earmarked for the particular project and unit. However, for the following item, the testing can be carried out with similar / equivalent dummy equipment fulfilling the following condition, subject to Employer's approval.

SN	ITEM	CONDITION
1	LVS	Testing of LVS functionalities can be done by using monitors connected to the LVS Workstations. Dispatch of LVS can be allowed like a cat-III item, but only after successful testing of functionalities as indicated above.
2	LVS WS / OWS	LVS WS / OWS for the first unit to be tested on the target machines. In case the testing carries over to next unit, dummy equipment may be used. Dispatch of LVS WS / OWS of subsequent units can be allowed like a cat-III item, but only after successful testing of first unit as indicated above.
3	MASTER CLOCK	Can be directly dispatched if alternate test set-up for time synchronization can be arranged.
4	NETWORK	To be done with target machines only for first unit. In



	COMPONENT	case the testing carries over to next unit, dummy equipment may be used. Dispatch of network components of subsequent units / station can be allowed like a cat-III item, but only after successful testing of functionalities as indicated above.
5	VARIOUS BUS SYSTEM CABLES	For FAT, the target Main system bus shall be used. In case the testing carries over to next unit, dummy equipment may be used.

1.01.01

The Authorization-To-Ship-Test (ATST) shall include all reasonable exercises which the combination of equipment and software can be expected to perform. These tests shall be divided into, as a minimum, but not limited to the following categories:

(a)	Hardware tests	
(b)	Functional tests	
(c)	Parametric test	


1.01.02


All reference documents like all approved drawings / documents, Consultant specifications, DDCMIS system manuals, etc. shall be available at the start of ATST. The Quality Assurance related tests shall be as per approved QP (Quality Plan) for DDCMIS. The ATST tests are briefly described in subsequent clauses.

**Hardware tests**

These tests shall include but not be limited to the following tests. These tests will be conducted on full population on sample basis as finalized during ATST procedure finalization and HPGCL/Consultant engineer's decision during ATST.

- (a.) Verification of healthiness of all types of modules e.g., I/O modules, controller modules, processors, peripherals, etc. on a sample basis.
- (b.) (1) System configuration verification of system configuration with reference to approved configuration diagrams including verification of controller configuration, group / sub-group segregation; grouping of controllers, I/O redundancy, verification of multiple measurement scheme, HMIPIS configuration, etc.
- (2.) Verification of major features of complete DDCMIS like on line removal of I/O and controller modules, etc. in line with specification requirements.
- (3.) Verification of spare capacity for example spare channels, spare wired-in space in cabinets/ cubicles, terminal blocks, peripherals, etc. as per approved documents.
- (c.) Simulation of inputs / Outputs

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<p><b>1.01.03</b></p>	<p>System shall have feature to simulate/ forcing I/Os on OWS / LVS OWS. Additionally hardware simulation of I/Os shall be available for specific applications like fail safe system.</p> <p>(d.) Accuracy test:</p> <p>System accuracy for each type of analog input shall be demonstrated on sample basis, if this test is not carried out in MDFT.</p> <p>(e.) Demonstration of the manual and auto switchover from master to standby system bus, controllers, I/Os, processors etc.</p> <p>(f.) Loop reaction time shall be demonstrated for loops / logics / functions applicable as per specification and ATST procedure.</p> <p>(g) SOE function shall be tested as follows, where the same is applicable (refer Part-A of specifications). For SER function, verification of resolution of SOE inputs, time synchronization with master clock, data base modification, SOE report, printout, other features etc. For this purpose a test-simulator to generate sequences of 1 ms resolution for 50 points (or as agreed during finalization of ATST procedure) distributed in different panels shall be made available during testing.</p> <p>(h) Power supply:</p> <p>Testing of power supply system to DDCMIS, tolerance of DDCMIS w.r.t. voltage &amp; frequency limits as specified, performance of DDCMIS with power supply break as specified .(One sample of each type)</p> <p>(i) Diagnostics Tests :</p> <p>On – line diagnostic tests on HMIPIS, individual peripherals, Control System, programmer stations, etc.</p> <p><b>Functional Tests</b></p> <p>The following tests shall be carried out on Contractor's DDCMIS.</p> <p>(a.) Functional tests of CLCS:</p> <ol style="list-style-type: none"> <li>(1.) Verification of proper signal acquisition, conditioning and distribution, 2 transmitters / 3 transmitter selection.</li> <li>(2.) Verification of proper realization of controller functions like bump less transfer from auto to manual and vice versa, functional checking of bias circuit (wherever provided), etc.</li> <li>(3.) Verification of response of control system by simulating changes in the system inputs in line with the approved ATST procedure.</li> </ol>	<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO: 31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-V-QC1 DDCMIS</p>	<p>PAGE 3 OF 8</p>

CLAUSE NO.	 <b>QUALITY ASSURANCE &amp; INSPECTION</b>		
	<p>(4.) Verification of signal exchange between FGs and from other systems (if applicable)</p> <p>(b.) Functional tests of OLCS:</p> <p>(1.) Verification of proper signal acquisition, conditioning and distribution, 1v2, 2v3 implementation.</p> <p>(2.) Verification of proper realization of logic functions, sequence control functions, running of complete start up program sequence in all modes of operation, shut down program, etc.</p> <p>(3.) Verification of logic computation in controller by simulating inputs.</p> <p>(4.) Verification of signal exchange between FGs and from other systems (if applicable)</p> <p>(c.) Functional tests for HMIPIS</p> <p>(1.) Verification of all types of displays, logs including their formats, bar graphs, X-Y plots etc. availability of all operator functions.</p> <p>(2.) Verification of event generation and handling capabilities of HMIPIS processors by simulating various types of events/data and observing associated event sequence display and alarms..</p> <p>(3.) Calculations:</p> <p style="padding-left: 40px;">All calculations shall be tested on sample basis to demonstrate that these are in accordance with the specification and Employer's inputs as applicable. The Contractor shall prepare all tests cases for calculations for proper verification for the features required for each type of computations.</p> <p>(4.) Checking historical storage and retrieval functions including long term storage.</p> <p>(5.) Testing of initialization and loading of configuration data, etc.</p> <p>(6.) Verification of all programmer's stations functions for HMIPIS and Control System, as well as for documentation facility as specified.</p> <p>(7.) Testing of each peripheral viz., monitors, printers, optical disks, hard disk drive, etc.</p> <p>(8.) Testing of time synchronisation function of system time of DDCMIS (Control System, HMIPIS &amp; Systems on LAN). In case it is not possible to bring the master clock procured under this package, then signal</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-V-QC1 DDCMIS</b>	<b>PAGE 4 OF 8</b>



generator with stable source, capable of generating all required type of synchronizing signal to be arranged by Contractor.

(9.) Testing of the Station LAN shall be carried out with unit DDCMIS (with panels), standalone DDCMIS (with panels or software simulation) and at least one (1) other DDCMIS system (with panels or software simulation), as well as two client PC's, one third party PLC and Numerical relay system (if applicable). Bidder shall arrange a PC with OPC server (excluded from his scope of supply) which shall be used by the Bidder to simulate signal exchange between Bidder's Station LAN and third party PLC during the testing of Station LAN, at Bidder's works.

(10.) Unified HMIPIS:

Testing of Unified HMIPIS functionality as per respective approved documents.

(d.) Security Audit (as applicable)

(1.) For checking compliance to the security policies & procedures in Station LAN/HMI of all DDCMIS, security audit by a certified auditor (as per CERT- IN panel) is to be arranged by the Contractor during ATST. This shall include vulnerability assessment of the workstations/ servers and penetration testing of the Station LAN through the firewall from a node outside the network. Suitable actions based on the findings of the security audit shall be carried out by the Contractor.

**1.01.04**

**Parametric tests**

Following tests shall be carried out to test Contractor's DDCMIS w.r.t. specification requirements.


(a.) For control system (CLCS+OLCS):

- (1.) CPU loading
- (2.) Cycle time/controller reaction time.
- (3.) Memory spare capacity


(b.) For MMIPIS

- (1.) CPU loading
- (2.) Spare duty cycle
- (3.) Spare memory capacity

(c.) Spare duty cycle for system bus

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	<p>(d.) Various display &amp; command response time</p> <p>(e.) System accuracy (if not carried out in MDFT)</p> <p>(f.) Display update time on OWS LVS</p> <p>Parametric tests of Unified HMIPIS for complete Unit DDCMIS shall also be carried out, if specified in Part-A of specifications.</p> <p><b>1.02.00 Integrated Test Set-Up</b></p> <p>For integrated testing of the total DDCMIS system, the Contractor shall employ a test set-up, which will be capable of generating I/O signals in a requisite manner. It is preferable to adopt soft signal simulating device to avoid / minimise the cumbersome process of physical connection of I/Os through potentiometers, switches, Lamps / LEDs etc. The exact configuration / set-up shall be as finalized during detailed engineering.</p> <p>1.02.01 The Contractor is to submit Authorization-To-Ship-Test (ATST) procedure and requirements of above and other applicable clauses of this specification. Since, the exact definition &amp; extent / parameters of ATST can be finalized only when the engineering of DDCMIS has been finalized to a great extent, it is required that the detailed draft ATST procedure be submitted by the Contractor at a later date as intimated by the Employer during engineering stage for Employer's comment and finalization. Contractor shall incorporate all modifications, additions/ deletions to the ATST procedure as indicated by the Employer. The ATST shall be conducted as per Employer approved procedure for ATST. The Employer reserves the right to ask the Contractor to conduct any other test not covered in ATST procedure also during the ATST which may be required to fully satisfy the Employer regarding full compliance with specification requirements. Contractor shall conduct all such tests also within the quoted lump sum price for this contract.</p> <p>1.02.02 The results of all ATS Tests shall be properly documented by the Contractor and submitted to Employer along with all annexures.</p> <p>1.02.03 Following the tests, if in the opinion of the Employer, the system has not been adequately manufactured, programmed, tested or debugged the Contractor shall make good all deficiencies, and re-run the test to fully satisfy the Employer regarding full compliance with specification requirements and requisite quality standards.</p> <p>1.02.04 The system shall not be shipped without approval of Employer in writing.</p> <p>1.02.05 Upon successful completion of Authorisation-To-Ship Test, the Employer will provide the Contractor with a written authorisation for shipment of the system equipment to the project site.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-V-QC1 DDCMIS</b>	<b>PAGE 6 OF 8</b>



CLAUSE NO.	 <b>QUALITY ASSURANCE &amp; INSPECTION</b>		
1.02.06	All final documentation as per requirement of this specification shall be available at the time of Authorisation-To-Ship-Test and this shall be dispatched along with the equipment in required number of copies.		
1.02.07	Contractor shall note that no payments towards dispatch of equipment and subsequent activities shall be due and payable to the Contractor till the Contractor is able to successfully demonstrate to Employer's satisfaction that the DDCMIS and parts thereof fully meet the Authorisation-To-Ship Test requirements.		
1.02.08	The ATST or FAT of DDCMIS shall be conducted at the employer approved works of the DDCMIS supplier or DDCMIS Supplier's Associate. Further DDCMIS shall be supplied from the same works.		
2.00.00	The ATST requirements as indicated above shall form an integral part of QAP (Quality Assurance Plan) of DDCMIS system(s) envisaged for the package/project. Over and above the tests and requirement indicated above, the QP for DDCMIS system shall be submitted to employer for approval. The QAP envisaged for the offered DDCMIS system for employer shall also include testing of following attributes of the offered system by Employer.		
2.01.00	The tests indicated in the following QA tables are indicative list of tests/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents, if desired by employer.		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-V-QC1 DDCMIS</b>	<b>PAGE 7 OF 8</b>



**DISTRIBUTED DIGITAL CONTROL MONITORING & INFORMATION SYSTEM (DDCMIS)**

TESTS										
ITEMS	Pre Power on Check (#) (R)	Post Power on Check (%) (R)	Internal cabling / Wiring checking(R)	Door Alignment, waviness, and Locking (R)	Louvers, Fans, wire mesh, Lifting arrangement (R)	HV / IR on wired panels (R)	Paint Shade, Thickness and Illumination (R)	Hardware/Make as per BOM (R)	Dimensions, GA, layout (R)	Environmental Stress Screening test (R).

DDCMIS

DDCMIS CUBICLES	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
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OWS and Peripherals								Y		
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R-Routine Test                      A- Acceptance Test                      Y – Test applicable

Note: 1) Detailed procedure of Environmental Stress Screening test shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure finalized during QP finalization.

2) These test are minimum requirement and necessary covered in Manufacturing Quality Plan and manufacturer is also need to include their practices and Procedure in MQP along with relevant supporting documents.

# Pre power on check: - Wire dressing, looseness, Availability of Fuses and MCB, Modules are inserted properly, Earthing connection, Input Voltage checking, Availability of resistance matt near panels, Availability of Electro Static Discharge measure for electronics components.

% Post Power On Check: - Current & power consumption of DDCMIS Cabinets, I/O check as per signal flow.



SUB-SECTION-V-QC2

MEASURING INSTRUMENTS  
(PRIMARY & SECONDARY)

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



**MEASURING INSTRUMENTS (PRIMARY AND SECONDARY) Page- 1/2**

ITEMS	TESTS								
	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)	IBR Certification (if applicable )(R)	Hydro Test(R)	Material Test certificate ®
1. PR Gauge (IS-3624)	Y	Y	Y	Y	Y				
2. Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y				
3. Pr./D.P.Switch(BS-6134)	Y	Y	Y	Y	Y	Y			
4. Electronic Transmitter(IEC-60770)	Y	Y	Y	Y	Y	Y			
5. Temp. Switch	Y	Y	Y	Y	Y	Y			
6. Recorder(IS-9319/ANSI C-39.4)	Y	Y	Y	Y	Y	Y			
7. Vertical indicators	Y	Y	Y	Y		Y			
8. Digital Indicators	Y	Y	Y	Y		Y			
9. Integrators	Y	Y	Y	Y					
10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y			
11. Transducer (IEC-688)	Y	Y	Y	Y	Y	Y			
12. Thermocouples (IEC – 754 / ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y			
13. RTD(IEC-751)	Y	Y	Y	Y	Y	Y			
14. Thermowell	Y		Y				Y	Y	Y
R-Routine Test    A- Acceptance Test    Y – Test applicable									
: Note: <b>1)</b> This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.									



MEASURING INSTRUMENTS (PRIMARY AND SECONDARY) Page- 2/2												
ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Calculation for accuracy (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
15. Cold junction compensation box	Y	Y	Y	Y					Y			
16. Orifice plate(BS-1042)	Y	Y	Y	Y*	Y	Y**	Y**			Y	Y**	Y
17. Flow nozzle(BS-1042)	Y	Y	Y	Y*	Y	Y	Y			Y	Y	Y
18. Impact head type element	Y	Y	Y					Y				Y
19. Level transmitter/float type switch	Y	Y	Y	Y					Y	Y	Y	Y
20. Analysers	Y	Y	Y	Y								
21. Dust emission monitors	Y	Y	Y	Y								
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.												
** If applicable												
R-Routine Test      A- Acceptance Test      Y – Test applicable												
Note: 1) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.												



SUB-SECTION-V-QC3

POWER SUPPLY

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



**POWER SUPPLY FOR C&I SYSTEMS (UPS/BATTERY/BATTERY CHARGER/ACDB/DCDB)**

ITEMS	Visual/dimension/rating/ (R)	Paint Adhesion/ Thickness	General arrangement/BOM/make of components /Mimic ®	Efficiency , regulation(R)	Input voltage variation (A)	Out put voltage and frequency adj.range(A)	Premilinary light load test(R)	Load transfer retransfer test (R) *	AC input failiure and return test (R)	Parralel operation and current divison(R)	Relative harmonic content(R)	Restart with PRI A.C and battery (separately)(R)	System transfer and retransfer (R)*	Asynchronous transfer(R)	Ripple content(R)	Load limiter operation (R)	IR/HV(R)	Tests as per standard &specification (R)&(A)
<b>UPS/CONVERTER (IEC-146 PT-4)</b>	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
<b>VOLTAGE STABILISER</b>	Y	Y	Y	Y	Y						Y		Y				Y	
<b>LEAD ACID BATTERY(TUBLAR )-IS-1651</b>																		Y
<b>LEAD ACID BATTERY (PLANTE)-IS-1652</b>																		Y
<b>NICKEL CADMIUM BATTERY(IS-10918/IEC-623)</b>																		Y
<b>SMF BATTERY</b>																		Y
<b>ACDB/DCDB</b>	Y	Y															Y	Y
<b>BATTERY CHARGER</b>	Y	Y	Y	Y	Y				Y					Y	Y	Y	Y	Y
R-Routine Test	A- Acceptance Test										Y – Test applicable							
* Transfer time and Over shoot /under shoot during load & system transfer shall be recorded.																		
<b>Note:</b> 1) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.																		



## SUB-SECTION-V-QC4

# CONTROL VALVE ACTUATORS AND ACCESSORIES

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**





**CONTROL VALVE ACTUATORS AND ACCESSORIES.**

TESTS	MAKE, MODEL, TAG (R)	DIMENSION®	SURFACE FINISH®	HEAT TREATMENT®	MATERIAL TEST CERTIFICATES®	IBR CERTIFICATES®	HYDRAULIC TEST®	UT/RADIOGRAPHY FOR >900 LB RATING®	MPI/DP®	PRESSURE RESISTANCE®	SEAT LEAKAGE®	TIMING OPEN/CLOSE®	LINEARITY/HYSTERISIS®	FUNCTIONAL TEST, REVIEW FOR MAKE AND TC OF ACCESSORIES®
ITEMS														
<b>CONTROL VALVE AND ACTUATOR</b>														
OVERALL	Y	Y	Y			Y	Y				Y	Y	Y	Y
BODY		Y	Y	Y	Y			Y	Y	Y				
BONNET		Y	Y	Y	Y									
TRIM		Y			Y			Y*						
PNEUMATIC ACTUATOR	Y	Y								Y				
ELECTRO PNEUMATIC POSITIONER	Y													Y
R- ROUTINE TEST                      A - ACCEPTANCE TEST                      Y - TEST APPLICABLE														
Y* - <b>UT ON SPINDLE DIA &gt;= 40 MM.</b>														
NOTE : 1) THIS IS AN INDICATIVE LIST OF TESTS/CHECKS. THE MANUFACTURE IS TO FURNISH A DETAILED QUALITY PLAN INDICATING HIS PRACTICE & PROCEDURE ALONG WITH RELEVANT SUPPORTING DOCUMENTS DURING QP FINALISATION FOR ALL ITEM.														



## SUB-SECTION-V-QC5

# ELECTRICAL ACTUATOR WITH INTEGRAL STARTERS

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**



ELECTRICAL ACTUATOR WITH INTEGRAL STARTER													
Test/Attributes Characteristics													
ITEM/ COPONENT/ SUB SYSTEM ASSEMBLY/ TESTING	RPM ®	No Load Current ®	IR & HV Test®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position	EPT output ®	Grease leakage ®	Local/ Remote ( Open-Stop-Close) Operation® Safety check (Single phasing, Phase correction, Tripping etc.) (A)
ELECTRICAL ACTUATOR WITH INTEGRAL STARTER(IS_9334)													
Motor	Y	Y	Y	Y	Y								
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
<p>Note: 1) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practices and procedure adopted along with relevant supporting documents.</p> <p>® - Routine Test                      (A) - Acceptance Test                      Y - Test applicable</p>													



## SUB-SECTION-V-QC6

# PROCESS CONNECTION AND PIPING

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
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SUB-SECTION-V-QC7

INSTRUMENTATION CABLE

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**





SUB-SECTION-V-QC8

CONTROL DESK AND PLC

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
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CONTROL DESK , PLC PANEL

ITEMS	TESTS														
	Visual ®	GA, BOM, Lay Out of components ®	Dimensions ®	Paint Shade/Thickness/Adhesion ®	Alignment of Section ®	Component Rating/ Make / Type ®	Wiring ®	IR & HV ®	Review of TC for instruments/ Devices/ Recorders, Indicators/ osaic Items/ Transducers ®	Accessibility of TBS/ Devices ®	Illumination ®	Functional Check for Control Element ,	Mimic ®	Test as per IEC 1131 ® *	Test as per Std ® & ( A)
1. Control Desk	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
2 PLC Panel	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y		Y	Y

**Note:** 1) This is an indicative list of test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure alongwith relevant supporting documents.

- \*Applicable for PLC
- Y - Test Applicable , ® - Routine Test (A) - Acceptance Test

SI No	ITEM	QP / Insp. Cat.	QP No:	QP Sub. Sch.	QP approval Sch.	Proposed sub-supplier	Place	Sub-Supplier approval status / category	Sub-supplier Details submission sch	Remark		
											C&I ITEMS- INDICATIVE SUB-VENDOR LIST	
Project : RGTPP HISAR (2X600 MW)		LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL					Rev No					:
Package : FGD Package							Date					:
Supplier :							Page					:
Contract No.:												
1	DDCMIS SYSTEM					SIEMENS	Germany / Gurgaon	A				
						ABB	Germany / Bangalore	A				
						Emerson	USA / Pawane / Singapore	A				
						GE (ALSTOM)	Noida	A				
						GE (ALSTOM)	France	A				
						Honeywell	USA / Pune	A				
						Yokogawa	Bangalore	A				
						Toshiba	Japan	A				
						Invensys (Schneider)	Singapore / Mumbai / Chennai	A				
2	Dust Emission Monitor					Land Instruments International	UK	A		Optical Transreceiver type		
						Codel	UK	A		Optical Transreceiver type		
						Durag	Germany	A		Optical Transreceiver type		
						Emerson Process Management	Ireland	A		Optical Transreceiver type		
						SICK AG	Germany	A		Optical Transreceiver type		
3	Flue Gas Analyser (CO)					Emerson Process Management	Pawane	A		Analyser from principals M/S Emerson Germany/ USA		
						Codel	UK	A				
						Land Instruments International	UK	A				
						Sick AG	Germany	A				
						Siemens	Germany	A				
4	Flue Gas Analyser (CO2)											
5	Flue Gas Analyser (SOX and Nox)					Emerson Process Management	Pawane	A		Analyser from principals M/S Emerson Germany/ USA		
						SICK AG	Germany	A				
						Fuji Electric	Japan	A				
						Siemens	Germany	A				
						Yokogawa Electric Corporation	Japan	A		IR-400 SERIES		

SI No	ITEM	QP / Insp. Cat.	QP No:	QP Sub. Sch.	QP approval Sch.	Proposed sub-supplier	Place	Sub-Supplier approval status / category	Sub-supplier Details submission sch	Remark		
											C&I ITEMS- INDICATIVE SUB-VENDOR LIST	
Project : RGTPP HISAR (2X600 MW)		Package : FGD Package		LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL							Rev No	:
Supplier :									Date	:		
Contract No.:									Page	:		
6	Flue Gas Analyser Panel (CEMS)					M/S YOKOGAWA India Ltd	Banglore	A		1. SOX,NOX & CO2 Analyser will be from M/S Yokogawa Electric Corporation Japan .		
						ADAGE AUTOMATION PVT. LTD.	GOA	A		1. SOX,NOX &CO2 analysers will be imported from M/S SIEMENS Germany .		
						M/s Thermo Fisher Scientific India Pvt. Ltd	Mumbai	A		Only for Dilution Extractive Technique 1)Analyser (SOX,NOX,CO,CO2,Mercury ),sampling probe ,sample handling system ,umbical cord etc to be supplied from M/S Thermo Fisher USA . 2) Opacity monitor to be supplied from M/S Durag , Germany .		
						Emerson Process Management Pvt Ltd	Pawane	A		Analysers from their prinipals i.e M/S Emerson USA		
						Analyser Instrument Co Pvt Ltd	Kota	A		Analysers from Fuji Japan		
						Chemtrols Engineering Ltd	Goa	A		Analysers from SICK AG Germany		
7	Mercury Analyser					DURAG	Banglore	A		Analyser from M/S Verewa Umwelt Germany		
						SICK AG	Germany	A				
8	Conductivity Analyser					Emerson Process Management	Pawane	A		Procured from USA, assembly & testing in pawane		
						Hach	USA	A				
						ABB	UK	A				
						Yokogawa	Japan	A				
9	PH Analyser					Emerson Process Management Pvt Ltd	Pawane	A		Procured from USA, assembly & testing in pawane		
						ABB	UK	A				
						Hach	USA	A				
						Yokogawa	Japan	A				


SI No	ITEM	QP / Insp. Cat.	QP No:	QP Sub. Sch.	QP approval Sch.	Proposed sub-supplier	Place	Sub-Supplier approval status / category	Sub-supplier Details submission sch	Remark	
Project : RGTPP HISAR (2X600 MW)		<b>C&amp;I ITEMS- INDICATIVE SUB-VENDOR LIST</b>				Doc No : 31/CE/PLG/RGTPP/FGD-250					
Package : FGD Package		<b>LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL</b>				Rev No :					
Supplier :						Date :					
Contract No.:						Page :					
10	Silica Analyser					Hach	USA	A			
						ABB	UK	A			
						Hach	Switzerland	A			
						Eutech Instrument PTE Ltd (part of Thermofisher Scientific Inc)	Singapore	A		For Orion brand Silica Analyser	
11	Turbidity Analyser					HACH	USA	A			
						ABB	UK	A			
						E & H	Germany	A			
						Emerson	USA	A			
						WTW	Germany	A			
12	VMS					M/S Schenck Rotec India Ltd	Noida	A		Loop powered sensor with indicator .Main sensor LPS-420 procured from M/S Hansford sensor UK	
						Forbes Marshall Pvt Limited	Pune	A		VMS hardware and sensors with integral cable shall be shinkawa Japan make .2. All other BOIL shall be from LOA agreed sources	
						GE	Pune	A		For GE Bentley , USA Make System	
						Meggitt	Bangalore	A		For Meggitt Switzerland Vibration system	
						Rockwell Automation	Sahibabad	A		For Rockwell USA make system	
						SKF	Pune	A		For SKF USA make system	
						Shinkawa	Japan	A			
						GE (Bentley Niveda)	USA	A			
						MEGITT (Vibrometer)	Switzerland	A			
						Rockwell Automation	USA	A			
						SKF	USA	A			
						Vibrometer	Switzerland	A			
						Sensonics Ltd	UK	A			





(CIVIL WORKS)  
SUB-SECTION-V-QD1

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**


**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**


CLAUSE NO.	 <b>Quality Assurance for Civil Works</b>			
<b><u>QUALITY ASSURANCE AND INSPECTION FOR CIVIL WORKS</u></b>				
<b>1.0.0</b>	<b>INTRODUCTION</b>			
1.1.0	This part of the specification covers the sampling, testing and quality assurance requirement (including construction tolerances and acceptance criteria) for all civil and structural works covered in this specification.			
1.2.0	This part of the technical specification shall be read in conjunction with other parts of the technical specifications, general technical requirements & erection conditions of the contract. Wherever IS code or standards have been referred they shall be the latest revisions.			
1.3.0	The rate for respective items of work or price shall include the cost for all works, activities, equipment, instrument, personnel, material etc. whatsoever associated to comply with sampling, testing and quality assurance requirement including construction tolerances and acceptance criteria and as specified in subsequent clauses of this part of the technical specifications. The QA and QC activities in all respects as specified in the technical specifications/ drawings / data sheets / quality plans / contract documents shall be carried out at no extra cost to the owner.			
1.4.0	The contractor shall prepare detailed construction and erection methodology scheme which shall be compatible to the requirements of the desired progress of work execution, quality measures, prior approvals if any and the same shall be got approved by the Owner. If required, work methodology may be revised/ reviewed at every stage of execution of work at site, to suit the site conditions by the contractor at no extra cost to the owner.			
<b>2.0.0</b>	<b>QUALITY ASSURANCE PROGRAMME</b>			
2.1.0	<p>The contractor shall adopt suitable Quality Assurance Programme (QAP) to ensure that the equipments and services under the scope of contract whether manufactured or performed within contractor's works or at his sub-contractor's premises or at the OWNER's site or at any other place of work are in accordance with the specifications. Such QAP shall be outlined by the contractor and shall be finally accepted by the OWNER or their authorized representative after discussions before the start of work. The QAP shall be generally in line with IS/ISO Systems.</p> <p>The contractor shall furnish complete QA &amp; QC programme for the work envisaged which may include the following</p> <ul style="list-style-type: none"> <li>• Organization structure for the management and implementation of the proposed quality assurance programme</li> <li>• Quality System Manual</li> <li>• Design Control System</li> <li>• Documentation and Data Control System</li> <li>• Qualification data / details for Contractor's key personnel</li> <li>• The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased, etc.</li> <li>• System for shop manufacturing and site erection controls including process, fabrication and assembly</li> </ul>			
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	<ul style="list-style-type: none"> <li>• Control of non-conforming items and system for corrective actions and resolution of deviations</li> <li>• Inspection and test procedure both for manufacture and field activities</li> <li>• Control of calibration and testing of measuring testing equipment</li> <li>• System for Quality Audits</li> <li>• System for identification and appraisal of inspection status</li> <li>• System for authorizing release of manufactured product to the OWNER</li> <li>• System for handling, storage and delivery</li> <li>• System for maintenance of records</li> <li>• Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of work/ equipment/component.</li> </ul> <p><b>3.0.0 QA AND QC MANPOWER</b></p> <p>3.1.0 The contractor shall nominate one overall QA coordinator for the contract detailing the name, designation, contact details and address at the time of post bid discussions. All correspondence related to Quality Assurance shall be addressed by the contractor's QA coordinator to OWNER. OWNER shall address all correspondence related to Quality issues to the contractor's QA coordinator. The contractor's QA coordinator shall be responsible for co-ordination of Quality activities between various divisions of the contractor and their sub-vendors on one hand &amp; with OWNER on the other hand.</p> <p>3.2.0 The contractor shall appoint a dedicated, experienced and competent QA&amp;QC in-charge at site, preferably directly reporting to the Project Manager, supported as necessary by experienced personnel, to ensure the effective implementation of the approved QAP. An indicative structure of contractor's QA&amp;QC manpower required to be deployed at site is enclosed at <b>Annexure-I</b>. Based on the finalized L-2 network and the approved Field Quality plan, the contractor shall finalize and submit a deployment schedule of QA&amp;QC personnel along with their details to OWNER for approval/ acceptance and further shall ensure their availability well before the start of the concern activity.</p> <p>3.3.0 The QA&amp;QC in-charge shall have the organizational freedom and authority to implement the requirements of these quality assurance arrangements, free from commercial and programme restraints. The QA&amp;QC setup of the contractor shall consist of qualified and experienced Civil, Electrical, Mechanical Engineers and Laboratory assistants with their supporting staff both at their works and site.</p> <p>3.4.0 The deployment of man power for QA &amp; QC set up shall be affected on the basis of agreed manpower deployment schedule, which shall be prepared by the contractor based on the L-2 network and the same shall be submitted to the Owner for acceptance.</p> <p><b>4.0.0 SAMPLING AND TESTING OF CONSTRUCTION MATERIALS</b></p> <p>4.1.0 The method of sampling for testing of construction materials and work / job samples shall be as per the relevant IS / standards / codes and in line with the requirements of the technical specifications / quality plans. All samples shall be jointly drawn, signed and sealed wherever required, by the contractor and the Owner or his authorized representative.</p> <p>4.2.0 The contractor shall carry out testing in accordance with the relevant IS / standards / codes and in line with the requirements of the technical specifications / quality plans. Where no specific testing procedure is mentioned, the tests shall be carried out as per</p>			
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	<p>the best prevalent engineering practices and to the directions of the Owner. All testing shall be done in the presence of the Owner or his authorized representative.</p>			
4.3.0	<p>Before execution of any civil work the contractor shall conduct full-scale suitability tests on various construction and building material such as fine and coarse aggregates, cement, reinforcement, construction chemicals, supplementary cementitious materials and construction water to ascertain their suitability for use and the concrete mix designs conducted from reputed institutes such as NCB-Ballabgarh, CSMRS-Delhi, selected IIT's, etc. as agreed by the Owner. A list of OWNER acceptable specialist laboratories is enclosed at <b>Annexure-II</b>. The test samples for such full scale testing shall be jointly sampled and sealed by the Owner and contractor, thereafter these shall be sent to the concerned laboratory through the covering letter signed by field quality assurance department (FQA) representative of the Owner. Format for sampling and testing of cement, coarse aggregate, fine aggregate, chemical admixture, fly ash, water, concrete mix design is enclosed at <b>Annexure-III</b>.</p>			
4.4.0	<p>The contractor shall timely initiate the action with regard to the evaluation of aggregates and other building material including concrete mix design, so as to ensure completion of these tests before start of civil works at site, thereby not affecting any project work. The test reports and recommendations for suitability of the materials including concrete mix design shall be promptly submitted by the contractor to the Owner.</p>			
4.5.0	<p>Evaluation of aggregate for potential alkali-aggregate reactivity shall be carried out as per following scope of work</p> <p>A. Evaluation of Aggregates for Mechanical / Physical Properties</p> <ol style="list-style-type: none"> <li>a) To carry out different tests on coarse aggregate sample i.e. specific gravity, water absorption, sieve analysis, deleterious material; soundness, crushing value, impact value, abrasion value, elongation index and flakiness index, as per IS: 2386.</li> <li>b) To carry out different tests on fine aggregate sample i.e. specific gravity, water absorption, sieve analysis, deleterious material, soundness, silt content, clay content and organic impurities as per IS: 2386.</li> <li>c) To prepare evaluation report based on test results of a) and b) above and to advise regarding suitability of fine and coarse aggregates.</li> </ol> <p>B. Evaluation of Aggregates for Potential Alkali-Aggregate Reactivity:</p> <ol style="list-style-type: none"> <li>a) To carry out petrographic analysis and accelerated Mortar bar Test on aggregate samples (1N NaOH at 80 deg. Centigrade for 14 days as per ASTM 1260, or the method established/ developed by CSMRS for 22days test).</li> <li>b) If rock type is limestone, alkali carbonate reactivity test shall also be carried out wherein the parameters shall be reported in conjunction with the petrographic analysis. Additionally, X-Ray diffraction test (XRD) shall be carried out to determine critical clay mineral in the rock for preliminary conclusions. For limestone aggregates to be used in dynamic foundations like TG, BFP, Fans, mills and crushers, repeated temperature cycle test shall also be carried out, to determine residual expansion of aggregate for concrete.</li> <li>c) To prepare a report based on test results of a) and b) above and to advise regarding suitability of aggregates to be used and further testing required if any.</li> </ol>			
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<b>5.0.0</b>	<b>LABORATORY AND FIELD TESTING</b>			
5.1.0	<p>The field laboratory for QA and QC activities shall be constructed and set-up by the contractor in line with the indicative field QA&amp;QC laboratory set-up enclosed at <b>Annexure-IV</b>. The Laboratory building shall be constructed and installed with the adequate facilities to meet the requirement of envisaged test setup. Temperature and humidity controls shall be available wherever necessary during testing of samples. The quality plan shall identify the testing equipments/ instrument, which the contractor shall deploy and equip the field quality laboratory for meeting the field quality plan requirements. The contractor shall furnish a comprehensive list of testing equipments/ instrument required to meet the planned/scheduled tests for the execution of works for OWNER acceptance/ approval. The contractor shall mobilize the requisite laboratory equipment and QA&amp;QC manpower at least 15 days prior to the planned test activity as per the schedule of tests.</p>			
5.2.0	<p>All equipments and instruments in the field shall be calibrated before the commencement of tests and then at regular intervals, as per the manufacturer's recommendation and as directed by the OWNER. The calibration certificates shall specify the fitness of the equipments and instruments within the limit of tolerance for use. Contractor shall arrange for calibration of equipments and instruments by an NABL / NPL accredited agency and the calibration report shall be submitted to OWNER.</p>			
5.3.0	<p>The tests which cannot be carried out in the field laboratory shall be done at a laboratory of repute. This includes selected IITs, NCB, CSMRS, reputed government / autonomous laboratories / organizations, NITs and other reputed testing laboratories. The test samples for such test shall be jointly selected and sealed by the Owner and thereafter these shall be sent to the concerned laboratory through the covering letter signed by OWNER engineer. The test report along with the recommendations shall be obtained from the laboratories without delay and submitted to OWNER.</p>			
5.4.0	<p>Based on the schedule of work agreed with the Owner and the approved FQP, the contractor shall prepare a schedule of tests and submit them to the Owner and organize to carry out the tests as scheduled / agreed.</p>			
<b>6.0.0</b>	<b>PURCHASE AND SERVICE</b>			
6.1.0	<p>The major items/ equipments/ components to be manufactured in the shop of the contractor i.e. in-house items and those procured from sub-vendors / sub-manufacturer / sub-contractors i.e. bought out items (BOIs) shall be listed out by the contractor in their bid proposal.</p>			
6.2.0	<p>The list of manufacturers/ sub-vendors for all the BOIs envisaged in contract shall be included in the bid proposal by the contractor which shall be discussed / reviewed by the OWNER during post bid discussions and the list of proposed manufacturers / sub-vendors for each of the BOIs shall be agreed/ approved. If any item is left out or gets included during detailed engineering, the contractor shall propose the manufacturer's / sub-vendor's details for review / approval of OWNER, prior to initiating the procurement of such materials.</p>			
6.3.0	<p>Where the manufacturers are placed in details required ("DR") category, the details of the manufacturers / sub-vendors placed in the "DR" category shall be submitted to the OWNER for approval in the prescribed OWNER format within the period agreed at the time of post bid discussions. The contractor's proposal shall include vendor's site</p>			
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	<p>facilities, expertise, facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-Contractors proposed. The formats for furnishing above details shall be given to the Contractor at post bid discussion stage. Monthly progress reports on sub-contractor detail submission / approval shall be furnished. Such manufacturers / sub-vendors approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.</p> <p>6.4.0 To facilitate advance planning of material testing/ approval of bought out items, well before the start of activity as per L-2 network, representative samples shall be procured by the contractor from approved sub-vendors and submitted to the Owner for his approval before bulk procurement at least two months prior to start of works. In case of manufacturers test certificate (MTC) is submitted for acceptance, it shall be clearly traceable and correlated with the consignment received at site. MTC of all bought out items shall essentially contain all the test parameters / characteristics specified in the technical specifications / standards / codes. In case the manufacturer's test certificate does not mention these details, sample from each lot shall be tested for these properties at the third party lab acceptable to OWNER. Approval of material / sample by the Owner shall not relieve the contractor of his responsibility, for their conformance to the specification, as well as the requisite performance and quality of material.</p> <p>6.5.0 Monthly progress reports on sub-contractor detail submission / approval shall be furnished as per Engineering Co-ordination Procedure. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract. Sub-vendor whose details are not submitted within the agreed cut-off date, shall be deemed to be withdrawn by the contractor.</p> <p>6.6.0 Structural steel and Reinforcement steel supply if in the scope of the contractor shall be procured from Main Steel Producers SAIL, JSW Steel Ltd, Jindal Steel &amp; Power, Tata steel Ltd. (for Reinforcement steel/TMT bars), RINL (for long products/Rolled sections and Reinforcement steel/TMT bars), Essar Steel India Ltd. (for Flat products/ Steel Plates), Electrosteel steel Ltd. (for Reinforcement steel/TMT bars) and Monnet Ispat and Energy Ltd. (for long products/Rolled sections and Reinforcement steel/TMT bars) as approved by owner.</p> <p><b>7.0.0 MANUFACTURING QUALITY PLAN AND FIELD QUALITY PLAN</b></p> <p>7.1.0 All materials / components and equipment covered under the scope of work, shall be procured by the contractor for the purpose of the contract, after obtaining the written approval of the OWNER, which are to be manufactured at shop/ factory of the vendor/sub vendor shall be covered under a comprehensive quality assurance programme. The contractor's purchase specifications and inquiries shall call for Manufacturing Quality Plans (MQP) to be submitted by the sub-contractor/ sub-supplier/ sub-vendor. The MQP called for from the sub-contractor shall detail out for all the components and equipment, various tests / inspection, to be carried out as per the requirements of this specification and standards mentioned therein, quality practices and procedures followed by contractor's / sub-contractor's / sub-supplier's quality control organization, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/ performance testing. Such quality plans of the vendors / sub-vendors shall be submitted to the OWNER for approval in the prescribed format enclosed at <b>Annexure VI</b> and such approved quality plans shall form a part of the purchase order / contract between the contractor and sub-contractor. The quality plans</p>			
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	<p>shall be submitted on electronic form e.g. CD or E-mail in addition to hard copy, for review and approval of OWNER. After approval the same shall be submitted in compiled form on CD in addition to hard copy.</p>			
7.2.0	<p>The contractor shall furnish copies of the reference documents/ plant standards / acceptance norms/ tests and inspection procedure etc., as referred in quality plans. These quality plans and reference documents/standards etc. will be subject to OWNER approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, OWNER shall identify customer hold points (CHP), i.e. test/ checks which shall be carried out in presence of the OWNER engineer or his authorized representative and beyond which the work shall not proceed without consent of OWNER in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to OWNER along with technical justification for approval and dispositioning.</p>			
7.3.0	<p>Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the OWNER for reference / record by the contractor along with a report of the purchase orders placed so far for the contract.</p>			
7.4.0	<p>Well before the start of the work, the contractor shall prepare and submit the Field Quality Plans (FQP) on the format enclosed at <b>Annexure VII</b>, and obtain approval of OWNER, which shall detail out for all the works, equipments, services, quality practices and procedures etc in line with the requirement of the technical specifications to be followed by the contractor at site. This FQP shall cover for all the items / activities covered in the contract / schedule of items required, right from material procurement to completion of the work at site. An Indicative Field Quality Plan for civil works is enclosed at <b>Annexure – V-A</b> (Indicative FQP for civil works) &amp; <b>Annexure – V-B</b> (Indicative FQP for structural steel works).</p>			
7.5.0	<p>Monthly progress reports on MQP / FQP submission / approval shall be furnished by the contractor. List of items requiring quality plans and sub-supplier approval shall be finalized with the contractor on the format enclosed at <b>Annexure VIII</b> during the post bid discussions.</p>			
<b>8.0.0</b>	<b>DISPOSITIONING OF NON CONFORMITIES</b>			
8.1.0	<p>The non-conformity for the site works on being detected / noted shall be reported by the contractor as per OWNER procedure. The dispositioning of the NCR relating to equipment, assemblies, materials condition or process during construction / erection shall describe the proposed correction and also include the preventive / corrective action plan for future.</p>			
<b>9.0.0</b>	<b>QUALITY AUDIT</b>			
9.1.0	<p>OWNER reserves the right to carry out quality audit and quality surveillance of the quality management and control activities, systems and procedures of the contractor or their sub-contractor. The contractor shall provide all necessary assistance to enable the OWNER carry out such audit and surveillance. The contractor shall also take necessary measures, raise NCRs wherever required based on the audit findings / observations.</p>			
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<b>10.0.0</b>	<b>QA DOCUMENTATION PACKAGE</b>			
10.1.0	<p>The contractor shall be required to submit the QA documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓) mark. Typical contents of QA documentation pertaining to field activities as per approved MQP, FQP and other agreed manuals / procedures, prior to commissioning of individual system shall generally contain the Quality Plan, Material mill test reports, Non-destructive examination results / reports, Heat Treatment Certificate/Record, Non-conformance Reports, CHP, Certificate of Conformance (COC) and MDCC.</p>			
<b>11.0.0</b>	<b>GENERAL QA REQUIREMENTS</b>			
11.1.0	<p>The contractor shall ensure that the works, BOIs and services under the scope of contract whether manufactured or performed within contractor's works or at his sub-contractor's premises or at the OWNER's site or at any other place of work are in accordance with the OWNER technical specification, applicable standards / codes, approved drawings / data sheets / quality plans and BOQ. All the works, BOIs and services shall be carried out as per the best prevalent engineering practices and to the directions of the Owner.</p>			
<b>11.1.1</b>	<b>STORAGE AND HANDLING OF CONSTRUCTION MATERIALS</b>			
	<p>All materials shall be stacked and stored by the Contractor as per IS-4082 and as per the requirements specified in OWNER Technical Specification.</p>			
<b>11.1.2</b>	<b>EXCAVATION AND FILLING WORKS</b>			
	<p>The contractor shall submit a work methodology covering various items of works for all stages of excavation and filling works. This methodology shall broadly include the quantity wise and classification wise identification of source of excavation and filling, suitability tests as per specification requirements, method of stockpiling, transportation, placement, spreading, compaction, equipment, list of protocols, in-situ tests, third party lab test if required, acceptance checks for final clearance.</p> <p>For blasting work at site if required, the contractor shall associate themselves with the reputed specialized blasting agency such as CMRI, NIRM for trials blasts, design blasts, blasting pattern, monitoring of blast during the blasting operations at site. The contractor shall install and operate equipment (such as tri-axial seismograph) for continuous monitoring and control of blast induced vibrations, noise level/ air pressure, dust, silica and noxious gases during all blasting operations in line with the technical specification requirements in association with the specialized blasting agency. The contractor shall submit the un-priced copy of the award on the specialized blasting agencies to OWNER, highlighting the scope of services / work awarded to them by contractor. The services of such specialized blasting agency shall be available through out the period in which the blasting work is undertaken at site. The blasting operation shall remain in charge of a responsible, competent, authorized and experienced supervisor (man-in-charge) and thoroughly acquainted workmen. All blasting work shall be done as per approved blasting scheme/ design/ pattern in line with the technical specification requirements and all statutory laws, rules, regulations, relevant standards pertaining to the acquisition, transport, storage, handling along with use of explosives shall be strictly followed by the contractor.</p> <p>Tolerance for finished surface level shall be within 20 mm of the level shown in the drawing. For an unimportant area, tolerance up to +75mm shall be acceptable at the</p>			
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discretion of the Owner. However, these tolerances shall be applicable for localized areas only.

Acceptance criteria shall be

- a) When only one set of sample is tested, then all individual samples collected and tested should pass without any deviation
- b) For retest of any sample two additional samples shall be collected and tested, and both should pass without any deviation.
- c) Where a large number of samples are tested for a particular test then 9 samples out of every 10 consecutive samples tested shall meet the specification requirement.

**11.1.3**


**MASONRY AND ALLIED WORKS**


The execution, finishing, testing and acceptance of masonry related works shall be as per the provisions of technical specifications / relevant practices IS code. Local depressions on account of faulty workmanship, broken / chipped edges shall not be acceptable.

All masonry shall be built true and plumb within the tolerances prescribed as below. Care shall be taken to keep the perpends properly aligned. Unless specified otherwise the tolerances in construction of masonry works shall be as below:

Sl. No.	Type of Check	Tolerance
	Deviation in verticality in total height of any wall of a building	Shall not exceed $\pm 12.5\text{mm}$ (more than one storey) $\pm 6\text{mm}$ per 3m height (within a storey)
	Deviation from the position shown on the plan of any brickwork	Shall not exceed 12.5mm (more than one storey)
	Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment	Shall not exceed 6mm
	Deviation of bed joint from horizontal in any length, and it	Shall not exceed 6mm (upto 12m) Shall not exceed 12.5mm total (in any length over 12m)
	Deviation from the specified thickness of bed-joints, cross-joints or perpends	Shall not exceed $\pm 3\text{mm}$
	Finished plastered surface	Deviation not more than 4 mm when checked with a straight edge of 2 m length placed against the surface
	The average thickness of plaster	Not be less than the specified thickness
	The minimum thickness over any portion of the surface	Not less than the specified thickness by more than 3 mm for plaster thickness above 12mm and 1 mm for ceiling plaster



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<p><b>11.1.4</b></p>	<p><b>CONCRETE WORKS</b></p> <p>For concreting works provisions of technical specifications and IS: 456 shall apply. A detailed methodology for concrete works shall be submitted by the contractor to OWNER for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.</p> <p>The methodology for concrete works shall broadly contain the suitability of source of aggregates, cement, admixture, water and reinforcement steel, etc. The available concrete mix design recommended from a specialist institute, results of trial mix carried out at site, method / control of batching, mixing, transportation, layer wise placement, compaction, fixing / removal of form work, staging, fixing of water stops at appropriate locations along with specials, expansion joints, contraction joints and construction joints, cover blocks and method of curing, methodology of repair of newly placed hardened concrete, testing and sampling of concrete during production and placement and acceptance checks for final clearance.</p> <p>The equipment, deployment of manpower and machinery shall arranged by the contractor to ensure the continuous rate of placement of specified grade of concrete so as to prevent segregation, bleeding, formation of cold joints, temperature control for concreting in extreme weather conditions and for mass concreting works.</p> <p>Exposed surfaces of concrete shall be kept continuously in a damp or wet condition for at least seven days from the date of placing concrete in case of ordinary Portland cement, not be less than 10 days for concrete exposed to dry and hot weather conditions, at least 10 days or period may be extended to 14 days where mineral admixtures or blended cements are used. Approved curing compounds may be used in lieu of moist curing with the permission of Owner.</p> <p>Reinforcement steel shall conform to relevant IS codes. Lapping / spacing of reinforcement shall be so staggered that under no circumstances more than 50% of bars at any cross section shall be lapped. Corrosion resistance Steel shall be used for the foundations wherever specified in the technical specification. Sample test for 3% of the number of mechanical bars grips subject to a minimum of three, shall be carried out up to the yield strength of reinforcement of bars.</p> <p>Test shall be conducted for the water tightness of the liquid retaining structures as per technical specifications, IS 3370 and IS 6494.</p> <p>All the materials, equipments, processes used in pre cast concrete work shall conform to the requirements for the cast-in-situ concrete.</p> <p>If fly ash is used in concrete, source of supply shall be checked for suitability as per IS 3812 (Part-I). Routine tests for retention of particles on 45µ sieve and loss on ignition shall be carried out on each lot of fly ash before its use. The storage of fly ash shall be similar to that of cement. Separate Silo for fly ash shall be provided in the batching plant. Validation of Mix design using fly ash shall be carried out by an approved specialist agency, before start of concrete production.</p> <p>The acceptance criteria of concrete shall be in accordance with clause no.16 of IS 456. However in exceptional circumstances and that too in non-critical areas, the Owner may</p>			
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>Bid Doc. No.: 31/CE/PLG/RGTPP/ FGD-250</p>	<p>TECHNICAL SPECIFICATIONS SECTION-VI, PART-B</p>	<p>PART-B SUB-SECTION-V-QD1 QA CIVIL WORKS</p>	<p>Page 9 of 18</p>

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	<p>accept concrete work which is marginally unacceptable as per the criteria laid down in IS 456. For such accepted work, payment shall be made at a reduced rate pro rata to the concrete cube strength obtained, against that stipulated.</p> <p>All records of concreting, reinforcement, testing of materials, as-built dimensions, the details of the rectification, etc, shall be maintained as given below. Four copies of such record in a bound form shall be submitted to owner for their record and future reference.</p> <ol style="list-style-type: none"> <li>a. Testing data / report of aggregates including petrographic examination &amp; potential reactivity of aggregate and repeated temperature cycle tests wherever specified</li> <li>b. Mix design details and record of trial mixes carried out at site</li> <li>c. Testing records of admixture as per IS-9103 / ASTM C494 including third party test reports.</li> <li>d. Approved scheme for concreting</li> <li>e. Hourly records of concreting including pour card</li> <li>f. Protocol indicating the dimensional tolerance and details of inserts</li> <li>g. Records giving the details of rectification giving the location of grouting, the quantity of grout used at each location, type of grout used</li> <li>h. Bar bending schedule</li> <li>i. Location and details of mechanical anchoring used for reinforcement</li> <li>j. Protocol giving the details of checking of reinforcements before concreting and conformance to the reinforcement details as shown in the construction drawings</li> <li>k. Photographs showing the areas where rectification works have been carried out. Photographs should be taken before and after rectification</li> <li>l. Temperature control record of concrete at the time of placement if applicable</li> <li>m. Details of curing, staging and fixing / removal of formwork, checklist for formwork as per Clause 9.9 and Annexure-C of IS 14687 including all machine foundations</li> <li>n. Batching Plant shall be calibrated regularly at least once in a 3 months. Computerized output shall be taken for each batch of production of concrete. For concreting works of ash pipe pedestals, mixer with weight batcher may be used.</li> <li>o. Dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances for pre cast members as per OWNER Technical Specification. Load test on Pre cast members (except pre- cast tiles to be laid in the reservoir) shall be carried out @ 1% up to 1000 nos., @0.5% from more than 1000 nos. precast members of one type. The load test shall be carried out as per the provisions of IS-456 and relevant IS code.</li> </ol>			
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<b>TOLERANCES</b>			
<b>Description of Item/ Structural Element</b>		<b>Max (mm)</b>	<b>Min (mm)</b>
<b>Cast In Situ Concrete</b>			
1.	Faces of concrete in foundations and structural members against which back fill is placed	+25	-10
2.	Eccentricity of footing as percentage of footing width in the direction of placement	2% but limited to 50mm	
3.	Top surfaces of slabs and of concrete to receive base plates to be grouted	+5	-5
4.	Alignment of beams, lintels, columns, walls, slabs and similar structural elements	+5	-5
5.	Cross sectional dimensions of walls, slabs and similar structural elements	+5	-5
6.	Deviation from specified dimensions of cross-section of columns and beams	+12	-6
7.	Alignment of holding down bolts without sleeves	+1.5	-1.5
8.	Alignment of holding down bolts with sleeves	+5	-5
9.	Level of holding down bolt assemblies	+10	-10
10.	Embedded Parts (in any direction).	+5	-5
11.	Level of embedment for equipment support	+1.5	0
12.	Level of embedment for other embedded parts	+5	-5
13.	Centers of pockets or holes with greatest lateral dimension not exceeding 150mm	+10	-10
14.	Variation in steps <ul style="list-style-type: none"> <li>• Riser</li> <li>• Tread</li> </ul>	+1.5 +3.0	-1.5 -3.0
<b>Pre- Cast Concrete</b>			
15.	Length:	+/- 0.1 percent	+/- 5    + 10
16.	Straightness or Bow	1/750 of the length	+/- 5    +/- 10
17.	Cross-sectional dimensions	+/- 3 mm or +/- 0.1 percent whichever is greater	
18.	Squareness:	When considering the squareness of the corner the length of the two adjacent sides being checked shall be taken as the base line. The shorter side shall not vary in length from the perpendicular by more than 5 mm.	
19.	Flatness:	The maximum deviation from a 1.5m straight edge placed in any position on a nominal plant surface shall not exceed 5 mm.	
<b>Placing of reinforcement and for cover (Cover blocks shall be of same grade of concrete in which these would be embedded)</b>		Clause 12.3.1 and 12.3.2 of IS 456	
<b>Formwork</b>		Clause 9.6 of IS 14687 and 11.1 of IS 456	
<b>Batching</b>		Clause 10.2.2 of IS 456	





**11.1.5 STRUCTURAL STEEL WORK**

- 11.1.5.1 For structural steel works provisions of technical specifications and IS: 800 shall apply. A detailed methodology for structural steel works shall be submitted by the contractor to OWNER for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.
- 11.1.5.2 The contractor shall submit the welding procedures specification (WPS), heat treatment procedures, NDT procedures etc. at least ninety days before scheduled start of erection work at site. All welding and brazing shall be submitted to the OWNER and carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the OWNER.
- 11.1.5.3 All brazers, welders and welding operators employed on any part of the contract either in the contractor's / sub-contractor's works or at site or elsewhere shall be qualified as per AWS D1.1/ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the OWNER.
- 11.1.5.4 The records of welding procedure qualification and welder qualification test results shall be furnished to the OWNER for approval. However, where required by the OWNER, the tests shall be conducted in presence of OWNER / authorized representative.
- 11.1.5.5 No welding shall be carried out on cast iron components for repair. All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 11.1.5.6 All Non-destructive examination shall be performed in accordance with written procedures as per International Standards and as mentioned elsewhere in the technical specification. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. The records of RT (Films) and UT (inspection records or printed reports if possible) shall be documented and produced to OWNER.

11.1.5.9 The following tests / checks shall be carried out for structural steel works


SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD
1.	Physical and chemical properties of material if supply in the scope of contractor	As per relevant codes, review of correlated mill test certificates or check testing in absence of MTC
2.	Ultrasonic test on plates above 40mm	As per ASTM A578 Level B-S2
3.	Welding procedure & welders qualification test	AWSD1.1/ASME Section-IX or BS-4871 or other equivalent International Standards
Fillet Weld		
4.	Macro-etch examination on production test coupons for main fillet welds	Minimum one joint per built up beams, columns and crane girder etc.
5.	Tension member of crane girder	Dye penetration test on 25% weld length


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SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD
6.	All other fillet welds	DPT on 5% of weld length with minimum 300mm at each location
Butt Weld		
7.	DPT	100% after back gouging on all butt welds except for coal bunker bins 10% after back gouging-For coal bunker bins
8.	Mechanical testing of production test coupons	Minimum one joint per built up beam, column and crane girder.
9.	Radiography test on butt welds (In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1. Wherever RT is not feasible UT to be carried out with the approval of the Owner)	100% RT on butt welds of tension flange (bottom flange) of crane girders 10% RT weld length of each welder on butt welds, except for crane girders and coal bunker 5% spot RT on butt welds / at inaccessible locations UT on butt welds- For coal bunker bins
10.	Ultrasonic testing on full penetration welds (other than butt welds)	100% UT on the web to flange joint of crane girder 10% UT on other full penetration joints
11.	Control assembly check in shop before erection	1 <sup>st</sup> and further every 10 <sup>th</sup> set of identical structure
12.	Dimensional tolerances during fabrication and erection	as per IS-7215 and IS-12843
13.	Surface Preparation and Paint thickness	SA 2 1/2 , By elcometer random after each coat, each member


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<p><b>11.1.8</b></p> <p><b>11.1.9</b></p> <p><b>11.1.10</b></p>	<p><b>PAINTING WORKS</b></p> <p>Painting works shall be carried out as per the provisions of technical specifications. A detailed methodology for painting works shall be submitted by the contractor to OWNER for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.</p> <p>The methodology for painting works shall broadly contain the source of approved brand of paints, blast cleaning as specified, minimum acceptable size of shot used for blasting, application of primer, intermediate coat and final coat, experience of applicator, etc. testing of painting work and acceptance checks for final clearance. For PU coating works if specified, material shall be procured from OWNER approved source and the application of the PU coating shall be carried out by an experienced authorized applicator of the material supplier approved by OWNER. A separate quality plan and methodology for PU coating works shall be submitted by the contractor for approval of OWNER. Based on the approved quality plan, the tests on material and works shall be got conducted at specialist laboratories like IICT Hyderabad, CECRI Karaikudi.</p> <p><b>SHEETING WORKS</b></p> <p>All bought out items shall be procured from the approved manufacturers and tested as per relevant Codes/ Specification. Raw material of colour coated sheets shall meet the chemical &amp; physical properties as per relevant standards / codes referred in the approved data sheet. It shall be tested for colour match, bare metal thickness, weight of Z/AZ coating, thickness of painting system, reverse impact, T-Bend adhesion, scratch resistance, salt spray test for 1000 Hrs and any other test / properties as specified in the technical specifications. Colour coated sheets shall be marked with video jet printing at the interval not more than 2m bearing manufacturer's name, date &amp; time of manufacturing. Fasteners shall also be tested for 1000 hrs salt spray test as per the requirement of technical specifications.</p> <p>Bonded Mineral Wool Insulation shall meet the requirements of thickness, density, thermal Conductivity, all other tests as per the technical specifications and IS-8183.</p> <p>For sheet installation no gas cut opening shall be allowed at the site, whenever opening is specified these shall be properly cut in the factory and shall be filled with lipping / flashing for true shape / dimension etc. The sheets/ packets shall be stacked neatly clear off the ground at an angle to the ground, over a base pallet to provide drainage. Water / moisture should not be allowed to stagnate on surface, or in between layers. This can damage the coating, and cause corrosion.</p> <p><b>TILE WORKS</b></p> <p>The contractor shall submit the work methodology which shall include the type, grade and make of materials along with their technical data sheets, details, etc, clearance from E-I-C regarding leak proofness and damp proofness of parent concrete surface, surface preparation, the procedure of application, curing, testing and acceptance.</p> <p>The agencies having adequate experience to execute the acid / alkali resistant lining works shall be engaged for executing the acid / alkali resistant lining works after obtaining the approval from the E-I-C.</p> <p>The execution, finishing, testing and acceptance of tile works shall be as per the provisions of technical specifications. The material for tile works shall be procured from the OWNER approved brand / source. Local depressions on account of faulty workmanship, tiles / natural stones with cracked or broken / chipped edges shall not be acceptable.</p> <p>The tests shall be carried out on acid resistant bricks / tile- water absorption, compressive strength, resistance to acid, flexural strength, dimensions and all other</p>	<p>RAJIV GANDHI THERMAL POWER PROJECT, KHEDAR, HISAR, UNIT 1 &amp; 2 (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>Bid Doc. No.:</p>	<p>TECHNICAL SPECIFICATIONS SECTION-VI, PART-B</p>	<p>PART-B SUB-SECTION-V-QD1 QA CIVIL WORKS</p>	<p>Page 14 of 18</p>

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<p><b>11.1.11</b></p> <p><b>11.1.12</b></p> <p><b>11.1.13</b></p>	<p>tests as per IS 4860 and IS 4457, bitumastic ready mixed paint as per IS 158, bitumastic as per IS 9510, potassium silicate, resin type and sulphur type mortars as per IS 4832, part I, II and III, surface preparation for painting as per IS 2395, epoxy painting shall be carried for required coating thickness and dry film thickness.</p> <p><b>FIRE PROOF DOORS</b></p> <p>Fire Proof doors shall be tested for the requirements mentioned in the Technical Specification. The type test of the doors shall be carried out at CBRI Roorkee for minimum 2 hours fire rating and its Fabrication drawing shall also be approved by CBRI, Roorkee. DFT of paint of Fire Proof Doors and its fittings and fixtures as per BOQ shall be checked. The doors shall be finished with suitable fire retardant painting system</p> <p><b>WATER PROOFING</b></p> <p>The execution, finishing, testing and acceptance of water proofing works shall be as per the provisions of technical specifications. The material for the works shall be procured from the OWNER approved brand / source and the works shall be executed by the authorized applicator of the supplier.</p> <p>Water proofing shall be tested for water tightness by creating a pond of water minimum 25 mm height on area of 6 m x 6 m, for the period of 48 hrs on fully dried elastomeric membrane surfaces. Minimum 5% area of the roof shall be subjected to water tightness test. Such test necessarily be conducted on vulnerable areas like drain channel / drain head. No dampness shall be visible on the underneath side of roof (i.e. ceiling), parapet and well junctions etc. which have been subjected for testing. The above testing shall be carried out prior to application of wearing course.</p> <p><b>PILING WORK (If Applicable)</b></p> <p>For piling works provisions of technical specifications, approved drawings, BOQs and relevant IS codes / standards shall apply. The piling works shall be executed by the agency meeting the qualifying requirements as specified. A detailed methodology for piling works shall be submitted by the contractor to OWNER for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.</p> <p>The methodology for piling works shall broadly contain the method of boring, stability of bore hole, termination criteria, tests / checks for termination level, fabrication of cage, cage lowering, concrete batching / mixing, transportation, placing, recording of the time of construction operations, method of conducting initial and routine load tests, testing and sampling of concrete during production and placement and acceptance checks on piles for final clearance.</p> <p>The equipment, deployment of manpower and machinery shall be arranged by the contractor to prevent the collapse of bore hole and to ensure continuous rate of placement of specified grade of concrete.</p> <p>The piling works shall be executed as per the technical specifications, approved drawings, relevant codes / standards, FQP and BOQ. In addition to the requirements of technical specifications, the following shall also be ensured while execution of piling works:</p>	RAJIV GANDHI THERMAL POWER PROJECT, KHEDAR, HISAR, UNIT 1 & 2 (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	Bid Doc. No.:	TECHNICAL SPECIFICATIONS SECTION-VI, PART-B	PART-B SUB-SECTION-V-QD1 QA CIVIL WORKS	Page 15 of 18

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	<p>a) Time gap between completion of pile boring and start of concreting should be kept to the minimum. However the maximum time gap shall not be more than 6 hours.</p> <p>b) Muck Debris should be removed from the pile bore by air lift technique (by keeping the tremie &amp; air pipe as close as to bottom of pile bore) i.e. after completion of boring, after completion of SPT (wherever applicable), after lowering reinforcement cage, but before start of concreting.</p> <p>c) Density of bentonite slurry shall be checked from the sample taken from the bottom of pile bore (not at 1.0 m above the bottom of the pile bore)</p> <p>d) Minimum two welding sets shall be kept ready to join the two cages of reinforcement by engaging 3 or more welders. This will ensure the lowering of R/F cage in minimum time.</p> <p>e) While lowering the R/F cage into the pile bore, two hooks shall always be used to ensure balanced/symmetrical insertion of cage into the pile bore.</p> <p>f) Concrete cover blocks at the junction of two R/F cage shall be ensured before lowering the second segment.</p> <p>g) Surge concreting of about 1.0 cum shall be ensured at the start of concreting (i.e. in the first pour), by suddenly allowing to fall through the tremie pipe from the funnel. This will help in displacing left out muck/debris in the pile bore (by the impact).</p> <p>h) Continuous feeding of concrete shall be ensured by deploying at least two transit concrete mixers (if required to be deployed) and mixing done through concrete batching plant (if deployed). Cold joints in the pile shall be avoided.</p> <p>i) In a pile group, SPT shall be carried out at termination level in the pile, taken up first.</p> <p>j) Bentonite slurry circulation to be ensured from start of boring to start of concreting. Flushing of bentonite slurry will only ensure maintaining of density of bentonite slurry uniformly and will not allow bentonite jelly to settle at the bottom, whereas air lift technique with bentonite circulation will ensure removal of muck debris from the bottom of pile bore.</p> <p>k) Properties of drilling mud shall be checked prior to commencement of the piling work and thereafter, minimum once per week or as found necessary by the Owner. One sample consisting of 3 specimens shall be tested for the above.</p> <p>l) Low strain pile integrity test on all job piles and test piles shall be conducted as specified in the Technical Specification. This test shall be suitably used to identify the piles for routine tests. High Strain dynamic test shall be done as per the technical specification. The frequency of the test shall be as per the BOQ</p> <p>m) For Working Piles: Minimum one sample consisting of 6 test cubes shall be made for first ten piles. Out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength. Minimum one sample of 6 test cubes for every 25 nos. of piles shall be tested, out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength</p> <p><b>PILE LOAD TEST</b></p> <p>Pile load testing shall conform to the requirements of IS-2911 (Part IV) and the technical specification. Initial load tests as specified in the contract documents shall be conducted to assess the safe load carrying capacity of pile before start of work. To verify the load carrying capacity of the working piles, routine load test shall be conducted.</p>			
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<p><b>11.1.14</b></p> <p><b>11.1.15</b></p>	<p>Pile load-testing procedure and the test setup / scheme shall be submitted for approval of OWNER. The contractor shall use the test setup having arrangement for anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge for both vertical compression and uplift (tension) Load test (initial) on piles. The cost of reaction system / piles shall deem to be included in the cost of test piles</p> <p>All the gauges and instruments shall be calibrated before the start of the tests on test piles and working piles and the calibration record shall be verified before start of execution of the test.</p> <p><b>WATER SUPPLY, DRAINAGE &amp; SANITATION</b></p> <p>Material used for sanitary and plumbing fittings and fixtures shall conform to and be tested as per the requirements of relevant IS Codes specified in OWNER technical specification.</p> <p>The obstructions in sewer lines shall be checked by inserting a smooth ball, of diameter 13 mm less than the pipe bore at the high end of the sewer or drain. If absence of any obstructions, such as yarn or mortar projecting through the joints, ball shall roll down the invert of the pipe and emerge at the lower end. The straightness shall be checked by means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of the light may be observed. The mirror will also indicate obstruction in the barrel, if the pipeline is not straight.</p> <p>The service pipes shall be slowly and carefully charged with water, allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under test / working condition of pressure and flow, when all draw-off taps are closed. The service pipes shall be checked for satisfactory support and protection from damage, corrosion and frost.</p> <p><b>ARCHITECTURAL &amp; MISC. WORKS</b></p> <p>Material used for sanitary and plumbing fittings and fixtures, floor finishes and allied work shall conform and tested as per the requirements of relevant IS Codes specified in OWNER technical specification.</p> <p>Fabricated item like metal doors, windows, ventilators, louvers, rolling shutters and grills etc. shall be checked for correctness of locations and smoothness of operation and fixtures. All controls and locking devices shall give fault free performance. Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm. For double leaf doors, the gap at the meeting stiles shall not be more than 2.5 mm.</p> <p>Materials used in glass and glazing shall be procured from source approved by OWNER and shall conform to the requirements of the Technical Specification and IS Codes.</p> <p>False ceiling panels shall be best quality material in thickness and properties called for in the specification / schedule of items. Material Test Certificate to be submitted before bulk supply.</p> <p>All bought items covered in the scope of contract shall be procured from sources approved by OWNER and shall conform to the requirements of the technical specifications and referred standards /codes.</p>			
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<b>11.1.16</b>	<p><b>ROAD WORK</b></p> <p>Quality Assurance and testing requirements for roadwork shall be as per the MORTH-Specification (latest), IRC specifications as specified in the technical specifications and BOQ of the contract.</p> <p>The testing and sampling shall include the checks on earth work for embankment and subgrade, sub bases and bases and bituminous constructions. The sampling and testing of concrete pavements shall be as per the respective items of earthwork, subgrade / sub-base, concrete, etc.</p>			
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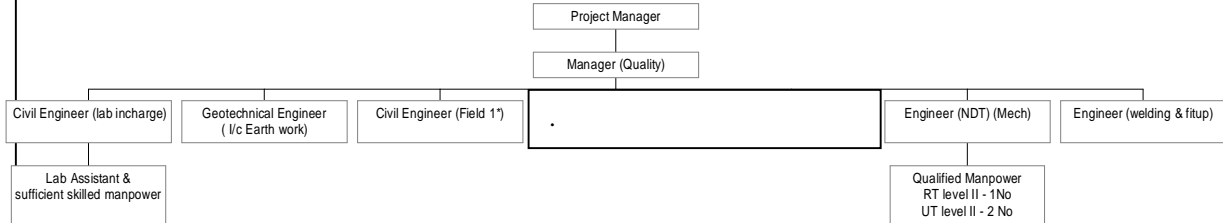
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**ANNEXURE-I**

**QA&QC ORGANISATION SETUP**



**NOTE:**

1. The above organization setup is minimum however their deployment shall be as per the agreed deployment schedule. The contractor shall prepare a manpower deployment schedule in line with the finalized work plan and the same shall be submitted to the engineer-in charge for acceptance/ approval.
2. The contractor shall mobilize the QA& QC manpower in line with the finalized manpower deployment schedule and shall ensure their availability well in advance (15 days approx.) of the beginning of the concerned activity/ work.
3. The contractor shall further mobilize required number of skilled & supporting staff and additional resources, if any to meet the work schedule.
4. \* For concrete work 2 Nos ( one for foundation work & one for superstructure)
5. \*\* For lines and levels - 1 No.
6. \*\*\* For Finishes and cladding work - 1 No



LIST OF SPECIALIST INSTITUTES / ORGANIZATIONS FOR TESTING AND EVALUATION OF BUILDING MATERIALS				
SI No.	Name of the Institute	Contact Person	Test Facilities	Special Studies / Investigation
1	Indian Institute of Technology Bombay, Powai, Mumbai - 400076	Head, Deptt of Civil Engg, Phone : 022 25722545	Mix design and material properties on selective basis	In situ non destructive testing (UPV) of concrete structures, design of mass concrete, temperature studies, distress assessment
2	Indian Institute of Technology Madras, Chennai- 600 036	Head, Deptt of Civil Engg. Phone: 044 22574266/5255	Selective specialised studies such as design of fly ash concrete and special concrete, non destructive testing (UPV) of structures	
3	Indian Institute of Technology Guwahati -781039	Head, Deptt of Civil Engineering, Phone : 0361 2582401, 258 2442, 258 2440	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, steel reinforcement, petrography, alkali aggregate reactivity, mix design	In situ non destructive testing (UPV) of concrete structures (selective basis), design of mass concrete, studies on properties of fly ash concrete
4	Indian Institute of Technology Kanpur (UP) - 208016	Head, Deptt of Civil Engineering, Phone: 0512 2597346	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design	Non destructive testing (UPV) on concrete structures, structural health assessment
5	Indian Institute of Technology Kharagpur (WB) -721302	Head, Deptt of Civil Engineering, Phone: 03222 283421	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design, petrography	
6	Indian Institute of Technology Delhi, Hauz Khas, New Delhi - 1100 016	Head, Deptt of Civil Engineering, Phone:01126591191	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design	In situ non destructive testing (UPV) of concrete structures (selective basis)
7	Indian Institute of Technology, Roorkee - 247667	Head, Deptt of Civil Engineering, Phone: 01332 285439, 273560	Testing and evaluation of cement(physical and chemical), aggregates (mechanical), fly ash (physical and chemical), admixtures, water, steel reinforcement, mix design, petrography, alkali aggregate reactivity	Various tests on other building materials such as silica fume, mass concrete, steel, bricks, tiles, doors, ferrocement covers, pipes, bridge bearings, PVC water tanks, etc
8	Indian Institute of Science Bangalore 560012	Head, Deptt of Civil Engineering, IISC Bangalore	Design of roller compacted concrete, radiation shield concrete, high volume fly ash concrete, fire behavior of concrete, micro cracking of concrete, non destructive testing (research & development) activities, behavior of concrete under shrinkage and creep, assessment of fire damaged concrete	IISc basically involved in r&d activities related to civil engineering and may only be contacted in case of specific studies / consultancy.
9	Institute of Technology, Banaras Hindu University (BHU) Varanasi (UP) -221005	Head, Deptt of Civil Engineering, Phone: 0542-2307016	Testing and evaluation of cement physical properties), aggregates (mechanical properties), admixtures, water, mix design, petrography	

LIST OF SPECIALIST INSTITUTES / ORGANIZATIONS FOR TESTING AND EVALUATION OF BUILDING MATERIALS				
SI No.	Name of the Institute	Contact Person	Test Facilities	Special Studies / Investigation
10	Central Building Research Institute (CBRI), Roorkee - 247667	Head, Structural engineering division, Phone: 01332 283382	Testing and evaluation of cement (physical and chemical), aggregates (mechanical), fly ash (physical and chemical), admixtures, water, mix design, alkali aggregate reactivity	Fire rating of doors, non destructive testing of structures, various tests on other building materials such as bricks, steel, tiles, etc
11	Central Soil and Materials Research Station (CSMRS), Near IIT Delhi, Olof Palme Marg, New Delhi - 110016	Joint Director Phone: 011 26962608	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, petrography, alkali aggregate reactivity, mix design	Various tests on other building materials such as steel, geotextiles, geomembrane, soil, instrumentation, monitoring, etc
12	National Council for Cement and Building Materials (NCB), 34 KM Stone, Delhi Mathura Road Ballabgarh(Har)	Head, Center for Construction Development & Research Phone : 0129 2246173	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, petrography, alkali aggregate reactivity, temperature cycle test, XRD, steel reinforcement, mix design	In situ non destructive testing (UPV) of concrete structures and special studies, testing of bricks, paving blocks, steel bars, silica fume, etc
13	National Council for Cement and Building Materials (NCB), NCB Bhawan, Old Bombay Road Hyderabad 500008	General Manager, Phone 040 23000344, 040-23000343	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, petrography, alkali aggregate reactivity, steel reinforcement, mix design	In situ Non destructive testing (UPV) of concrete structures (selective basis)
14	National Test House, Taramani Chennai 600 113	S.O.(Civil) Phone:04422432374, Fax:04422433158	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, steel reinforcement, water, mix design	Various tests on other building materials such as paving blocks, GI pipes, wires, steel plate, flush doors, <b>salt spray test</b> , etc
15	National Test House, Block CP Sector V, Salt Lake city Kolkata-700 091	S.O. (Civil), Phone:033 2367 3870	Testing and evaluation of cement(physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, steel reinforcement, mix design	Various tests on other building materials such as paving blocks, GI pipes, wires, steel plate, flush doors, etc
16	National Test House (NTH), Kamla Nehru Nagar, Ghaziabad (UP)	S.O. (Civil), NTH Ghaziabad	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, stel reinforcement	Timber, clay products, water proofing compound, flush doors, laminated sheets, plywood, etc
17	Structural Engineering Research Centre (SERC), Taramani, Chennai 600 113	Head, Department of Material Testing, Phone: 044 22549152, 22541735	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, steel reinforcement water, mix design	In situ Non destructive testing (UPV) of concrete structures (selective basis) and special studies such as cement admixture compatibility, design of special concrete, evaluation of structures

LIST OF SPECIALIST INSTITUTES / ORGANIZATIONS FOR TESTING AND EVALUATION OF BUILDING MATERIALS				
SI No.	Name of the Institute	Contact Person	Test Facilities	Special Studies / Investigation
18	Vishveswaraiya National Institute of Technology(VNIT), Nagpur (MH) - 440010	Director, VNIT Nagpur, Phone:0712 2223710, 2222828	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design, petrography	In situ non destructive testing (UPV) of concrete structures and soil tests
19	Anna University, Department of Structural Engineering, Chennai - 600 025	Head, Deptt of Civil Engineering	Testing and evaluation of cement (physical and chemical) , aggregates (mechanical properties) , fly ash (physical and chemical) , admixtures, water, mix design	
20	Shriram Institute for Industrial Research, 19 University Road, Delhi 110007	Dr (Mrs) Laxmi Rawat, Asstt Director & Chief Phone:011 27667267	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design	Various tests on other building materials such as steel, geotextiles, geomembrane, soil, bricks, tiles, etc
21	Spectro Analytical Lab, E-41, Okhla Indl Area, Ph II, New Delhi 110021	Phone: 011 26383048-49 Fax: 40503150, 40503151	Testing of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water	Chemical and physical tests on steel reinforcement
22	Motilal Nehru National Institute of Technology (MNIT), Allahabad - 211004	Director, MNIT Allahabad, Phone: 0532 2271305, Fax: 0532 2545341	Testing and evaluation of cement (physical and chemical) , aggregates (mechanical properties), fly ash (physical and chemical), admixtures, steel reinforcement water, mix design	In situ non destructive testing (UPV) of concrete structures.
23	Govt Engineering College, Jalpaiguri (WB) - 735102	Head Deptt of Civil Engg, Fax: 03561256143	Testing and evaluation of cement (physical) , aggregates (mechanical properties), water, mix design	
24	College of Engineering Pune - 411005	Head Deptt of Civil Engg, Phone No : 02025507067, Fax : 02025507299	Testing and evaluation of cement (Physical & Chemical properties), fly ash (Physical & Chemical properties), aggregates (Mechanical properties except alkali aggregate reactivity & Petrography), water, admixtures and mix design	
25	Maulana Azad National Institute of Technology, Bhopal (MP)	Head Deptt of Civil Engg, Phone No : 07554051390	Testing and evaluation of cement (physical) , aggregates (mechanical properties),water, mix design	In situ non destructive testing (UPV) of concrete structures and soil tests.
26	National Institute of Technology, Rourkela (Odisha)	Head Deptt of Civil Engg, Phone No : 06612462300	Testing and evaluation of cement (physical) , aggregates (mechanical properties), mix design,	In situ non destructive testing (UPV) of concrete structures and soil tests. Test on steel reinforcement, bricks and bitumen



**ANNEXURE - III**

**Format of Request Letter for Evaluation of Materials**

Ref: \_\_\_\_\_

Date: \_\_\_\_\_

To,

**Sub.: Evaluation of materials and concrete mix design**

Dear Sir,

We have awarded the work of ..... on M/s ..... vide our LOA No. ....dated.....for execution of Civil Works. Based on provisions of contract, M/s ..... are expected to get the following tests/ evaluation done through your laboratory and accordingly the tests have been described below.

M/s ..... have been advised to deposit the requisite evaluation/ testing charges and to deliver the test samples of quantities, specified below.

**1. Evaluation of Cement:**

- a) To carry out different physical tests on cement samples i.e. Blaine's fineness, initial and final setting time, soundness and compressive strength at 3, 7 and 28 days as per IS: 4031 and drying shrinkage and specific gravity in case of PPC.
- b) To carry out chemical analysis of the cement samples as per IS: 4032, including the total alkali content of the cement (Na<sub>2</sub>Oequivalent).
- c) To advise the suitability of cement based on the test results of a) and b) above.

**2. Evaluation of Aggregates:**

- a) To carry out different tests on coarse aggregate sample i.e. specific gravity, water absorption, sieve analysis, deleterious material; soundness, crushing value, impact value, abrasion value, elongation index and flakiness index, as per IS: 2386.
- b) To carry out different tests on fine aggregate sample i.e. specific gravity, water absorption, sieve analysis soundness, deleterious material, silt content, clay content and organic impurities as per IS: 2386 and mica content.
- c) To prepare evaluation report based on test results of a) and b) above and to advise regarding suitability of fine and coarse aggregates to be used with the cement of 1) above.

**3. Evaluation of Aggregates for Potential Alkali-Aggregate Reactivity:**

- a) To carry out petrographic analysis and accelerated Mortar bar Test on aggregate samples (1N NaOH at 80 deg. Centigrade for 14 days as per ASTM 1260, or the method established/ developed by CSMRS for 22days test).
- b) If rock type is limestone, X-Ray diffraction test (XRD) shall be carried out to determine clay mineral in the rock for preliminary conclusions and to carry out repeated temperature cycle test to determine residual expansion of aggregate for concrete to be used in dynamic foundations like TG, Fans, mills, crushers etc. Additionally, Alkali carbonate reactivity test shall be carried out as per ASTM C 1105 wherein the parameters shall be reported in conjunction with the petrographic analysis.
- c) To prepare a report based on test results of a) and b) above and to advise regarding suitability of aggregates to be used with the cement of 1) above and further testing required if any.



**4. Evaluation of Flyash Sample:**

- a) To carry out various physical and chemical tests on fly ash sample i.e. Blaine's fineness, lime reactivity, specific gravity, loss on ignition and other chemical tests as per IS: 3812, conforming to grade-I.
- b) To advise the suitability of fly ash sample based on the test results of a) above.

**5. Evaluation of water:** To carry out various physical and chemical tests as per IS: 456 and IS: 3025.

**6. Evaluation of admixtures:** To carry out various physical and chemical tests as per IS: 9103.

**Note:** Test certificate shall be obtained from the supplier to compare the values given in Table 2 of IS: 9103 i.e. uniformity requirements.

**7. Concrete Mix Design:** Based on the provisions of technical specification, the Following may be specified by site Construction department/Quality department \*\*

- a) For RCC Work
  - i) Grade of concrete
  - ii) Slump required, mm:
  - iii) Cement- Type and grade
  - iv) Max Size of Aggregates, mm
  - v) Exposure conditions
  - vi) Maximum water-cement ratio
  - vii) Minimum cement content
  - viii) Plasticizer/ admixture to be used or not (If yes, specify the brand/ type/batch no. of plasticizer)
  - ix) Fly ash to be used or not (If yes, indicate % of fly ash to be used)
- b) For PCC work: Same as i) to ix) of a) above
- c) For piling work (if required): Same as i) to ix) of a) above

**8. Details of material sampled:** In order to facilitate the above mentioned tests, specified quantities of samples have been collected and sealed jointly (by OWNER – Quality department and contractors' representative) is being sent for testing. The impression of seal has also been punched below.

**a) Quantity of material required for each mix-design:**

Sl. No.	Material Description	Quantity Required
i)	Cement	2 bags (sealed in double polythene bags)
ii)	Coarse Aggregates	100 Kg of each fraction as explained below : e.g.; If Maximum size of aggregates (MSA) is 20mm, then 100 Kg each of 20-10mm and 10mm down are required. If MSA is 40mm then 100Kg each of 40-20mm, 20-10mm and 10mm down are required.
iii)	Fine Aggregates	200Kg
iv)	Chemical Admixtures	2 Litres
v)	Water	100 Litres
vi)	Fly ash (If decided to be used)	100Kg



**b) Quantity of material required for Alkali-Aggregate reactivity**

Sl. No.	Material Description	Quantity Required
i)	Coarse aggregate	
a)	80-40mm	60Kg
b)	40-20mm	60Kg
c)	20-10mm	60Kg
d)	<10mm	60Kg
ii)	Fine aggregates	60Kg
iii)	Cement	2 samples (1 bag each), contemplated for use in construction.

**c) Impression/ Punch Mark of seal:**

You are requested to kindly forward us the test reports along with the recommendations regarding the suitability of materials to us at the earliest.

Thanking you,

Yours faithfully,  
Name:  
Contact Number:  
Email ID:

(Quality department Representative of OWNER)

**Note:**

1. Based on provisions of technical specification, the testing charges for all the above mentioned tests shall be borne by the contractor.
2. The content of the letter is for guidance only, and if required may be suitably modified to suit the specific requirements of the package in consultation with QA-Civil.

\*\* This line may be deleted in the letter sent to the institute.

**TYPICAL QA/QC LAB EQUIPMENT**

Project: RGTPP HISAR

Package: FGD

Sl. No.	Equipment	Nos.
1	Vicat Apparatus with deskpot	2
2	Le Chatelier flask & Mould	2 each
3	Automatic/Manual concrete & Mortar Mixer	1 set each
4	Cube Moulds for cement testing	12
5	Vibration Machine	1
6	Length comparator	2
7	Shrinkage Bar mould	2
8	Automatic Sieve shaker	1
9	IS Sieves for coarse & fine aggregate	1 set for each
10	IS Sieves for coarse aggregate for Road	1 set
11	Proctor testing equipment	2 sets + 18 cores
12	Slump testing equipment	6 sets
13	Oven	2
14	Physical balance	1
15	Rapid moisture meter	2
16	Thermometer	4
17	Burret	2
18	Measuring cylinders	9
19	Measuring flasks	3
20	Compression testing machine	2 sets of 2000 kN capacity each
21	Cube moulds	30
22	Electronic balance	2 (12 kg capacity), 2 (200 mg capacity)
23	pH balance	As per requirement
24	Radiographic facilities	As per requirement, Party should deploy BARC approved agency for carrying out RT
25	Mechanical weighing machine	1 (100 kg capacity)
26	Ultrasonic testing machine	As per requirement
27	D.P. Test kit	10
28	Vernier 300 mm, 600 mm	2
29	Micrometer (0.25 mm) out side (25.00)	2
30	Radiography film viewer	2
31	Inside Micrometer 25-750 dia	2
32	Digital elcometer for paint thickness	2
33	Baking oven for electrode	3
34	Portable ovens	2
35	Rebar detector to locate the reinforcement before core cutting operation	1
36	Concrete coring machine (55mm, 60mm upto 150 mm dia core bit)	1
37	Rebound hammer	1
38	Ultrasonic pulse velocity tester	May be arranged from specialist laboratory.

CLAUSE NO.



Quality Assurance for Civil Works

39	Curing tank	1 set
40	Flakiness and elongation index test gauges	2 each
41	Atterberg Limits set-up (Liquid Limit and Plastic Limit) and Shrinkage Limit Apparatus with mercury	1 set each
42	Impact testing machine	1 set
43	Pycnometer	2 set
44	Crushing value apparatus	1 set
45	Los angeles Abrasion Testing Machine	1 set
46	Free swell Index Apparatus	1 set
47	Bitumen Extractor Machine	1 set

Note:

1. The equipments listed above are indicative and required to be mobilized as minimum requirement. Additional equipment if any, required for successful completion of work shall be provided /arranged by the contractor.
2. All test reports/ inspection reports have to be computerized and maintained on LAN with an access to the owner
3. Computers - 2 Nos shall be deployed with Windows operating system and connected to the OWNER server
4. Based on the schedule (L2/L3 Network), Quality control & Quality Assurance work plan shall be finalized by the contractor and the same shall be submitted to the engineer-in-charge for acceptance/approval. The Finalized work plan shall be maintained on the computer to be accessed by the owner for database and day to day monitoring.



LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN				PROJECT:	RGTPP HISAR (2X600 MW)			
		ITEM : CIVIL WORK	QP NO. :	1	PACKAGE:	FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE				
Sl. No	Activity and operation	Characteristics / instruments	Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
								9	D*	
1	2	3	4	5	6	7	8	9	D*	10
1	<b>GENERAL REQUIREMENTS</b>									
A	Setting up of Field QA&QC laboratory	As agreed / required	A	Physical	Once prior to start of work	Tech Specs and Const. Drawings	SR	√		Functioning of laboratory equipment in proper working condition to be verified on monthly basis
B	Availability of requisite laboratory set up and equipment in good working condition well before commencement of concerned activity	As agreed / required	A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings	SR	√		
C	Submission of QA & QC manpower deployment schedule based on agreed L-2 network .	As agreed / required	A	Physical	Once prior to start of work	Tech Specs and Const. Drawings		√		
D	Availability of QA& QC manpower based on deployment schedule .	As agreed / required	A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings	SR	√		
E	Sampling for testing of building materials, concrete admixture, concrete mix design etc.	As agreed / required	A	Physical	Once per each source	Tech Specs and Const. Drawings	SR/TR	√		Test report along with the recommendations from Owner approved laboratories as mentioned in TS to be submitted to Owner.
F	Submission of schedule of tests to be done monthly / quarterly and maintenance of the same on a computer connected to LAN of Owner for monitoring	As agreed / required	A	Physical	Once prior to start of work and thereof monthly	Tech Specs and Const. Drawings	SR	√		
G	Stacking and storage of construction materials and components at site	As per IS:4082	B	Physical	Random	Tech Specs and Const. Drawings and IS: 4082	SR	√		
H	All bought out items to be procured from the approved vendor and on approval of Quality plans by Owner as per inspection Category	-	B	Verification of TC and/or Testing	100%	Tech. Spec. /BOQ	SR/LB	√		The TC submitted should bear proper identification or correlation with the batch of material supplied and same shall be brought out in the challan/ consignment note .
I	Submission of list of Bought out items and their vendors for each of the bought out item identified for approval within the period agreed in LoA.	-	A	Physical	One time	Tech. Spec. /BOQ	SR/LB			To be submitted to CQA for approval with a copy to site .
2	<b>EXCAVATION AND FILLING IN FOUNDATION WORKS</b>									
	<b>Excavations-</b>									
2.1	Nature, type of soil/rock before and during excavations	As agreed / required	B	Visual	Random in each shift	Tech Specs and Const. Drawings	SR			
2.2	Initial ground level before start of excavations	As agreed / required	B	Measurement	100%	Tech Specs and Const. Drawings	SR	√		
2.3	Final shape and Dimensions of excavations.	As agreed / required	B	Measurement	100%	Tech Specs and Const. Drawings	SR			
2.4	Final excavation levels	As agreed / required	B	Measurement	100%	Tech Specs and Const. Drawings	SR	√		
2.5	Side slope of final excavation	As agreed / required	B	Measurement	Random in each shift	Tech Specs and Const. Drawings	SR			
2.6	Excavation in Hard Rock- If required									
i	Receipt, Storage, accountability of Explosive	As agreed / required	B	Physical	Random in each week	Indian Explosive Act 1940/all statutory norms, Tech Specs and Const. Drawings	SR	√		Owner approved specialist blasting agency such as CMRI, NIRM shall be deployed at site for trial blasts, design blasts, blast vibration monitoring etc.
ii	Execution of Blasting Operation	As agreed / required	B	Physical	Random in each shift	IS:4081, Tech Specs and Const. Drawings	SR	√		Seismographs shall be deployed at site for monitoring of blast operation vibrations.
iii	Submission of Blasting report to EIC	As agreed / required	C	Physical	Each blast	Tech Specs and Const. Drawings		√		
2.7	Excavation in Hard Rock (Blasting Prohibited)	As agreed / required	B	Physical	100%	As per approved drawing/ scheme, Tech Specs and Const. Drawings	SR	√		

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN					PROJECT:	RGTPP HISAR (2X600 MW)		
		ITEM : CIVIL WORK	QP NO. :	1	REV. NO. :	0	PACKAGE:	FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		
		SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.	DATE :		CONTRACT NO.		MAIN CONTRACTOR			
			PAGE :							
Sl. No	Activity and operation	Characteristics / instruments	Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3	4	5	6	7	8	9	D*	10
	Fill/ Backfill -									
2.8	Suitability of borrow fill material									
i		Grain size analysis	Set of Sieves, Hydrometer etc.	B	Physical	Once per each type of source or change of source subject to a min. of 2 samples	IS:2720 (Pt.IV), Tech Specs and Const. Drawings	SR/TR	√	
ii		Liquid & plastic limit	Mechanical liquid limit device, grooving tools, Evaporating Disc, Spatula, Palette knives, Balance oven containers, etc.	B	Physical	Once per each type of source or change of source subject to a min. of 2 samples	IS:2720 (Pt.IV) , Tech Specs and Const. Drawings	SR/TR	√	
iii		Shrinkage limit	-do-	B	Physical	Once per each type of source or change of source subject to a min. of 2 samples	IS:2720 (Pt.IV), Tech Specs and Const. Drawings	SR/TR	√	
iv		Free Swell Index	Measuring cylinders, etc.	B	Physical	Once per each type of source or change of source subject to a min. of 2 samples	IS:2720 (Pt.XI), Tech Specs and Const. Drawings	SR/TR	√	
v		<b>Chemical Analysis</b>								
a		Organic Matter	Oven chemical balance, volumetric flasks, pipettes, conical flasks, set of sieves, measuring cylinders etc.	B	Physical	Once per each type of source or change of source subject to a min. of 2 samples	IS:2720 Pt.XXII, Tech Specs and Const. Drawings	SR/TR	√	
2.9	Standard proctor Test	Optimum moisture content and max. dry density before fill	As per IS: 2720, Proctor needle apparatus etc.	A	Physical	One in every 10000 cum for each type and source of fill materials	IS 2720 (Pt.VII), Tech Specs and Const. Drawings	SR/TR	√	
2.10	Moisture content	Moisture content of fill before compaction	As per IS: 2720, balance, oven etc.	A	Physical	One in every 10000 cum for each type and source of fill materials	IS 2720 (Pt.II), Tech Specs and Const. Drawings	SR/TR	√	
2.11	Degree Of Compaction Of Fill / Backfill									
i		Dry density by core cutter method ---- OR---- Dry density in place by sand displacement method	As per IS: 2720/compaction test (core cutter), balance etc.	A	Physical	i) For foundation fill/ backfill one for every 10 foundations for each compacted layer. ii) For area filling, one every 10000 SQM area for each compacted layer.	IS 2720 (Pt. XXIX), Tech Specs and Const. Drawings	SR/TR	√	
ii		Relative density (Density Index)	As per IS: 2720, balance oven etc.	A	Physical	----do---- (i) & (ii) above	IS 2720 (Pt. XIV), Tech Specs and Const. Drawings	SR/TR	√	
iii		Dry Density by proctor needle penetration	As per IS-2720, proctor needle apparatus etc.	B	Physical	Random checks to be carried out for each compacted layer	Tech Specs and Const. Drawings	SR/TR	√	
iv		Compaction using Rock boulders & construction debris (if applicable)	As agreed / required	A	Physical	i) For foundation fill/ backfill one for every 10 foundations for each compacted layer. ii) For area filling, one every 10000 SQM area for each compacted layer.	Tech Specs and Const. Drawings	SR/TR	√	Where rock boulders (broken into the pieces not more than 200 mm size), construction debris have been used for filling, it shall be compacted to minimum of 85% of original stack of material after filling the interstices with the selected excavated material.

		INDICATIVE FIELD QUALITY PLAN								
LOGO	SUPPLIERS NAME AND ADDRESS:	ITEM : CIVIL WORK		QP NO. :	1	PROJECT:	RGTPP HISAR (2X600 MW)			
		SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.		REV. NO. :	0	PACKAGE:	FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE			
				DATE :		CONTRACT NO.				
				PAGE :		MAIN CONTRACTOR				
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3		4	5	6	7	8	9	D*
3.0	MATERIALS									
3.1	CEMENT									
i		Retesting of cement	as per IS:4031	A	Testing	At Random	As per relevant IS Codes		Test Report	√ Each consignment of cement shall be duly correlated with manufacturers TC. In case the cement is supplied by the contractor one sample from each lot shall be tested for setting time and compressive strength . Acceptance norms shall be as per relevant IS. If cement is stored more than 90 days in godown of contractor same shall be retested for comp. Strength & setting time.
3.2	Coarse Aggregate									
i		Moisture content	IS:2386	B	Physical	Once for each stack of 100 Cum. or part there of	IS : 456/IS : 383/Tech Spec		SR/LB	√ during monsoon when this has to be done every day before start of concreting
ii		Specific gravity, water absorption	IS:2386	A	Physical	Once for each source & for every change of source	IS: 2386 Part-III, IS:383/Tech Spec	IS:456,	SR/LB/ Test Report	√
iii		Sieve analysis, flakiness index, elongation index,	IS:2386	B	Physical	One per 100 cum., or part thereof	IS: 2386 Part-I, Spec	IS:383/Tech	SR/LB	√
iv		Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale)	IS:2386	A	Physical	Once per source/ on every change of source	IS: 2386 Part-II, Spec	IS:383/Tech	SR/LB/ Test Report	√
v		Soundness	IS:2386	A	Physical	-do-	IS: 2386 Part-V, IS:383		SR/LB/ Test Report	√
vi		Alkali aggregate reactivity		A	Physical	-do-	IS: 2386 (Part-VII), IS:383 /Tech Spec/ASTM C-1260 / ASTM 1293		SR/LB/ Test Report	√ The aggregate type (deleterious/innocuous result should be supported by petrographic examination
vii		Petrographic examination	IS:2386 Pt VIII	A	Physical	-do-	IS: 2386 Part-VIII, IS:383 /Tech Spec		SR/LB/ Test Report	√
viii		Crushing value, abrasion value and impact value	IS:2386	A	Physical	-do-	IS:383, IS-2386 Part IV/Tech Spec		SR/LB/ Test Report	√
3.3	Fine Aggregate									
i		Moisture content	balance , oven etc.	B	Physical	To be done every day before start of work	IS: 2386 Part-III	IS:383	SR/LB/ TR	√
ii		Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale)	IS:2386	A	Physical	Once per source& for on every change of source	IS: 2386 Part-II, IS:383		SR/LB/ TR	√
iii		Silt content	As agreed/required	B	Physical	One per 100 cum., or part thereof	CPWD/Tech Spec/IS 2386/IS 456/IS 383		SR/LB/ TR	√
iv		All other tests similar to coarse aggregates as mentioned above.					IS-2386, IS-383		SR/LB/ TR	√ except test for flakiness index, elongation index, abrasion value, impact value

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		SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.	REV. NO. :	0	CONTRACT NO.					
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3.4	<b>Water</b>									
i		Complete Testing as per IS:456-2000	Burette, conical flask, pipette etc.	B	Testing	Once for each source and thereafter yearly in case of borewell. If water is used from open source like river, stream, canal etc., then water testing is to be done quarterly.	IS:456-2000		SR/LB/ TR	√
3.5	<b>CONCRETE</b>									
i		4 Trial mixes to ascertain the workability and cube strength	After receiving the recommended mix design from specialist agency.	A	Physical	One for each mix proportion	Tech. Spec.		SR/LB	√
ii		Crushing strength (works Tests cubes)	IS:516	A	Physical	One set of 6 cubes per 50 Chum or part thereof for each grade of concrete per shift whichever is earlier.	IS:516, IS:456, Tech. Spec.		SR/LB/ Test Report	√
iii		Workability - slump test	IS:1199	B	Physical	At the time of concrete pouring at site every two hrs	IS:456/Tech. Spec.		SR/LB/ TR	√
iv		Water content		B	Physical	Once per shift	As per approved design mix.		SR/LB	√
3.5.1	<b>Admixtures for Concrete</b>	Material/Type of admixture	As per IS:9103	A	Review of MTC/ test reports	For each lot received at site	Designed mix and IS:9103		Test Report/ MTC	√
3.6	<b>Concrete conveying, placing &amp; compaction</b>									
i	mixing of concrete shall be done in a approved mixer such as to produce a homogenous mix	Calibration of Batching Plant	batcher should comply with requirement of IS 4926/IS:4925	A	Physical	To be calibrated at the time of starting and subsequently once in three months, and shall conform to IS:4925	Review of calibration chart/ Certificate/IS 4925		Calibration Certificate	√
ii		Arrangement for transportation & placement of concrete.	As required	C	Visual	100%	Before clearance for concreting		Inspection Report	√
iii		Handling and Transportation of concrete	As required	B	Physical	100%	As per construction/erection methodology (to be approved one week prior to start of work)		SR	
iv		Placement of concrete	Visual	B	Physical	100%	As per construction/erection methodology and tech.specs / No segregation		SR	√
v		Compacting	As required	B	Physical	At Random	IS:456		SR	√
vi		Curing	As required	B	Physical	At Random	Period of curing as per IS 456 (use gunny bags / curing compound)		SR	√
3.7	<b>TEST/CHECK ON RCC STRUCTURE IN HARDENED CONDITIONS</b>									
i		Visual inspection of concrete surface of all dynamic foundations just after removal of shuttering	As required	A	Visual	100%	As per Technical Specification		SR	√
ii		Embedment of inserts in concrete shall be checked for gap if any using hammer for all dynamic foundations	Hammer	B	Physical	100%	As per Technical Specification		SR	√

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iii		Core Test	IS:516	A	Physical	As required by Owner EIC.	As per IS:456, IS 516	SR/LB/ Test Report	√	Compressive strength based on core test is required to be carried out in case of doubt regarding the grade of concrete used, either due to poor workmanship or based on the results of cube strength test as per 3.5 ii) above / discretion of EIC..
iv		Rebound Hammer test	IS:13311	A	physical	as required by the Owner EIC	As per relevant / tech. Specification.	SR/LB	√	This test may be carried out to assess the strength of concrete in case of non-critical and lightly loaded structures as the discretions of EIC
v		Dimensional check on finished structures & Dimensional tolerances	As required	B	Measurement	Approved Drawing	As per IS:456/ tech. Specification.	SR/LB	√	
vi		Water Tightness Test of liquid retaining structure/ tanks	As required	A	Test	100%	IS:3370/ Tech. Specification	SR/LB	√	
3.8	<b>REINFORCEMENT STEEL</b>									
i		Physical and Chemical Properties for each lot	As required/ agreed	A	Review of MTC/ test reports	Each batch of delivery	IS : 1786, IS:432, IS:1566, Tech Specs and Const. Drawings	MTC	√	To be procured from Owner approved source
ii		Freedom from cracks surface flaws, Lamination & excessive rust.	As agreed / required	B	Visual	Random in each shift	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings	SR		To be checked at site. Steel collected from source should be free from excessive rust. To be stored as per Technical Specs.
iii		rust/ loose scale	As required	B	Physical	100%	IS:456, approved drawing and Tech specification	SR/TR		
3.9	<b>PLACEMENT OF REINFORCEMENT STEEL</b>									
i		Bar bending schedule with necessary lap, Spacers & Chairs	As agreed / required	B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings, IS:2502	SR	√	
ii		Bending of bars, cutting tolerance	As agreed / required	B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings, IS:2502	SR	√	
iii		Acceptance - Cover, spacing of bars, spacers and chairs after the reinforcement cage is put inside the formwork	As agreed / required	B	Visual & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings	SR	√	
3.10	<b>STAGING AND FORMS</b>									
i		Materials and accessories	As agreed / required	B	Visual	Once before start of work	As per relevant IS, Tech Specs and Const. Drawings	SR		
ii		Soundness of staging, shuttering and scaffolding including application of mould oil / release agent	As agreed / required	B	Visual	Once before start of work	As per manufacturer's spec.and as per 3696,4014, 4990, Tech Specs and Const. Drawings	SR		
iii		Acceptance of formwork before start of concreting		B	Physical / visual	Before start of each concreting	As per provisions and tolerances, Tech Specs and Const. Drawings	SR	√	
3.11	<b>INSPECTION OF CONCRETE SURFACE JUST AFTER REMOVAL OF FORM WORK</b>									
i	Visual inspection jointly with Owner	Concrete surface, position and alignment of embedded parts and inserts	--	B	Visual	Once for TG, BFP & MILL foundations	As per provisions and tolerances of equipment supplier, Tech Specs and Const. Drawings		√	Inspection protocol shall be signed Jointly by Contractor and Owner Erection

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ii	Submission of grouting / repair methodology if concrete surface / position and alignment of embedded parts / inserts are found defective	--	B	Review and approval	once for each type of defect	As per provisions and tolerances, Tech Specs and Const. Drawings		√		
3.12	<b>EMBEDDED PART(INCLUDING LAYING OF RAILS &amp; ANCHOR FASTENERS)</b>									
i		Position / alignment / levels of embedded parts / bolt hole / pipe sleeves / rails / PVC pipes / etc	As agreed / required	B	Physical/ measurement	100%	As per drawing, Tech Specs and Const. Drawings	SR/ Protocol	√	Exposed surface of the embedded parts other than holding down bolts are to be painted with as per technical specifications
ii		Welding / tying of embedment to reinforcement	As agreed / required	B	Physical/ measurement	Random in each shift	As per drawing, Tech Specs and Const. Drawings	SR		
3.13	<b>PRE-CAST CONCRETE</b>									
i		Crushing strength	compression strength testing machine	A	Physical	one sample of six cubes per 50m m3 or part thereof	IS:516 & IS: 456	SR/LB	√	A minimum of three specimen shall be tested for 7 and 28 days compressive strength
ii		Workmanship and dimensions	Visual	B	Physical	100%	As per IS:456/Tech. Specification.	Register		
3.14	<b>JOINTS IN CONCRETE</b>									
i		Joint material - bitumen impregnated fibre board, PVC water stops, Sealing compound, Expanded polystyrene board, Hydrophilic strip, Acrylic polymer etc.	As per manufacturer Standards	A	Review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings, IS 1838, IS 1834, IS12200	MTC	√	
ii		Acceptance of installation	As agreed / required	B	Acceptance	Each installation randomly	Tech Specs and Const. Drawings			
3.15	<b>DAMP PROOF COURSE</b>									
i		Material - Hot bitumen and water proofing materials etc.	As agreed / required	A	Review of MTC/ test reports	Each batch of delivery at site	Tech Specs and Const. Drawings, IS 702	SR/MTC	√	
ii		Acceptance of damp proof course	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR		
3.16	<b>GROUTING</b>									
i		Material	As agreed / required	A	Review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings	SR/MT C	√	
ii		Type of mix - fluid mix, plastic mix, stiff mix etc.	As agreed / required	B	Physical	Prior to start of work	Tech Specs and Const. Drawings	SR	√	
iii		Mixing, placement, application and grout pressure	As agreed / required	C	Physical	Random in each shift	Tech Specs and Const. Drawings	SR		
iv		Compressive strength	As agreed / required	A	Physical	Random in each shift	Tech Specs and Const. Drawings	SR	√	
v		Acceptance of the grouts	As agreed / required	B	Physical	Each grout section	Tech Specs and Const. Drawings	SR		
3.17	<b>SLIPFORM SHUTTERING</b>									
i		Submission of Slip form Work system to be used	-	B	Submission	Before Commencement of work	As per specifications	SR		
ii		Check for the Slip form shutters	As required	B	Physical	Before Commencement of work	As per specifications	SR		Check for water level system, Controls, Walkways etc.
iii		Details Positions and arrangement of Jack rods	-	B	Approval	Before Commencement of work	As per specifications	SR		Submitted to EIC for approval

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iv		Details of Proposed arrangement for continuous readings	-	B	Approval	Before Commencement of work	As per specifications	SR		Submitted to EIC for approval
v		Check for All type of openings, Chases, Fixing of Blocks and similar built-up features	As required	B	Physical	100% during execution	Construction Drawings and specifications	SR		No any type of openings ,chases , blocks other than shown in the construction drawings or approved by EIC shall be executed in the concrete.
vi		Details of proposed method for concrete curing and protection	-	B	Approval	Before Commencement of work	Construction Drawings and specifications	SR		Submitted to EIC for approval
vii		Check of Concrete Curing and Protection	As required	B	Physical	At Random	Construction Drawings and specifications	SR		Concrete shall not remain uncured for period longer than 12 hours
viii		Check for Sliding Operation & Monitoring of Sliding Portion	As required	B	Physical	Each Sliding	As per specifications	SR		Rate of Sliding, Delays in sliding, Discontinuity or stop start sliding to be checked
ix		Progress Height	As required	B	Physical	Six hourly intervals	As per specifications	SR		To be recorded in tabular form and on graphs immediately after each monitoring
x		Centre line in relation to the centres at the base	As required	A	Physical	Six hourly intervals	As per specifications	SR	✓	To be recorded in tabular form and on graphs immediately after each monitoring
xi		Internal wall faces in relation to the concrete at the base	As required	B	Physical	Six hourly intervals	As per specifications	SR		To be recorded in tabular form and on graphs immediately after each monitoring
xii		Wall thickness	As required	B	Physical	Six hourly intervals	As per specifications	SR	✓	To be recorded in tabular form and on graphs immediately after each monitoring
xiii		Twist	As required	B	Physical	Six hourly intervals	As per specifications	SR	✓	To be recorded in tabular form and on graphs immediately after each monitoring
xiv		Verticality of the structure	Optical Theodolite	B	Physical	Every day in morning	As per specifications	SR		To be recorded in tabular form and on graphs immediately after each monitoring
xv		Check for Tolerances for chimney construction	As required	B	Physical	For every day monitoring	As per specifications	SR		
4.00	<b>BRICK MASONARY</b>									
4.1	<b>Test on Bricks</b>									
		Compressive strength, water absorption	As agreed / required	A	Measurement/ Physical Test	As per relevant IS Code/ One Sample for 30,000 nos. or part thereof	IS: 1077, IS:13757, IS: 12894 / Tech Specs and const. Drawings	Inspection Report	✓	
i		Dimensions , shape, warpage, efflorescence.	As agreed / required	B	Measurement/ Physical Test	As per relevant IS Code/ One Sample for 30,000 nos. or part thereof	IS: 1077, IS:13757, IS: 12894 / Tech Specs and const. Drawings	Inspection Report	✓	Efflorescence shall be checked at each source. Warpage test is applicable for facing bricks only as per IS:2691. For clay bricks as per IS 1077, warpage test is not required.
4.2	<b>Test on Mortar</b>									
i		Compressive strength	As agreed / required	B	Test	At random	IS 2250-1981, Tech Specs and Const. Drawings	LB		
ii	<b>Sand</b>	Grading	As agreed / required	B	Test		IS:2116	SR/LB		
4.3	<b>Masonry construction</b>									
		Workmanship, verticality and alignment	As agreed / required	B	Visual/ Physical	100%	IS 2212, IS 1905 , Tech Specs and Const. Drawings	SR/LB		
5.00	<b>FINISHING AND ALLIED WORKS</b>									
5.1	<b>PLASTERING- MATERIAL</b>									

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i	Sand	Deleterious Material	As agreed / required	B	Physical	Once per source	IS : 2386 (Part-I &II) & IS :2116, Tech Specs and Const. Drawings	SR			
ii		Grading	As agreed / required	B	Physical	50 Cum./or part thereof	Tech Specs and Const. Drawings	SR			
iii		Silt content	As agreed/required	B	Physical	One per 100 cum., or part thereof	CPWD/Tech Spec/IS 2386/IS 456/IS 383	SR/LB/TR	√		
iv	Galvanised wire mesh	Galvanized hexagonal wire netting for lath plastering	As agreed / required	B	Review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC			
<b>5.2 PLASTERING - WORKMANSHIP</b>											
i		Curing	As agreed / required	C	Visual	100%	Tech specifications, construction drawings and agreed methodology	SR			
ii		Thickness and finishing of plaster, grooves etc.	As agreed / required	B	Visual/ Measurement	Random in each shift	Tech Specs and Const. Drawings	SR/LB			
iii		Trueness of plastering system	As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings	SR			



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5.3	<b>STONE GRIT PLASTER/ GRANULAR TEXTURED COAT FINISH</b>										
i		Material	As agreed / required	B	Review of MTC	For each lot received at site	Tech Specs and Const. Drawings	SR/MTC	√		
ii		Thickness, finishing and grooves etc.	As agreed / required	B	Visual/ Measurement	Random in each shift	Tech Specs and Const. Drawings	SR	√		
6.00	<b>SHEETING AND OTHER WORKS</b>										
6.1	<b>PAINTING SYSTEM - CONCRETE WORKS AND PLASTERED MASONARY SURFACES</b>										
i		Materials and accessories- Oil Bound, Acrylic Emulsion, Chemical Resistant, Oil Resistant Paint etc.	Shade, type from brand and manufacturer as approved by EIC.	As agreed / required	A	Review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	√	Mfr.'s T.C. shall be correlated with the consignment received.
ii		Surface preparation	As required	As agreed / required	C	Physical /visual	Random in each shift	Tech Specs and Const. Drawings	SR		
iii		Acceptance of painted surfaces	As required	As agreed / required	B	Physical/visual	Each surface at random	Tech Specs and Const. Drawings	SR		
6.1.1	<b>PAINTING SYSTEM - STEEL WORKS (OTHER THAN STRUCTURAL STEEL WORKS)</b>										
i		Painting Materials and accessories	-	As agreed / required	A	Review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	√	Mfr.'s T.C. shall be correlated with the consignment received.
ii		Surface preparation	As agreed / required	B	Physical /visual	Each Erection Mark	Tech Specs and Const. Drawings, Relevant code/ standards	SR	√		
iii		Primer Thickness	Elcometer	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR	√		
iv		DFT of paint	Elcometer	A	Measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR	√		
v		Acceptance of painted surfaces	Elcometer	B	Visual and measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR			
6.2	<b>Modular aerated panel</b>	As required	As agreed / required	A	Review of MTC/test report	Each batch of delivery	Tech Specs and Const. Drawings	SR/LR/ MTC	√		
6.3	<b>Permanently colour coated sheets, metal decking</b>										
i		Storage	As agreed / required	B	Visual	Random in each shift	Tech Specs and Const. Drawings	SR		Prevention of distortion / blemishing / water staining	
ii		Installation, lap alignment & workmanship.	As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings	SR		No gas cutting of sheets acceptable .	
iii		Finishing and acceptance	As agreed / required	B	Visual/ Physical	Random in each shift	Tech Specs and Const. Drawings	SR/LB			
6.4	<b>INSULATION WORKS</b>										
i		Material	Insulation material, galvanised wire net, aluminium foil, fasteners	As agreed / required	A	Review of MTC/ test reports	For each lot received at site	Tech Specs and Const. Drawings	SR / LB/MTC	√	All tests as per specification
ii		Acceptance of each type of installation	As agreed / required	B	Visual/ Physical	Each installation	Tech Specs and Const. Drawings	SR/LB			
6.5	<b>PRE-ENGINEERED BUILDING</b>	Installation and acceptance	As agreed / required	A	Review of MTC/ test reports	For each building	Tech Specs and Const. Drawings	SR/LB/ MTC	√		
6.6	<b>CHIMNEY PAINTING</b>										
i		Requirements for Steel Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings	SR		No of Coats applied and DFT/WFT to be checked as per specified	
ii		Requirements for Cast Iron Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings	SR		No of Coats applied and DFT/WFT to be checked as per specified	
iii		Requirements for Concrete Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings	SR		No of Coats applied and DFT/WFT to be checked as per specified	
iv		Material Requirements	As Required	A	Review of MTC/ test reports	Randomly	Tech Specs and Const. Drawings	SR/MTC		Requirement of DFT to be checked as per Specifications.	
v		Preparation of Surfaces	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings	SR			
vi		Application of Paint	As Required	B	Physical	Randomly	Tech Specs and Const. Drawings	SR		AS per recommendations by Manufacturer along with Relevant IS Codes and Specification requirements	
7.00	<b>DOORS , WINDOWS VENTILATORS &amp; GRILL</b>										

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7.1	<b>Steel doors</b>										
i		Materials (MS sheet, fasteners, hinges, jamba, lock strike plate etc	As agreed / required	B	Visual/ Physical / test report	For each lot received at site	Tech Specs and Const. Drawings	SR / LB	√	Review of test report	
ii		Check for shape tolerances thickness, welding & finishing of sections	As agreed/required	B	Physical & acceptance	Random for each delivery	Tech Specs and Const. Drawings		SR		
iii	Checking of works	Acceptance of steel glazed doors, windows and T-iron shapes sections after fixing	As agreed/required	B	Physical & acceptance	Random	Tech Specs and Const. Drawings		SR		
iv		Acceptance of fixing after completion	As agreed/required	B	Acceptance	Random	Tech Specs and Const. Drawings		SR		
7.2	<b>Wood Work</b>										
i	Wood/Timber	Moisture content	Electrical Moisture meter as per IS 287	A	Physical	For each lot received at site	Tech Specs and Const. Drawings/ IS 287		SR/LB	√ To be carried out from Forest Research Institute Dehradun. Frequency of check may be decided by EIC based on quantity and requirement	
ii		anatomy	As agreed/required	A	Physical	One for each lot of timber	Tech Specs and Const. Drawings		SR/LB	√	
iii	Wood work in frames	Check for dimensions, surface finish	As agreed/required	B	Physical	Random for each installation	Tech Specs and Const. Drawings		SR		
iv	Flush Door shutter	End emersion test, knife test, adhesion test	As agreed/required	A	Review of MTC/ test reports	For each lot received at site	IS 2202, Tech Specs and Const. Drawings		SR/MTC	√ Review of test report	
v	Particle Door		As agreed / required	A	Review of MTC/ test reports	For each lot received at site	IS:12823, Tech Specs and Const. Drawings		SR/MTC	√ Review of test report	
vi		Acceptance	As agreed / required	B	Visual/ Physical	Random	Tech Specs and Const. Drawings		SR/LB		
7.3	<b>Anodised aluminium works</b>										
i		Materials- Aluminium sections, Coating	As agreed / required	A	Visual/ Physical / test report	For each lot received at site	IS: 1948, IS: 1949, IS:733, IS1285, IS:1868, IS:11857/ Tech Specs and Const. Drawings		SR / LB	√ Review of test report For aluminium door/windows, check for anodization as per Tech. Spec	
ii		Acceptance	As agreed / required	B	Visual/ Physical	Random	Tech Specs and Const. Drawings		SR		

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1	2	3		4	5	6	7	8	9	D*	10	
7.4	<b>Fire proof doors</b>											
i		Material	As agreed / required	A	Review of MTC/ purchase order (unpriced copy) / drawings of suppliers / certificate of CBR/CPRI/GOV. LAB.	For each source	Tech Specs and Const. Drawings	SR/MTC	√	The door drawing proposed for supply should have been tested and approved by CBR/ Roorkee/CPRI/GOV. LAB. for the similar dimensions for minimum 2 hours fire rating.		
ii		Receipt inspection	As agreed / required	A	Visual/ Physical/ Review of MTC	For each lot received at site	Tech Specs and Const. Drawings	SR/MTC	√			
iii		Finishing and acceptance	As agreed / required	B	Visual / physical	Random	Tech Specs and Const. Drawings	SR				
7.5	<b>Rolling shutters</b>											
i		Surface finish and thickness of plate of approved make and DFT	As agreed / required	B	Physical / visual / review of MTC	Random for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√			
ii		Finishing and acceptance	As agreed / required	B	Physical and acceptance	Random	Tech Specs and Const. Drawings	SR				
7.6	<b>Steel windows / Grills/ Louvre</b>											
i		Material fabrication and fixtures	As agreed / required	B	Review of MTC/ test reports	Each lot of delivery	IS: 1038 / IS:1361, IS: 7452 and Tech Specs and Const. Drawings	SR/MTC	√			
ii		Finishing and acceptance	As agreed / required	B	Visual / physical	Random	IS: 1038 / IS:1361, IS: 7452 and Tech Specs and Const. Drawings	SR	√			
7.7	<b>Glass and glazing</b>											
i	Clear float glass, wired glass, tinted glass, curtain glass, hermetically sealed glass	Material	As agreed / required	B	Review of MTC/ test reports	For each lot received at site	IS: 14900, IS:1081, IS: 3548, IS:5437 Tech Specs and Const. Drawings	SR/MTC	√			
ii		Installation finishing and acceptance	As agreed / required	B	Visual/ Physical	Random	Tech Specs and Const. Drawings	SR		Leak proof installation with neoprene gasket		
7.8	<b>Curved dome on roof/ Poly Carbonate Sheet</b>											
i	Source of supply	Impact strength, K value, light transmission value with class -I fire rating	As agreed / required	B	Review of MTC/ test reports	For each lot received at site	Tech Specs and Const. Drawings	SR/MTC	√			
ii		Installation finishing and acceptance	As agreed / required	B	Visual / physical	Random	Tech Specs and Const. Drawings	SR				
7.9	<b>Reflective toughened glass</b>											
i		Material	As agreed / required	B	Review of MTC/ test reports	For each lot received at site	Tech Specs and Const. Drawings	SR/MTC	√			
ii		Installation finishing and acceptance	As agreed / required	B	Visual / physical	Random	Tech Specs and Const. Drawings	SR				
7.10	<b>False Ceiling</b>											
i		Materials ( gypsum glass, glass fibre membrane, fibre board acoustical tiles etc)	As agreed / required	A	Review of MTC/ test reports	For each lot received at site	Tech Specs and Const. Drawings	SR/MTC	√	Compare MTC with technical specification and requirement		
ii		Installation finishing and acceptance	As agreed / required	B	Visual / physical	Random	Tech Specs and Const. Drawings	SR				
7.11	<b>WATER PROOFING</b>											
		Methodology for the application of water proofing system	As required	B	Review	for each type of treatment	Tech Specs and Const. Drawings	SR	√			

LOGO	SUPPLIERS NAME AND ADDRESS:	INDICATIVE FIELD QUALITY PLAN				PROJECT:	RGTPP HISAR (2X600 MW)				
		ITEM : CIVIL WORK		QP NO. :	1	PACKAGE:	FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE				
		SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.		REV. NO. :	0	CONTRACT NO.					
				DATE :		MAIN CONTRACTOR					
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1	2	3	4	5	6	7	8	9		10	
7.11.1	<b>General Requirement- Water Proofing</b>										
i	Material	As agreed / required	A	Review of MTC/ test reports	For each lot received at site	Tech Specs /Const. Drawings	SR/MTC	√		MTC shall contain all the parameters specified in the technical specifications	
ii	Acceptance of water proofing work	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings					
7.11.2	<b>Roof / Basement Treatment</b>										
i	Graded under bed	Levels / slopes	As required	C	Physical	100%	Tech Specs and Const. Drawings				
ii	Elastomeric coatings	Material- Primer coat, finishing coat	As required	B	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√		
iii	Wearing course	Materials - PCC, chicken wire mesh, elastomeric sealant	As required	B	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√		
iv	Acceptance of water proofing work	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings					
7.12	<b>Fencing and Gates</b>										
i	PVC coated chain link fencing (IS 2720), Welded wire mesh (IS 1566), Reinforced barbed tape galvanised (IS 2629) etc.	Materials	As agreed / required	A	Review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	√	MTC shall contain all the parameters specified in the technical specifications	
ii	Structural steel, painting system, caster wheel, ball and bearing, fixtures and fasteners	Materials	As agreed / required	A	Review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	√	MTC shall contain all the parameters specified in the technical specifications	
iii		Alignments, erection painting, DFT etc.	As agreed / required	B	Physical / measurements	Each installation	Tech Specs and Const. Drawings	SR			
iv		Acceptance of the installation and working	As agreed / required	B	Physical / measurements	Each installation	Tech Specs and Const. Drawings	SR			
7.13	<b>FLOOR FINISHES AND ALIED WORKS</b>										
7.13.1	<b>Cement Concrete Flooring</b>										
i		Glass/ PVC strips in joints	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings	SR			
ii		Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR			
7.13.2	<b>Tiles</b>										
i	Ceramic, vitrified, glass mosaic, acid alkali resistant, heavy duty cement concrete tiles	Materials	As agreed / required	B	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√	MTC shall contain all the parameters specified in the technical specifications. In case non-availability of MTC, sample to be tested as per relevant IS code.	
ii		Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR			
7.13.3	<b>Interlocking Blocks</b>										
i		Materials	As agreed / required	B	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√	MTC shall contain all the parameters specified in the technical specifications	
ii		Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR			
7.13.4	<b>Kota Stone, Granite and Marble</b>										
i		Quality, texture, thickness, colour for each lot of delivery	As agreed / required	B	Physical	Each batch of delivery	Tech Specs/ BOQ and Const. Drawings	SR	√		
ii		Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR			

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			SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.		REV. NO. :	0			CONTRACT NO.	MAIN CONTRACTOR		
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1	2	3	4	5	6	7	8	9	D*	10		
7.13.5	<b>Metallic / non-metallic hardener</b>											
i		Material	As agreed / required	B	Physical	Each batch of delivery	Tech Specs and Const. Drawings	SR	√			
ii		Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR				
7.13.6	<b>Acid / alkali and oil resistant high built seamless epoxy based resin and treatment</b>											
i	Material	Bricks, vitreous tiles, mortar, sealing, paints, coatings, sheets, fillers etc	As agreed / required	A	Review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	√	work to be done by skilled manpower		
ii		Surface preparation	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings, IS 2395					
iii		Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR				
7.13.7	<b>Rubber Flooring</b>											
i	Material		As agreed / required	B	Review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings / IS 809	SR/MTC	√	MTC shall contain all the parameters specified in the technical specifications		
ii		Finishing and acceptance	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR				
7.14	<b>Doors/Windows Sections</b>											
i	Material - Rolled Steel, Z Sections, T-iron frames sections, Plates etc.		As agreed / required	B	Review of MTC/ test reports	For each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	√			
ii		Acceptance of Steel Glazed doors and T-iron frames sections after fixing	As agreed / required	B	Physical and acceptance	Random for each installation	Tech Specs and Const. Drawings	SR				
8.0	<b>WATER SUPPLY / SANITARY INSTALLATIONS</b>											
8.1	<b>Water supply fittings and fixtures</b>											
i	Materials	GI/ MS pipes and fittings	As agreed / required	B	Review of MTC/ test reports	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR/MTC	√			
ii	Disinfection	Before use	As agreed / required	B	Physical	Each installation	Tech Specs and Const. Drawings	SR				
iii	Hydraulic test	Before use / leakage	As agreed / required	A	Physical	Each installation	Tech specs and const drawings	SR	√			
iv		Acceptance and working	As agreed / required	B	Acceptance	Random	Tech Specs and Const. Drawings	SR				
8.2	<b>Sand cast iron / cast iron pipes</b>											
i	Material	SCI / CI pipes and fittings / joints	As agreed / required	B	Review of MTC/ test reports	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR/MTC	√			
ii		Acceptance and leakage	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR				
8.3	<b>Sanitary fittings and fixtures</b>											
i	Material	Sanitary items and fixtures i.e. water closets, urinals, wash basins, sinks, mirrors, shelves, towel rail, soap containers, geyser, water cooler, etc, water supply / sanitation pipes, manhole cover and frames etc	As agreed / required	B	Review of MTC/ test reports	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR/MTC	√			
ii		Acceptance of installations of all sanitary items and fixtures	As agreed / required	B	Acceptance	100%	Tech Specs and Const. Drawings	SR				
8.4	<b>RCC Pipes</b>											
i	Material	RCC pipes	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR/MTC	√			
ii		Acceptance and leakage	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR				
8.5	<b>Water Storage Tanks</b>											
i	Material	Over head / loft type	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery as per Specifications	Tech Specs and Const. Drawings	SR/MTC	√			
ii		Acceptance and leakage	As agreed / required	B	Acceptance	Random	Tech Specs and Const. Drawings	SR				

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			SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.			REV. NO. :	0	PACKAGE:	FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE		
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1	2	3		4	5	6	7	8	9	D*	
10	10										
9.0	<b>SPECIAL ITEMS</b>										
9.1	<b>Earthing Mat (Grounding System)</b>										
i	Material	Earthing mat	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery as per Specifications	As per relevant IS and Tech. Specs / Manufacturer's, IS 3043	SR/MTC	√		
ii		Weld sizes & length	Visual/Tape	B	Visual/ Measurement	100%	Tech Specs and Const. Drawings				
iii		D P test	DP test Kit	A	Physical	10% at random of the offered lot	Tech Specs and Const. Drawings	TR	√		
iv		Earth test	Earthing test kit	A	Physical	100%	Tech Specs and Const. Drawings,	SR	√		
9.2	<b>Bitumen layer for tank foundation</b>										
i	Material	Grade of bitumen	As agreed / required	B	Review of MTC/ test reports	Each lot of delivery as per Specifications	As per relevant IS and Tech. Specs /MTC	SR/MTC	√	APPROVED SOURCE FOR MATERIAL PROCLUREMENT SHALL BE ALL GOVERNMENT REFINARIES	
ii	Acceptance and workmanship	Application / workmanship	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR			
9.3	<b>Composite Aluminium Panels and structural glazing</b>										
i	Material	Type of aluminium panels / structural glazing / fasteners and fixtures / silicon sealant	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery as per Specifications	Technical specifications / drawings	SR/MTC	√	MTC shall cover all the properties / parameters as per technical specifications	
ii	Acceptance and workmanship	Installation / workmanship	As agreed / required	B	Physical	Random	Technical specifications / drawings	SR			
9.4	<b>Pressure Relief Valves</b>										
i	Material		As agreed / required	B	Review of MTC/ test reports	Each lot of delivery as per Specifications	IS 4558/Technical specifications / drawings	SR/MTC	√		
ii	Acceptance and workmanship	Acceptance / Installation / workmanship	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR	√		
10.0	<b>ANTI WEED TREATMENT</b>										
i		Anti-weed treatment materials	As agreed / required	B	Review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	√		
ii		Execution of treatment	As agreed / required	B	Physical	Random check for each treatment	Tech Specs and Const. Drawings	SR			
11.0	<b>PILING WORK (If Applicable)</b>										
11.1	<b>Execution</b>										
i		Borehole diameter	As required	B	Physical	100%	Tech. Specs	SR/LB	√	If carried out by the contractor	
ii		Pile layout	Total station	B	Measurement	100%	As per appd. Drawings and technical	SR/LB	√		
iii		Recording ground level	As required	B	Measurement	Random	IS:2911, as per appd. Drawings and technical specification	SR/LB	√		
iv		Cleaning/Flushing of pile bore	As required	B	Visual	Random	As per appd. Drawings and technical specification	SR/LB	√		
v		Size of bore and During boring of pile record commencement of SPT/ core recovery to ensure socketing length equivalent in terms of the Diameter of the pile below the socketing horizon.	As required	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	√		
vi		Trial mix to ascertain the workability and cube strength	After receiving the recommended mix design from specialist agency,	B	Physical	One for each mix proportion	Tech. Spec.	SR/LB	√	Necessary correction for moisture content and water absorption according to mix design recommendation may be carried out during the trial mix	
vii		Cement content	As required	B	Physical	Once per shift	As per approved design mix.	SR/LB	√	At batching plant	
viii		Pouring of concrete to project above cut off level.	As required	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	√		
ix		Pile termination level	SPT & core recovery	A	Soil data	as per Tech. Spec.	As per appd. Drawings and technical specification	SR	√		

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		SUB-SYSTEM : GEOTECH INVI, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.			REV. NO. :	0	PACKAGE:	FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE				
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11.2	Testing											
i		Bentonite	IS:2720	A	Physical / testing	Once per source	As per IS:2720 / tech. Specs.	SR/LB	√	Review of test report		
ii		Density check on sample of mud collected from pile bore bottom	Sample collection	A	Physical	As per Tech. Spec.	Tech Spec.	SR/LB	√	Tests to be done before placing concrete. Samples to be collected from pile bore bottom.		
iii		Slump test of concrete	IS:1199	B	Physical	Every 2 hrs at pouring point of concrete	IS:2911, As per appd. Drawings and technical specification	SR/LB	√			
iv		Cube sampling for works cube test	IS:456	A	Physical	One set of 6 cubes per 50 CuM or part thereof for each grade of concrete per shift whichever is earlier.	IS:2911, As per appd. Drawings and technical specification	SR/LB	√			
v		Initial pile load test, Vertical (Compression), Lateral (horizontal) and pull-out (tension).	IS:2911 / as required	A	Testing	100% for 3 nos. for each type or as specified in BOQ / Tech. Spec.	IS:2911, As per appd. Drawings and technical specification	SR/LB	√	In case of compression test method the loading shall be cyclic.		
vi		Routine pile tests, compression and horizontal	Calibrated dial gauges etc. as required.	A	Testing	100% for 0.5% of the total number of piles provided for each type of test/Tech. Spec. subject to a min. of 2 nos.	IS:2911, As per appd. Drawings and technical specification	SR/LB	√	Routine Test shall be conducted by direct loading method.		
vii		Integrity Tests	PEM	A	Testing	100%	IS:2911, As per appd. Drawings and technical specification and suppliers	Test Report	√	CHP		
12.0	FOUNDATION SYSTEM											
	SHALLOW FOUNDATIONS											
i		Foundation excavation - Location, Layout, size, depth etc.	As required / agreed	B	Physical	Each location	As per technical specifications and construction drawings	SR		lines and levels to be checked		
ii		Foundation casting - Layout, Shape, dimensions, Reinforcement, concreting, curing etc.	As required / agreed	B	Physical	Each foundation	As per technical specifications and construction drawings	SR		lines and levels to be checked. Concrete Grade to be checked as per Mix Design		
14.0	GEOTECHNICAL INVESTIGATION WORK											
i		Deployment of approved Geotechnical Investigation Agency - Equipments, Manpower etc.	As required / agreed	A	Physical	Once before commencement of work	As per technical specifications and relevant IS Codes	SR	√			
ii		Execution of Geotechnical Investigation locations, type etc. as per scheme	As required / agreed	B	Physical	Each Location	As per technical specifications and relevant IS Codes	SR	√			
iii		Collection of disturbed and undisturbed samples, their packing and storage	As required / agreed	B	Physical	each sampling	As per technical specifications and relevant IS Codes	SR				
iv		Conducting filed tests as per investigation scheme- such as, SPT/ERT/SCPT/PLT/PMT etc.	As required / agreed	B	Physical	each field test	As per technical specifications and relevant IS Codes	SR				
v		Submission of Field Bore logs in approved format	As required / agreed	B	Review	Within 24 hours after completion of each BH	As per technical specifications and relevant IS Codes	SR	√			
vi		Submission of laboratory test schedule and selection of samples for laboratory testing	As required / agreed	A	Review and acceptance	as per consultation with engineer during dispatch of samples to approved laboratory	As per technical specifications and relevant IS Codes	SR	√			
vii		Submission of Final Geotechnical investigation report along with recommendations	As required / agreed	B	Physical	After completion of investigation work and review of draft reports	As per technical specifications and relevant IS Codes	-	√			
		<b>Legend to be used: Class # : A = Critical, B=Major, C=Minor;</b>										

INDICATIVE FIELD QUALITY PLAN									
LOGO	SUPPLIERS NAME AND ADDRESS:	ITEM : CIVIL WORK	QP NO. :		1	PROJECT:	RGTPP HISAR (2X600 MW)		
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Manufacturer/ Sub-supplier	Main-supplier	Categorization Witnessing & Accepting (As per Owner QA&I System) Category 'A' FQA Engineer in association with Executing Engineer, Category 'B' Executing Engineer, Category 'C' Executing Engineer ;SR = Site Register , TR= Test Report, MTC = Manufacturer's Test Certificate (MTC shall contain all the parameters specified in the technical specifications)				For Owner USE			
Signature		This document shall be read in conjunction with Tech. Specifications, BOQ, Drawings					REVIEWED BY	APPROVED BY	APPROVAL SEAL



INDICATIVE FIELD QUALITY PLAN											
LOGO	SUPPLIERS NAME AND ADDRESS:	ITEM : STRUCTURAL STEEL WORK		QP NO. :	2	PROJECT:	RGTPP HISAR (2X600 MW)				
		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. :	0	PACKAGE:	FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE				
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<b>1.00</b>	<b>MATERIALS</b>										
i		Structural steel procured from OWNER approved sources- Mechanical (YS, UTS, Elg, UT if specified), and Chemical properties (CE as per IS)		A	Review of MTC	For each batch of each section delivered at site	Technical Specification and Construction Drawings, IS 2062	SR/MTC	√	Correlated MTC shall be verified. In the event of non submission of MTC , sample shall be selected by FOA for testing as per specification.	
<b>2.00</b>	<b>FIT-UP</b>										
i		Marking and Cutting	As agreed / required	B	Visual & Measurement	Each plate/ Section	Tech Specs and Const. Drawings/ Approved cutting plan	SR			
ii		Match markings for trial assembled components	As agreed / required	B	Physical	Each fit-up	Tech Specs and Const. Drawings	SR			
iii		Weld Fit Up	As agreed / required	B	Physical	Each fit-up	Tech Specs and Const. Drawings	SR	√	Edge Preparation/ Gap/ Alignment	
<b>3.00</b>	<b>PRE HEATING (wherever applicable)</b>										
i		Pre-Heating Temperature	As agreed / required	B	Measurement	Each pre-heating	Tech Specs and Const. Drawings, Approved WPS	SR	√		
ii		Post Weld Heat Treatment (PWHT), if required	As agreed / required	A	Time & Temperature	Each PWHT	Tech Specs and Const. Drawings, Approved WPS	SR	√		
<b>4.00</b>	<b>WELDING REQUIREMENTS</b>										
i		PQR and Welder's Qualification	As agreed / required	A	Physical	Each welder	Approved WPS/ PQR, AWS-D1.1/ASME-IX, Tech Specs and Const. Drawings	Test Report	√	Main contractor approved WPS to be used.	
ii		Welding consumables	As agreed / required	B	Physical	Random in each shift	electrodes used shall be as specified in Approved WPS	SR	√		
iii		Sequence of welding	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings	SR			
iv		Removal/ grinding of temporary attachments	As agreed / required	B	Measurement	All cleats/ attachments	Tech Specs and Const. Drawings, IS-7215	SR			
v		Completeness after welding- Dimensions/ distortion	As agreed / required	B	Visual	Each structure component	Tech Specs and Const. Drawings	SR			
<b>5.00</b>	<b>NON DESTRUCTIVE AND DESTRUCTIVE TESTING</b>										
<b>5.01</b>	<b>Fillet Welds</b>										
i		Visual	As required/ agreed	B	Visual/ Measurement	Each welded joint	As per technical specifications and construction drawings	SR		As per requirement of OWNER Engineer	
ii		Macro-Etch Examination	As required/ agreed	B	Physical	Main fillet weld with min one joint per built up beam, columns and crane girders	As per technical specifications and construction drawings	SR	√		
iii		Dye Penetration Test (DPT)	As required/ agreed	B	Physical	25% weld length of tension member of crane girder- For crane girder 5% of Weld length with min. 300mm at each location - Except Crane Girder, for all other Fillet Welds	As per technical specifications and construction drawings	SR	√		

INDICATIVE FIELD QUALITY PLAN											
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		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. :	0	PACKAGE:	FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE				
				DATE :		CONTRACT NO.					
				PAGE :		MAIN CONTRACTOR					
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3		4	5	6	7	8	9	D*	10
5.02	<b>Butt Welds</b>										
i		Visual	As required/ agreed	B	Visual	Random in each shift	As per technical specifications and construction drawings	SR			
ii		Dye Penetration Test	As required/ agreed	B	Physical	100% DPT after back gouging on all butt welds except for coal bunker bins 10% DPT after back gouging-For coal bunker bins	As per technical specifications and construction drawings	SR		All butt welds to be back gouged before DPT	
iii		Mechanical testing on production test coupons	As required/ agreed	A	Physical	Min. one joint per built up beams, columns and crane girder.	As per technical specifications and construction drawings	SR	√	Test on production test coupons	
iv		Radiography Test (RT)	As required/ agreed	A	Physical	100% RT on butt welds of tension flange (bottom flange) of crane girders 10% RT weld length of each welder on butt welds, except for crane girders and coal bunk	As per technical specifications and construction drawings	SR	√	In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled. Acceptance criteria of NDT on welds shall be as per AWS D1.1.  Wherever RT is not feasible UT to be carried out with the approval of the Engineer	
5.03	<b>Full Penetration Welds (Other than butt welds)</b>										
i		Ultrasonic Testing (UT)	As required/ agreed	A	Physical	100% UT on the web to flange joint of crane girder 10% UT on other full penetration joints	As per technical specifications and construction drawings	IR	√	In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled. Acceptance criteria of NDT on welds shall be as per AWS D1.1.	
5.04	<b>NON DESTRUCTIVE AND DESTRUCTIVE TESTING FOR CHIMNEY STEEL LINER</b>										
i		Visual examination	As required/ agreed	B	Visual	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1	SR	√	As per requirement of OWNER Engineer	
ii		DPT	As required/ agreed	B	Physical	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1	IR	√		
iii		RT	As required/ agreed	A	Physical	10% FOR SHOP BUTT WELD AND 15% FOR SITE BUTT WELDS	As per technical specifications and construction drawings, IS 822, AWS D 1.1				
6.00	<b>FOUNDATION CHECKS</b>										
i		Dimensions and levels	As agreed / required	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings	SR	√	Shape, lines (including diagonal checks)	
ii		Foundation Bolts (materials)	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√	Foundation bolts shall conform to IS:5624 and property class shall be 4.6 as per IS:1367 (Part-3).	
ii		Foundation Bolts and Embedment's	As agreed / required	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings	SR	√	Measurement of Verticality, Levels, pitch distance	
7.0	<b>Receipt of shop fabricated steel structure at site</b>	Material	As agreed / required	A	Visual/ Physical & Review of CHP	Each structural member	Tech Specs and Const. Drawings	SR	√	Checks for visual defects and completeness of painting as per CHP	

INDICATIVE FIELD QUALITY PLAN										
LOGO	SUPPLIERS NAME AND ADDRESS:	ITEM : STRUCTURAL STEEL WORK		QP NO. :	2	PROJECT:	RGTPP HISAR (2X600 MW)			
		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. :	0	PACKAGE:	FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE			
				DATE :		CONTRACT NO.				
				PAGE :		MAIN CONTRACTOR				
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks
1	2	3		4	5	6	7	8	9	D*
8.0	Submission of Erection sequence/ methodology of erection for all structures		-	A	Approval	Once prior to erection of each structure	Approved drawings and Technical Specifications	SR	√	

INDICATIVE FIELD QUALITY PLAN										
LOGO	SUPPLIERS NAME AND ADDRESS:	ITEM : STRUCTURAL STEEL WORK		QP NO. :	2	PROJECT:	RGTPP HISAR (2X600 MW)			
		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. :	0	PACKAGE:	FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE			
				DATE :		CONTRACT NO.				
				PAGE :		MAIN CONTRACTOR				
Sl. No	Activity and operation	Characteristics / instruments	Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3	4	5	6	7	8	9	D*	10
<b>9.00</b>	<b>PRE-ASSEMBLY CHECKS</b>									
i		Punch Erection marks and match marks on members	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings			Markings for - Assembly designation, Part number, Weight, Any other important identifications.
ii		Pre-assembly as per match mark	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings			
iii		Camber, sweep and total length after trial assembly of structure.	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings	SR	√	
iv		Control assembly check at shop	As agreed / required	B	Visual/ Physical	Every first and tenth set of identical structure	Tech Specs and Const. Drawings			
<b>10.00</b>	<b>ERECTION CHECKS</b>									
i		Alignment, slopes, level, tolerances of erected member	As agreed / required	B	Measurement	Each structural member	Tech Specs and Const. Drawings	SR	√	
ii		Tightening of bolts including foundation bolts with lock nuts	As agreed / required	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings	SR	√	
iii		Acceptance of erected structure	As agreed / required	A	Visual/ Physical	Each erected structure	Tech Specs and Const. Drawings, IS 7215 and IS 12843	SR	√	To be verified w.r.t. approved methodology for erection / erection sequence
<b>11.00</b>	<b>INSTALLATION AND ALIGNMENT OF STEEL LINER</b>									
i		Submission of Installation/ Erection sequence/ methodology of erection for all structures	-	A	Approval	Once prior to erection of each structure	Approved drawings and Technical Specifications	SR	√	
ii		Check for Erection Marks	-	B	Visual	100%	Approved drawings and Technical Specifications	SR		
iii		Check for Installation of Steel Liners	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	SR		
iv		Check for Site Joints	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	SR		
v		Check for Installation of Inlet Transition Ducts	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	SR		
vi		Check for Installation of Insulations and Expansion Compensators	As required	B	Visual, Physical, Acceptance	100%	Approved drawings and Technical Specifications	SR		Each layer of expansion Compensator to be checked at shop for thickness, unit weight, tensile strength & elongation along with temp. withstand ability for composite joints
vii		Ensure the Erection of all steel structures along with permissible tolerances and their acceptance	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	SR		
viii		Check and approval for Dismantling, Modification and Re-erection, if required for any reason	As required	B	Visual/ Acceptance	100%	Approved drawings and Technical Specifications	SR		

INDICATIVE FIELD QUALITY PLAN											
LOGO	SUPPLIERS NAME AND ADDRESS:	ITEM : STRUCTURAL STEEL WORK		QP NO. :	2	PROJECT:	RGTPP HISAR (2X600 MW)				
		SUB-SYSTEM : FABRICATION & ERECTION		REV. NO. :	0	PACKAGE:	FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE				
				DATE :		CONTRACT NO.					
				PAGE :		MAIN CONTRACTOR					
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3		4	5	6	7	8	9	D*	10
<b>12.00</b>	<b>PAINTING SYSTEM</b>										
i		Painting Materials and accessories	As agreed / required	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	√	Material to be procured from OWNER approved sources.	
ii		Surface preparation	As agreed / required	B	Physical /visual	Random in each shift	Tech Specs and Const. Drawings, Relevant code/ standards	SR	√		
iii		DFT of paint - Over steel surface	As agreed / required	A	Physical	Each surface at random	Tech Specs and Const. Drawings	SR	√		
iv		Acceptance of painted surfaces	As agreed / required	B	Physical	Each surface at random	Tech Specs and Const. Drawings	SR			
<b>13.00</b>	<b>PERMANENT BOLTS AND NUTS AND WASHERS</b>										
i		Material	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√	All bolts , nuts and washers for connections shall be conforming to relevant IS as given in the Tech. Spec./ Construction Drawing	
ii		Contact surfaces before bolting	As agreed / required	B	Physical	Random before assembly for bolting	Tech Specs and Const. Drawings, IS 4000	SR			
iii		Inspection of the assembled bolts	As agreed / required	B	Physical	Randomly in each shift for assembled bolts	Tech Specs and Const. Drawings, IS 4000	SR			
iv		Tensioning	As agreed / required	B	Physical	Randomly during snug tight test and after full tensioning	Tech Specs and Const. Drawings, IS 4000	SR	√		
v		Acceptance of installed bolts	As agreed / required	B	Physical	Each bolt	Tech Specs and Const. Drawings	SR			
<b>14.00</b>	<b>ELECTROFORGED GRATINGS</b>										
i		Material from approved source	As agreed / required	A	Physical and CHP Review	Once for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√	Also refer the approved MQP	
ii		Acceptance of Erection, alignment and each Installation	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR			
<b>15.00</b>	<b>STAINLESS STEEL HAND RAILS</b>										
i		Material	As agreed / required	A	Physical/MTC Review(In case procured by contractor)	Once for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√	Also check grade of steel	
ii		DPT for welding	As agreed / required	A	Physical	Random for each fabrication	AWS D1.1 / Tech Specs and Const. Drawings	SR/LB	√	Main contractor approved WPS shall be used, electrodes used shall be as specified in WPS	
iii		Acceptance of stainless steel hand rails	As agreed / required	B	Physical	Each installation	Tech Specs and Const. Drawings	SR			
<b>16.00</b>	<b>PTFE SLIDING BEARINGS AND ELASTOMERIC BEARINGS</b>										
i		Material	As agreed / required	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√		
ii		Acceptance of installation of bearings	As agreed / required	B	Physical	Each installation	Tech Specs and Const. Drawings	SR			
LEGEND: D* Records, identified with "Tick" (√) shall be essentially included by supplier in QA documentation.							DOC. NO.:		REV: 0		
Legend to be used: Class # : A = Critical, B=Major, C=Minor: SR, TR, MTC, LB											
Categorization Witnessing & Accepting (As per OWNER QA&I System) Category 'A' FQA Engineer in association with Executing Engineer, Category 'B' Executing Engineer, Category 'C' Executing Engineer ;SR = Site Register , TR= Test Report, Mfr TC = Manufacturer's Test Certificate							For OWNER USE				
Manufacturer/ Sub-supplier	Main-supplier	This document shall be read in conjunction with OWNER Tech. Specifications, BOQ, Drawings					REVIEWED BY	APPROVED BY	APPROVAL SEAL		


SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / O				D*	M	C	O	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	** 10.			11.

		<b>LEGEND:</b> * RECORDS, IDENTIFIED WITH "TICK" ( √ ) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER, O: OWNER P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: OWNER SHALL IDENTIFY IN COLUMN "O" AS ' W"		DOC. NO.:  REV..... CAT.....
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER		FOR OWNER USE	REVIEWED BY
SIGNATURE				APPROVED BY
				APPROVAL SEAL

<b>SUPPLIER'S LOGO</b>	<b>SUPPLIER'S NAME AND ADDRESS</b>	<b>FIELD QUALITY PLAN</b>				<b>PROJECT : RGTPP HISAR</b>	
		<b>ITEM :</b>	<b>QP NO.:</b>			<b>PACKAGE : FGD SYSTEM PACKAGE</b>	
		<b>SUB-SYSTEM:</b>	<b>REV. NO.:</b>			<b>CONTRACT NO. :</b>	
			<b>DATE:</b>			<b>MAIN-SUPPLIER:</b>	
			<b>PAGE: .... OF....</b>				

SL. NO	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK #	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	10.

		<b>LEGEND: *</b> RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. <b>LEGEND TO BE USED: CLASS # : A = CRITICAL, B=MAJOR, C=MINOR;</b> 'A' SHALL BE WITNESSED BY OWNER FQA, 'B' SHALL BE WITNESSED BY OWNER ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY MAIN SUPPLIER (A & B CHECK SHALL BE OWNER CHP STAGE)		<b>DOC. NO.:</b>		<b>REV.....</b>		
<b>MANUFACTURER/ SUB-SUPPLIER</b>	<b>MAIN-SUPPLIER</b>		<b>FOR OWNER USE</b>					
<b>SIGNATURE</b>				<b>REVIEWED BY</b>	<b>APPROVED BY</b>	<b>APPROVAL SEAL</b>		

	<b>Project</b> :RGTPP HISAR	<b>LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL</b>  <b>SUB-SYSTEM :</b>	<b>DOC. NO.:</b>
	<b>Package</b> :FGD		<b>REV. NO.:</b>
	<b>Supplier</b> :		<b>DATE</b> :
	<b>Contractor No.</b> :		<b>PAGE</b> : <b>OF</b>

S. N.	Item	QP/ Insp. Cat.	QP No.	QP Sub. Schedule	Proposed sub-supplier	Place	Sub-suppliers approval status / category	Sub-supplier Details submission schedule	Remarks

**LEGENDS**

**1. SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY OWNER)**  
**A** – For these items proposed vendor is acceptable to OWNER. To be indicated with letter “A” in the list alongwith the condition of approval, if any.  
**DR** – For these items “Detailed required” for OWNER review. To be identified with letter “DR” in the list.

**2. QP/INSPN CATEGORY:**  
**CAT-I** : For these items the Quality Plans are approved by OWNER and the final acceptance will be on physical inspection witness by OWNER.  
**CAT-II** : For these items the Quality Plans approved by OWNER. However no physical inspection shall be done by OWNER. The final acceptance by OWNER shall be on the basis review of documents as per approved QP.  
**CAT-III** : For these items Main Supplier approves the Quality Plans. The final acceptance by OWNER shall be on the basis certificate of conformance by the main supplier.

**UNITS/WORKS** : Place of manufacturing Place of Main Supplier of multi units/works.







## SUB-SECTION-VI


(PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS)


**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**


**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**


<b>CLAUSE NO.</b>	 <b>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</b>		
<b>1.00.00</b>  1.01.00  1.02.00  1.03.00  <b>2.00.00</b>	<p><b>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</b></p> <p><b>GENERAL</b></p> <p>The pre-commissioning and commissioning activities including Guarantee tests, checks and initial operations of the equipment furnished and installed by the Contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices, etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at Site during such operations.</p> <p>It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and initial operation of the equipment systems which are installed by him. The Contractor shall also be responsible for flushing &amp; initial filling of all oils &amp; lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications &amp; documents.</p> <p>The Contractor upon completion of installation of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the facilities ready for sustained safe, reliable and efficient operation. All pre-commissioning/ commissioning activities considered essential for such readiness of the facilities including those mutually agreed and included in the Contractors quality assurance program as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the Contractor.</p> <p><b>TESTING / COMMISSIONING PROCEDURES</b></p> <p>The contractor shall submit his testing / commissioning check lists and procedures for various equipments / systems covered under the contract at least 10 months before the actual commissioning of the equipments / systems for review and approval of employer.</p> <p>The testing / commissioning procedures are to be of a standard format in order to maintain consistency of presentation, content and reporting. The list of commissioning check lists and procedures to be submitted and their content details shall be agreed upon during preaward discussions.</p> <p>An indicative list of Testing / Commissioning procedures and Standard Checklists and the details regarding the contents are enclosed as annexure at the end of this</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI BID DOC NO:31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-VI PRE-COMMISSIONING</b>	<b>PAGE 1 OF 5</b>


<b>CLAUSE NO.</b>	 <b>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</b>		
	<p>sub-section of section-VI, Part B. The actual list of such equipments / systems shall depend on the equipments / systems being supplied by the contractor.</p> <p>i) Annexure-I : Standard Checklist of items</p> <p>ii) Annexure-II : Testing / Commissioning Procedure</p> <p>iii) Annexure-III : Commissioning procedures requiring approval of Employer.</p> <p>iv) Annexure – IV : Brief write up on Contents of Testing / Commissioning Procedures</p> <p><b>3.00.00 PRECOMMISSIONING &amp; COMMISSIONING ACTIVITIES</b></p> <p><b>3.01.00 General</b></p> <p>The pre-commissioning activities including some of the important checks &amp; tests for certain major equipment/ systems (as a minimum) are described below, although it is the Contractor's responsibility to draw up a detailed sequential &amp; systematic list of checks / tests and various activities / procedures connected with pre-commissioning of the complete facilities with all systems, sub-systems and equipment supplied and installed by him and get the same approved by the Employer.</p> <p><b>3.02.00 PRE-COMMISSIONING ACTIVITIES/TESTS:</b></p> <p><b>3.02.01 Air and Gas Tightness Test</b></p> <p>After completion of installation of Booster fans, ducts, absorber and before commencement of application of thermal insulation a test shall be performed on the FGD system by the contractor to prove or to establish the tightness of the erected equipments within the Terminal points. The procedure adopted for such tests shall have the prior approval of the Employer. Normally physical leak detection method by pressurizing the section under test by running Temporary blower is adopted. The contractor may adopt any other better method of testing.</p> <p>All equipments including any temporary blanking, if required, for the above test shall be provided by the Contractor.</p> <p>The Contractor's air and gas tightness test procedure shall be such that it shall enable conductance of air/gas tightness test on the ducts in segmented manner (as and when these duct segments are ready), so that these duct segments can be immediately released for application of insulation after their gas tightness tests. Contractor shall made all necessary arrangement for conducting tests in this</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI BID DOC NO:31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-VI PRE-COMMISSIONING</b>	<b>PAGE 2 OF 5</b>

CLAUSE NO.	 <b>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</b>		
<p>3.02.03</p> <p>3.03.00</p> <p>3.03.01</p>	<p>manner. Any blanking etc. on the duct side required for testing of duct segments shall be provided by Contractor. Contractor shall bring fan / blower (s) of adequate size / capacity and other necessary instruments so that these tests can be conducted. The above equipment shall be brought to site by the Contractor on temporary basis and shall be taken back after successful completion of air / gas tightness test.</p> <p>All pre-commissioning tests &amp; activities as indicated in Annexure-I, II &amp; III and elsewhere in the technical specification shall be performed by the Contractor.</p> <p><b>COMMISSIONING OF FACILITIES</b></p> <p><b>General</b></p> <p>Upon completion of pre-commissioning activities/test the Contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carryout system checking and reliability trials on various parts of the facilities.</p> <p>Contractor shall carry out these checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is installed in accordance with requirements specified. Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.</p> <p>The Contractor shall finalize the protocol of check lists, after erection of the system and equipment, as per International Codes/Standard with the Employer.</p> <p>The Contractor shall furnish requisite no. of copies of procedures and list of start up, pre-commissioning, commissioning and initial operation tests for Employer's approval.</p> <p>The Contractor shall also demonstrate the performance of all C&amp;I equipment, the tests on main equipment or prior to that as the case may be.</p> <p>Other tests shall be conducted, if required by the Employer, to establish that the plant equipments are in accordance with requirements of the specifications.</p> <p>The Commissioning tests/checks shall specifically include but will not be limited to following:</p> <p>(a) Checks on the operation of all controls of isolating gas and air dampers</p>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC NO:31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-VI PRE-COMMISSIONING</p>	<p>PAGE 3 OF 5</p>


CLAUSE NO.	 <b>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</b>		
	<p>(b) Checks on operation of fans to ascertain level of noise and vibration</p> <p>(c) Test running of all pumps, blowers &amp; compressors</p> <p>(d) Checks on operation of Fire Fighting System</p> <p>(e) Checks on operation of all ZLD system (wherever provided).</p> <p>(f) Checks on operation of all rotating equipments to ascertain level of noise and vibration</p> <p>(g) Standard commissioning tests and procedures as per Contractor's practice for FGD plant</p> <p>(h) Checks on operation of all individual control loops in the FGD control loops in the FGD control system.</p> <p>(i) Checks on inter-relation between each control loop in the FGD control system.</p> <p>(j) Calibration tests of orifice, flow nozzles, instruments and control equipment to the extent included in these specifications.</p> <p>(k) Checks on operation of all static equipments to ascertain level of noise and vibration</p> <p>(l) Tests on Control &amp; Instrumentation (C&amp;I) Equipments</p> <p>The Contractor shall finalise the protocol of check lists, after erection of the system and equipment, as per International Codes/Standard with the Employer.</p> <p>The Contractor shall furnish requisite no. of copies of procedures and list of start up, precommissioning, commissioning and initial operation tests for Employer's approval.</p> <p>The Contractor shall also demonstrate the performance of all C&amp;I equipment, the tests on main equipment or prior to that as the case may be.</p> <p>Other tests shall be conducted, if required by the Employer, to establish that the plant equipments are in accordance with requirements of the specifications.</p>		
<p align="center">RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p align="center">TECHNICAL SPECIFICATION SECTION-VI BID DOC NO:31/CE/PLG/RGTPP/FGD-250</p>	<p align="center">PART-B SUB-SECTION-VI PRE-COMMISSIONING</p>	<p align="center">PAGE 4 OF 5</p>


CLAUSE NO.	 <b>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</b>		
3.03.02	<p><b>Balance equipment &amp; systems</b></p> <p>All pre-commissioning tests &amp; activities as required for successful running of the equipment or as mentioned in the technical specification elsewhere shall be performed by the contractor.</p>		
4.00.00	<p><b>INITIAL OPERATION</b></p> <p>Upon completion of system checking/tests and as a part of commissioning of facilities, complete FGD plant/facilities shall be put on initial operation for a period of thirty (30) days or 720 hours as stipulated in General Technical Requirements.</p>		
5.00.00	<p>The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all Electrical &amp; C&amp;I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied &amp; installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications (Section-VI).</p>		
6.00.00	<p>The Contractor shall conduct all the commissioning tests and undertake commissioning activities pertaining to all other auxiliaries and equipments including all Electrical &amp; C&amp;I equipment/systems not specifically brought out above but are within the scope of work and facilities being supplied &amp; installed by the Contractor and follow the guidelines indicated above or elsewhere in these technical specifications (Section-VI).</p>		
7.00.00	<p><b>COMMISSIONING SPARES</b></p>		
7.01.00	<p>It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However, such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.</p>		
7.02.00	<p>These spare will be received and stored by the Contractor at least 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilized as and when required. The unutilized spares and replaced parts, if any, at the end of successful completion of guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.</p>		
<p>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC NO:31/CE/PLG/RGTPP/FGD-250</p>	<p>PART-B SUB-SECTION-VI PRE-COMMISSIONING</p>	<p>PAGE 5 OF 5</p>


<b>CLAUSE NO.</b>	 <b>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</b>		
	<p style="text-align: right;"><b>ANNEXURE-I</b></p> <p style="text-align: center;"><b><u>STANDARD CHECKLIST</u></b></p> <p>This is an indicative list of items. The actual list shall depend on the Equipment / System being supplied by the contractor.</p> <p style="text-align: center;"><b><u>MECHANICAL</u></b></p> <p><b><u>VALVES</u></b></p> <ol style="list-style-type: none"> <li>1. Manually Operated Valve</li> <li>2. Electrically Operated Valve</li> <li>3. Pneumatically Actuated Valve</li> <li>4. Hydraulically Actuated Valve</li> <li>5. Safety Valve</li> <li>6. Electromatic Relief Valve</li> <li>7. Steam Trap</li> <li>8. Non Return Valve (including Hydraulic/ Pneumatic QCNRVS)</li> <li>9. Control Valve</li> <li>10. Relief Valve</li> <li>11. Differential Pressure Regulating Valve</li> <li>12. Pinch valve</li> </ol> <p><b><u>TANKS &amp; PRESSURE VESSELS</u></b></p> <ol style="list-style-type: none"> <li>1. Limestone silos</li> <li>2. Gypsum storage silos</li> <li>3. Limestone slurry tanks</li> <li>4. Filtrate tank</li> <li>5. Waste water tank</li> <li>6. Secondary hydrocyclone feed tank</li> <li>7. Lime dosing tank</li> <li>8. Process water tank</li> <li>9. Absorber</li> </ol>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B, SUB-SECTION-VI ANNEXURE-I PRE-COMMISSIONING</b>	<b>PAGE 1 OF 7</b>


CLAUSE NO.	 <b>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</b>		
	<p>10. Auxiliary absorbent tank</p> <p>11. Mill circuit tank</p> <p>12. Any other tank not covered above</p> <p>13. Vacuum tanks</p> <p>14. Air Receiver(if any)</p> <p><b><u>PUMPS</u></b></p> <p>1. Slurry recirculation pumps</p> <p>2. Gypsum bleed pumps</p> <p>3. Limestone slurry pumps</p> <p>4. Process water pumps</p> <p>5. All other slurry pumps</p> <p>6. Vacuum pumps</p> <p>7. Sump pumps</p> <p><b><u>PIPE WORK SYSTEM</u></b></p> <p>1. Steam services</p> <p>2. Water services</p> <p>3. Slurry services</p> <p>4. Air services</p> <p>5. Constant load support</p> <p>6. Spring supports</p> <p>7. Hangers and other Supports</p> <p><b><u>STRAINER AND FILTER</u></b></p> <p>1. Strainer / Filter Basket Type</p> <p>2. Strainer Rotary (Low Pressure)</p> <p>3. Filter &amp; Strainers Centrifugal Separators</p> <p>4. Filter &amp; Strainer Y-Type</p> <p>5. Filter &amp; Strainer (Plate Type)</p>		
RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250	PART-B, SUB-SECTION-VI ANNEXURE-I PRE-COMMISSIONING	PAGE 2 OF 7




CLAUSE NO.	 <b>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</b>		
	<p>6. Purifier</p> <p>7. Filter – Compressed Air Line</p> <p><b><u>FANS &amp; COMPRESSORS</u></b></p> <p>1. Booster Fans– Axial Flow pressure Lubricated</p> <p>2. Oxidation Blowers</p> <p>3. Compressors</p> <p><b><u>DAMPERS &amp; GATES</u></b></p> <p>1. Manually Operated Damper</p> <p>2. Pneumatically Operated Damper</p> <p>3. Electrically Operated Damper</p> <p>4. Manually Operated Gates</p> <p>5. Pneumatically Operated Gate</p> <p>6. Electrically Operated Gate</p> <p><b><u>DUCT WORK</u></b></p> <p>1. Flue Gas Ducting</p> <p>2. Expansion Joints</p> <p>3. Observation &amp; Access Door</p> <p><b><u>CRANES AND ELEVATORS</u></b></p> <p>1. Crane</p> <p>2. Hoists</p> <p>3. Passenger cum goods elevator</p> <p><b><u>POWER TRANSMISSION</u></b></p> <p>1. Power Transmission Gear Box</p> <p>2. Bearings</p> <p>3. Couplings</p>		
RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250	PART-B, SUB-SECTION-VI ANNEXURE-I PRE-COMMISSIONING	PAGE 3 OF 7

CLAUSE NO.	 <b>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</b>		
	<p><b><u>FGD &amp; AUX.SYSTEM</u></b></p> <ol style="list-style-type: none"> <li>1. Agitators</li> <li>2. Air Motor</li> <li>3. Process trestle</li> <li>4. Limestone feeder</li> <li>5. Vacuum belt filter</li> <li>6. Limestone ball mill</li> <li>7. Limestone Hydrocyclones</li> <li>8. Primary Hydrocyclones</li> <li>9. Secondary Hydrocyclones</li> <li>10. Absorber internals</li> <li>11. Absorber Auxiliaries</li> </ol> <p><b><u>ELELCTRICAL</u></b></p> <ol style="list-style-type: none"> <li>1. D.C. Motor</li> <li>2. HV Squirrel Cage Induction Motor</li> <li>3. 415 V Squirrel Cage Induction Motor</li> <li>4. Motor Operated Actuators</li> <li>5. Transformers</li> <li>6. Aux. Control and Relay Panel Desk</li> <li>7. HT &amp; LT SWITCHGEARS/MCC               <ol style="list-style-type: none"> <li>(I.) STANDARD CHECLISTS FOR ALL TYPES OF RELAYS USED IN SWITCHGEARS PROTECTION SYSTEM</li> <li>(II.) PT CARRIAGE AND CUBICLES</li> <li>(III.) CABLE/BUS DUCT/BUS BARS</li> <li>(IV.) CONTRACTOR MODULE</li> <li>(V.) SWITCH FUSE MODULE</li> <li>(VI.) MASTER PANEL OF LUBE OIL PANEL</li> <li>(VII.) FEEDER PANEL OF LUBE OIL PANEL</li> <li>(VIII.) SPACE HEATER AND CABLE MODULE</li> <li>(IX.) HT CIRCUIT BREAKER</li> </ol> </li> </ol>		
RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250	PART-B, SUB-SECTION-VI ANNEXURE-I PRE-COMMISSIONING	PAGE 4 OF 7

CLAUSE NO.	 <b>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</b>		
	<p>(X.) 415 V CIRCUIT BREAKER</p> <ol style="list-style-type: none"> <li>8. POWER CABLE</li> <li>9. AUXILIARY CABLE</li> <li>10. D.C. CABLE</li> <li>11. EXPLOSION PROOF ELECTRICAL EQUIPMENT</li> <li>12. JUNCTION BOX</li> <li>13. CONTROL TRANSFORMER MODULE</li> <li>14. BRUSH GEAR ASSEMBLY</li> <li>15. AUX. CONTROL AND RELAY PANEL DESK</li> <li>16. INDICATING INSTRUMENT</li> <li>17. RECORDING INSTRUMENT</li> <li>18. INTEGRATING INSTRUMENT</li> <li>19. D.G SET</li> <li>20. STATION LIGHTING</li> </ol> <p><b><u>CONTROL &amp; INSTRUMENTATION</u></b></p> <ol style="list-style-type: none"> <li>1. Conductivity Measuring Equipment Including Test Procedures</li> <li>2. pH Analyser Including Test procedure</li> <li>3. Silica Analyser</li> <li>4. Level Switch (Float Actuated)</li> <li>5. Level Switch (Electrode Type)</li> <li>6. Level Switch (Displacer Actuated)</li> <li>7. Transmitter (Float Operated Pneumatic Output including Testing procedures)</li> <li>8. Level indicator (Float/Pulley Type)</li> <li>9. Local Temperature Indicator Including Test Procedure</li> <li>10. Resistance Thermometer Element Including Test procedure</li> <li>11. Thermocouple Element and Connecting Cable</li> <li>12. Thermocouple and Resistance Thermometer Converter/Transmitter Including Test Procedures</li> <li>13. Temperature Switch Including Test Procedure</li> <li>14. Cold Junction Boxes</li> </ol>		
RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE	TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250	PART-B, SUB-SECTION-VI ANNEXURE-I PRE-COMMISSIONING	PAGE 5 OF 7

CLAUSE NO.	 <b>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</b>		
	<ol style="list-style-type: none"> <li>15. O<sub>2</sub>Analyser</li> <li>16. SO<sub>2</sub> analyzer</li> <li>17. O<sub>2</sub> in Hydrogen including Test procedures</li> <li>18. Pressure and Vacuum Gauge</li> <li>19. Pressure and Vacuum Switch Including Test procedures</li> <li>20. Differential Pressure Transmitter including Test Procedures</li> <li>21. Differential pressure switch including Test procedures</li> <li>22. Flow indicator (Variable Area)</li> <li>23. Orifice plate</li> <li>24. Flow Switch</li> <li>25. Nozzle</li> <li>26. Flow Integrator (pneumatic input) including test procedure</li> <li>27. Flow indicator (Float Operated) Including Test Procedure</li> <li>28. Venturi (Fluid)</li> <li>29. Flow Switch (Magnetic Type)</li> <li>30. Limit Switches</li> <li>31. Turbine Supervisory Measuring System</li> <li>32. Position Measurement &amp; Indication Including Test procedures</li> <li>33. Vibration Measurement</li> <li>34. Digital Indicator</li> <li>35. Moving Coil Indicator Including Test Procedures</li> <li>36. Recorder Including Test procedure</li> <li>37. Flame Scanner</li> <li>38. Electrical Auto Manual Control Station</li> <li>39. Push Button Module</li> <li>40. Test Procedure for Electronic Modules of DDCMIS</li> <li>41. Alarm Annunciator Equipment Including Test Procedure</li> <li>42. Test procedure for Adjustment of Modulating Controller-PID Term</li> <li>43. Test Procedure Indicating Controller-Electrical Input &amp; Pneumatic Output</li> <li>44. Density monitors</li> </ol>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B, SUB-SECTION-VI ANNEXURE-I PRE-COMMISSIONING</b>	<b>PAGE 6 OF 7</b>

<b>CLAUSE NO.</b>	 <b>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</b>		
	<p style="text-align: center;"> <b>AIR CONDITIONING &amp; VENTILATION SYSTEM</b>  <b>FIRE FIGHTING SYSTEM</b> </p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B, SUB-SECTION-VI ANNEXURE-I PRE-COMMISSIONING</b>	<b>PAGE 7 OF 7</b>

**CLAUSE NO.****PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS****ANNEXURE-II****TESTING / COMMISSIONING PROCEDURES**

Following is an indicative list of equipments / systems for which Testing / Commissioning procedures are to be submitted. The actual list will depend on the equipment / system being supplied by the Contractor.

<b>S. No</b>	<b>DESCRIPTION</b>
<b>FGD</b>	
1.	Booster Fan
2.	Absorber System
3.	Limestone grinding system
4.	Absorber system
5.	Gypsum dewatering system
6.	PT & SWRO System (if provided)

CLAUSE NO.




**PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS**

**ANNEXURE-III**

**COMMISSIONING PROCEDURES REQUIRING APPROVAL OF EMPLOYER**

S.NO.	DESCRIPTION
1.	AIR & GAS TIGHTNESS TEST
2.	OIL FLUSHING OF LUB OIL SYSTEM OF ROTARY EQUIPMENTS
3.	LIMESTONE GRINDING SYSTEM
4.	GYPSUM DEWATERING SYSTEM
5.	PT & SWRO SYSTEM

<b>CLAUSE NO.</b>	 <b>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</b>		
	<p style="text-align: right;"><b>ANNEXURE-IV</b></p> <p style="text-align: center;"><b>BRIEF WRITE UP ON THE CONTENTS OF TESTING / COMMISSIONING PROCEDURE</b></p> <p>Testing / Commissioning Procedure is required to be of a standard format in order to maintain consistency of presentation, content and reporting. These should contain the following sections to make the document a self contained one.</p> <ol style="list-style-type: none"> <li>1. Plant Details / Design data</li> <li>2. Objective</li> <li>3. Proposal</li> <li>4. Services Required</li> <li>5. Safety Precautions</li> <li>6. Emergency Procedures</li> <li>7. State of the Plant (Status in respect of erection completion of Mech, Elect and C&amp;I items)</li> <li>8. Method</li> <li>9. Completion / Acceptance Criteria</li> <li>10. Appendix <ul style="list-style-type: none"> <li>• Result</li> <li>• Log sheet</li> <li>• Drawing etc.</li> </ul> </li> </ol>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION – VI BID DOC. NO.: 31/CE/PLG/RGTPP/FGD-250</b>	<b>PART-B SUB-SECTION-VI ANNEXURE-IV PRE-COMMISSIONING</b>	<b>PAGE 1 OF 1</b>








**SUB-SECTION-VII**  
**OPERATION & MAINTENANCE PHILOSOPHY**


**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**


<b>CLAUSE NO.</b>	 <b>TECHNICAL REQUIREMENTS</b>		
	<p style="text-align: center;"><b>OPERATION AND MAINTENANCE PHILOSOPHY</b></p> <p>The details covered below are the general aspects of scope and other requirements to be carried out during operation and maintenance of FGD systems including supply of spares &amp; consumables for two (02) years as per scope identified in the technical specifications of this project. Commencement of O&amp;M period will start after Taking Over of the plant by HPGCL after completion of initial operation. (definition of initial operation as defined in Part-C of the specification).</p> <p><b>1.00.0</b> The scope includes Operation and Maintenance of complete FGD Plant which are presently covered in bidder's scope of supply and installation of FGD plant from date of Taking Over of the plant by HPGCL after completion of initial operation upto a period of two (02) years. During O&amp;M period, Owner's personnel shall have unrestricted entry to the FGD plant and Control Room any time. Owner may suitably depute its personnel to associate with O&amp;M activities. Contractor shall assist them in developing expertise through their day to day O&amp;M activities. All records of maintenance must be maintained by the Contractor which can be accessed by OWNER on demand. These records are to be handed over to Owner after the O&amp;M period of the contract.</p> <p><b>2.00.00</b> The bidder shall be responsible for supply of all spare parts &amp; consumables and repairs / replacement of any defective equipment(s) at his own cost as required from time to time during the O&amp;M period.</p> <p><b>3.00.00</b> The Contractor shall be responsible for the complete Operation and Maintenance of the entire FGD plant during the O&amp;M period including storage of limestone inside designated place inside plant to disposal of gypsum at designated place inside plant i.e. all equipment supplied by Contractor which is erected and commissioned as per the scope of contract.</p> <p><b>4.00.00</b> Owner's scope shall be limited to supply of Limestone only, provision of process water &amp; supply of electricity. Further, Lime stone will be supplied at designated point and gypsum shall be taken out of plant from designated point inside plant.</p> <p><b>5.00.00</b> The brief scope of works is as indicated below. The details shall be further elaborated by the bidder in the O&amp;M manual to be submitted to OWNER for approval. Items though not specifically mentioned but needed for continuous operation and maintenance of entire FGD plant to meet the intent of specification, shall be deemed to be included in scope of work of Contractor. The scope shall include all supply of spares and consumables and services indicated but will not be limited to the following:</p> <p>(a) Ensuring successful operation of FGD Plant in three shifts for required SO<sub>2</sub> reduction efficiency with optimum energy and Limestone consumption and producing good quality of gypsum.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO: 31/CE/PLG/RGTPP/FGD-250</b>	<b>SUB-SECTION-VII OPERATION &amp; MAINTENANCE PHILOSOPHY</b>	<b>PAGE 2 OF 8</b>


<b>CLAUSE NO.</b>	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>Further, maintenance of the entire FGD plant by appointing experienced service engineers, supervisors, operators and technicians round the clock is covered in the scope of Contractor.</p> <p>(b) Carrying out necessary Preventive maintenance and Breakdown maintenance, overhauls, furnishing technical assistance from experts &amp; arranging visit of O&amp;M experts to site from time to time (as &amp; when required and to be discussed mutually by Contractor &amp; Owner) for ensuring smooth operation and maintenance of the plant. Also carrying out maintenance during annual overhauling /capital overhaul of the unit</p> <p>(c) Contractor has to ensure that FGD plant is operated and maintained as per “Operation and Maintenance instruction manuals” and in accordance with Engineer-in charge for coordination with operation/maintenance of main plant. Daily work of the operators involves logging the all the important parameters as required and running of the FGD plant in most efficient manner. As Owner is ISO certified company, Contractor has to prepare and maintain all documents as per the requirements of ISO standards</p> <p>(d) The Contractor’s O&amp;M personnel shall record monthly energy output of each array and transformer and reports shall be prepared on performance of FGD plant.</p> <p>(e) Submission of periodical reports to the owner on the operating conditions of the FGD plant. Contractor has to ensure that adequate measures are initiated in advance to overcome any actual or likely shortfall in performance</p> <p>(f) Ensuring Safety and protection of the plant by deputing sufficient security personnel. High order of safety practices and standard engineering methods shall be adopted during O&amp;M. All safety tools and personal protection equipment are in the scope of bidder</p> <p>(g) Monitoring, controlling, troubleshooting, maintaining of records, registers.</p> <p>(h) Supply of all type of maintenance spares, consumables and fixing / application of the same. Contractor has to maintain all spares and including critical spares in case of any major breakdown/annual overhaul and consumables required for the entire period of two (02) years based on his experience.</p> <p>(i) Cleaning of the plant on regular basis and as and when required.</p> <p>(j) Cleaning of drains, cable trenches, box culverts etc.</p> <p>(k) Washing of all area as per as per approved schedule.</p> <p>(l) Herbicide spray and grass cutting on a periodic basis.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO: 31/CE/PLG/RGTPP/FGD-250</b>	<b>SUB-SECTION-VII OPERATION &amp; MAINTENANCE PHILOSOPHY</b>	<b>PAGE 3 OF 8</b>

<b>CLAUSE NO.</b>	 <b>TECHNICAL REQUIREMENTS</b>		
	<p>(m) All actions to be taken to prevent pollution due to flue gas from duct /slurry leakage from pipeline during operation of the FGD plant. It shall be the responsibility of Contractor to ensure minimum wastage of water and Contractor to analyze the cause of extra requirement and attend the same immediately.</p> <p>(n) The maintenance shall include all repair/replacement of lime handling and milling system, absorber tank, gypsum handling system, cleaning/repair/rectification of nozzles of absorber and mist eliminator, repair/replacement of all cladding/lining inside absorber and low height chimney lining, maintenance of all valves, pumps, blowers, agitators, nozzles in flushing and filling lines, repair/replacement /fabrication of connected water/slurry lines &amp; bends of FGD system &amp; all other equipment etc.as per scope of package. Further, preventive, routine and annual overhauling/breakdown maintenance related to all electrical and C&amp;I works is also included in the scope of Contractor.</p> <p>(o) The Contractor shall at his own expense provide all amenities to his workmen as per applicable laws and rules.</p> <p>(p) All interlocks/protections shall always be in place and no bypassing shall be done.</p> <p>(q) The Contractor shall ensure that all safety measures are taken at the site to avoid accidents to his employees or his Co-contractor's employees.</p> <p>(r) The Contractor shall immediately report the accidents, if any, to the Engineer In charge &amp; to all the concerned authorities as per prevailing laws of the state. During maintenance work, any damage to valuable parts/equipment/spares due to mishandling or excessive wastage of materials or repeat failure of material/equipment/spares/lining etc, shall be avoided by Contractor.</p> <p>(s) The Contractor shall comply with the provision of all relevant Acts of Central or State Governments including payment of Wages Act 1936, Minimum Wages Act 1948, Employer's Liability Act 1938, Workmen's Compensation Act 1923, Industrial Dispute Act 1947, Maturity Benefit Act 1961, Employees State Insurance Act 1948, Contract Labor (Regulations &amp; Abolishment) Act 1970 or any modification thereof or any other law relating whereto and rules made there under from time to time.</p> <p>(t) In order to ensure longevity, safety of the core equipment and optimum performance of the system the Contractor should use only genuine spares of high quality standards.</p> <p>(u) Deployment of Plant in Charge from Contractor's side, adequate number of his technical support staff and other supporting personnel during the O&amp;M period.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO: 31/CE/PLG/RGTPP/FGD-250</b>	<b>SUB-SECTION-VII OPERATION &amp; MAINTENANCE PHILOSOPHY</b>	<b>PAGE 4 OF 8</b>

<b>CLAUSE NO.</b>	 <b>TECHNICAL REQUIREMENTS</b>		
<b>6.00.00</b>	<p>(v) Bidder is required to maintain adequate O&amp;M spares during the O&amp;M contract period of the FGD plant with the view to maximize availability of the plant.</p> <p>(w) At the time handing over of the plant by the Contractor to Owner, the Contractor shall handover equipment and spares in healthy condition.</p> <p>(x) Bidder has to take Comprehensive Annual Maintenance Contract (AMC) from Original Equipment Manufacturer (OEM) or OEM authorized service provider for Booster fans, Wet Ball Mills, Oxidation blowers, Vacuum filters, Slurry Recirculation pumps, Agitators, Slurry pumps Mist eliminators, Motors etc and any other equipment deemed necessary as per experience of Contractor</p> <p>The AMC document along with authorization document (if applicable) has to be submitted before completion of trial run.</p> <p>(y) Replacement of equipment/spare parts/ updation of software being phased out or not being supported by OEM's is also included in bidder's scope.</p> <p>(z) Contractor shall be responsible to carry out all tests and works as required by statutory regulations in effect as on date of Techno-commercial bid opening during O&amp;M period.</p> <p><b>INSURANCE</b></p> <p>(a) Owner shall take Fire &amp; Allied Peril insurance during O&amp;M period. Insurance for theft to be taken by Contractor.</p> <p>(b) <b>Workmen's Compensation Insurance</b></p> <p>This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability disease or death of his or his Sub-Contractor's employees, which for any reason are not covered under the Workmen's Compensation Act, 1948. The liabilities shall not be less than the following:</p> <p>Workmen's Compensation - As per Statutory Provisions</p> <p>Employee's Liability - As per Statutory Provisions</p> <p>(c) <b>Comprehensive Automobile Insurance</b></p> <p>This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Employer's men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the Ownership of such vehicles. The liability covered shall be as herein indicated:</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO: 31/CE/PLG/RGTPP/FGD-250</b>	<b>SUB-SECTION-VII OPERATION &amp; MAINTENANCE PHILOSOPHY</b>	<b>PAGE 5 OF 8</b>



<b>CLAUSE NO.</b>	 <b>TECHNICAL REQUIREMENTS</b>					
	<p>(ii) FGD will be regarded as a FGD in operation, when by-pass damper is closed and total flow of flue gas from boiler goes via FGD, and SO<sub>2</sub> content is below 200 mg/Nm<sup>3</sup> (dry basis at 6% O<sub>2</sub>) in cleaned flue gas for the range of specified coals &amp; loads.</p> <p>(iii) FGD may be required to be taken out of service as a result of the Employer's decision OR due to non-availability of items to be provided by the Employer (e.g. Limestone, Process water, power, etc.). In such instances, this duration will be considered as FGD operation time.</p> <p>(iv) Boiler operation hours will be counted based on the recorded boiler operation hours and the recorded data will be made available to the Contractor by the Employer.</p> <p>(v) For the purpose of calculation of availability, the mutual agreed period used by the contractor for rectification of equipment in accordance to contract provision after conductance of PG test shall not be considered.</p> <p>If the calculated Availability after availability guarantee test for a year is lower than the guaranteed value, the Contractor will undertake adequate actions to achieve the guaranteed availability in subsequent years. However, LD for shortfall in guaranteed availability shall be applicable as per conditions stipulated above. The rate of liquidated damages and acceptable shortfall limits for the same shall be as under and such liquidated damages shall be deducted from the Contract Price.</p> <table border="1"> <tr> <td> <b>Availability of FGD plant</b>             For shortfall in guaranteed Availability in percentage points under conditions stipulated above         </td> <td> <b>INR 11,657,000/-</b> (INR Eleven Million Six Hundred Fifty Seven Thousand only) for every 1% shortfall in Availability from the guaranteed value for one unit for one year and applicable for first year.   <b>INR 12,006,000/-</b> (INR Twelve Million Six Thousand only) for every 1% shortfall in Availability from the guaranteed value for one unit for one year and applicable for second year.         </td> <td>           (-)5 % point from the guaranteed Availability.         </td> </tr> </table>			<b>Availability of FGD plant</b>  For shortfall in guaranteed Availability in percentage points under conditions stipulated above	<b>INR 11,657,000/-</b> (INR Eleven Million Six Hundred Fifty Seven Thousand only) for every 1% shortfall in Availability from the guaranteed value for one unit for one year and applicable for first year.  <b>INR 12,006,000/-</b> (INR Twelve Million Six Thousand only) for every 1% shortfall in Availability from the guaranteed value for one unit for one year and applicable for second year.	(-)5 % point from the guaranteed Availability.
<b>Availability of FGD plant</b>  For shortfall in guaranteed Availability in percentage points under conditions stipulated above	<b>INR 11,657,000/-</b> (INR Eleven Million Six Hundred Fifty Seven Thousand only) for every 1% shortfall in Availability from the guaranteed value for one unit for one year and applicable for first year.  <b>INR 12,006,000/-</b> (INR Twelve Million Six Thousand only) for every 1% shortfall in Availability from the guaranteed value for one unit for one year and applicable for second year.	(-)5 % point from the guaranteed Availability.				
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO: 31/CE/PLG/RGTPP/FGD-250</b>	<b>SUB-SECTION-VII OPERATION &amp; MAINTENANCE PHILOSOPHY</b>	<b>PAGE 7 OF 8</b>			

<b>CLAUSE NO.</b>	 <b>TECHNICAL REQUIREMENTS</b>		
	<p><b>NOTES:</b></p> <p>(i) The LD values are applicable on per unit basis.</p> <p>(ii) The contractor's liability under the contract during the year of O&amp;M period shall not exceed the amount payable to contractor in that particular year.</p> <p><b>8.00.00 HANDING OVER OF THE PLANT</b></p> <p>At the end of the contract period, the contractor shall hand over the plant and equipment back to the owner in completely safe and healthy condition and without any pending defect.</p> <p><b>9.00.00</b> After O&amp;M period, OWNER may at its discretion, decide to extend the existing O&amp;M contract on mutually acceptable terms &amp; conditions or undertake the O&amp;M of the FGD Plant on its own.</p> <p><b>10.00.00 GENERAL</b></p> <p>(i) The whole contract shall not be assigned or sublet to any other agency or individual under any circumstances and violations of the same will be viewed seriously. However for arranging any minor services and or any manpower, the same shall be done in consultation with EIC to ensure credentials of persons deployed and safety of plant.</p> <p>(ii) Separate staff to be kept for leave reserves so that in any day/shift, minimum staff required for O&amp;M is not reduced and is maintained as per requirement of plant &amp; EIC. In case of any breakdown maintenance/extraordinary situation, Contractor shall arrange to mobilize requisite labour forces at short notice to meet such emergency situation over &amp; above their normal routine staff.</p> <p>(iii) Wherever possible and necessary, workshop facility if available for minor repairing may be extended to Contractor on his request, based on discretion of EIC looking to other priorities.</p> <p>(iv) Operation and maintenance of entire FGD plant to be managed in such a way to ensure that no power generation loss occurs. In case of any dispute arising in this contract, the decision of Owner shall be final &amp; binding to Contractor.</p> <p>(v) Bidders shall make proper and adequate arrangement i.e. covered storage space, as applicable for storing spare consumables during O&amp;M phase in proper condition.</p>		
<b>RGTPP HISAR (2X600 MW) FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE</b>	<b>TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO: 31/CE/PLG/RGTPP/FGD-250</b>	<b>SUB-SECTION-VII OPERATION &amp; MAINTENANCE PHILOSOPHY</b>	<b>PAGE 8 OF 8</b>





SUB-SECTION-VIII  
MASTER DRAWING LIST

**RGTPP HISAR (2X600 MW)  
FLUE GAS DESULPHURISATION (FGD)  
SYSTEM PACKAGE**

**TECHNICAL SPECIFICATION  
SECTION-VI  
BID DOCUMENT NO.:  
31/CE/PLG/RGTPP/FGD-250**

S. No.	NTPC_DRG_NO	DRG_TITLE	DRG_PURPOSE
1	9944-250-PVC-B-001	GA & RCC Detail of Foundation of Reagent Feed Tank	A
2	9944-250-PVC-B-002	GA & RCC Detail of Foundation of Secondary HC Feed Tank	A
3	9944-250-PVC-B-003	GA & RCC Detail of Foundation of Filtrate water Tank	A
4	9944-250-PVC-B-004	GA & RCC Detail of Foundation of Waste water Tank	A
5	9944-250-PVC-B-005	GA & RCC Detail of Foundation of Auxilliary Storage Tank	A
6	9944-250-PVC-B-006	GA & RCC Detail of Foundation of Process Water Tank	A
7	9944-250-PVC-B-011	GGH - Foundation/Pilecap & Pedestal - R/F DETAILS FOR GGH SUPPORT STRUCTURE	A
8	9944-250-PVC-B-014	Pipe Rack structure- GA & RCC detail of Foundation	A
9	9944-250-PVC-B-016	GA of Foundation of Electrical equipments & control Building	A
10	9944-250-PVC-B-017	RCC Detail of Foundation of Electrical equipments & control Building	A
11	9944-250-PVC-B-018	GA & RCC Detail of Superstructure of Electrical equipments & control Building - SHEET-1 - DETAILS OF GRADE BEAMS	A
12	9944-250-PVC-B-018-SHT-2	GA & RCC Detail of Superstructure of Electrical equipments & control Building - SHEET-2 - DETAILS OF LINTEN BEAMS	A
13	9944-250-PVC-B-018-SHT-3	GA & RCC Detail of Superstructure of Electrical equipments & control Building - SHEET-3 - DETAILS OF FLOOR BEAMS & SLABS	A
14	9944-250-PVC-B-018-SHT-4	GA & RCC Detail of Superstructure of Electrical equipments & control Building - SHEET-4 - DETAILS OF FROOF BEAMS & SLABS AT RL (+) 295.250 (TOC)	A
15	9944-250-PVC-B-018-SHT-5	GA & RCC Detail of Superstructure of Electrical equipments & control Building - SHEET-5 - DETAILS OF GRADE SLAB AT RL (+) 285.800 (TOC)	A
16	9944-250-PVC-B-018-SHT-6	GA & RCC Detail of Superstructure of Electrical equipments & control Building - SHEET-6 - DETAILS OF STAIR CASES & ITS BEAM UPTO ROOF	A
17	9944-250-PVC-B-018-SHT-7	GA & RCC Detail of Superstructure of Electrical equipments & control Building - SHEET-7 - DETAILS OF COLUMNS	A
18	9944-250-PVC-B-019	Architectural dwg of Electrical equipments & control Building	A
19	9944-250-PVC-B-020	GA of Foundation of Gypsum Dewatering Building	A
20	9944-250-PVC-B-021	RCC Detail of Foundation of Gypsum Dewatering Building	A
21	9944-250-PVC-B-022-SHT-1	GA & RCC Detail of Superstructure of Gypsum Dewatering Building : GA & RC Details of Grade Beams	A
22	9944-250-PVC-B-022-SHT-10	GA & RCC Detail of Superstructure of Gypsum Dewatering Building - GA & RC Details of Lintel Beams at RL 311.2 m (BOC)	A
23	9944-250-PVC-B-022-SHT-2	GA & RCC Detail of Superstructure of Gypsum Dewatering Building : RC Details of Columns above Ground Level	A
24	9944-250-PVC-B-022-SHT-3	GA & RCC Detail of Superstructure of Gypsum Dewatering Building : GA & RC Details of Floor Beams & Slab at RL 302.65 m & RL 306.65 m	A
25	9944-250-PVC-B-022-SHT-4	GA & RCC Detail of Superstructure of Gypsum Dewatering Building : GA & RC Details of Floor Beams & Slab at RL 300.65 m	A
26	9944-250-PVC-B-022-SHT-5	GA & RCC Detail of Superstructure of Gypsum Dewatering Building : GA & RC Details of Grade Slab	A
27	9944-250-PVC-B-022-SHT-6	GA & RCC Detail of Superstructure of Gypsum Dewatering Building : GA & RC Details of Roof Beams & Slab	A
28	9944-250-PVC-B-022-SHT-7	GA & RCC Detail of Superstructure of Gypsum Dewatering Building : GA & RC Details of Lintel Beam	A
29	9944-250-PVC-B-022-SHT-8	GA & RCC Detail of Superstructure of Gypsum Dewatering Building : GA & RC Details of Roof Beams & Slab at RL 308.65 m	A
30	9944-250-PVC-B-022-SHT-9	GA & RCC Detail of Superstructure of Gypsum Dewatering Building - Superstructure Stairs	A
31	9944-250-PVC-B-023	Architectural dwg of Gypsum Dewatering Building	A
32	9944-250-PVC-B-024	GA of Foundation of Recycle Pump & Oxidation Blower Building	A
33	9944-250-PVC-B-026	GA dwg of Recycle Pump & Oxidation Blower bldg Structure	I
34	9944-250-PVC-B-028	GA of Foundation of Ball Mill Building	A
35	9944-250-PVC-B-029	RCC Detail of Foundation of Ball Mill Building	A
36	9944-250-PVC-B-030-SHT-1	GA & RCC Detail of Superstructure of Ball Mill Building : GA & RC Details of Grade Beams	A
37	9944-250-PVC-B-030-SHT-10	GA & RCC Detail of Superstructure of Ball Mill Building : GA & Detail of Side Runner	I
38	9944-250-PVC-B-030-SHT-11	GA & RCC Detail of Superstructure of Ball Mill Building : GA & Detail Monorail Beam	A
39	9944-250-PVC-B-030-SHT-2	GA & RCC Detail of Superstructure of Ball Mill Building : RC Details of Columns above Ground Level	A
40	9944-250-PVC-B-030-SHT-3	GA & RCC Detail of Superstructure of Ball Mill Building : GA & RC Details of Floor Beams & Slab at RL 292.1 m	A
41	9944-250-PVC-B-030-SHT-4	GA & RCC Detail of Superstructure of Ball Mill Building : GA & RC Details of Floor Beams & Slab at RL 296.76 m	A
42	9944-250-PVC-B-030-SHT-5	GA & RCC Detail of Superstructure of Ball Mill Building : GA & RC Details of Grade Slab	A
43	9944-250-PVC-B-030-SHT-6	GA & RCC Detail of Superstructure of Ball Mill Building : GA & RC Details of Lintel Beams	A
44	9944-250-PVC-B-030-SHT-7	GA & RCC Detail of Superstructure of Ball Mill Building : GA & Detail of Base Plate of Steel Structure	I
45	9944-250-PVC-B-030-SHT-8	GA & RCC Detail of Superstructure of Ball Mill Building : GA & Detail of Steel Superstructure	I
46	9944-250-PVC-B-030-SHT-9	GA & RCC Detail of Superstructure of Ball Mill Building : GA & Detail of Steel Truss	I
47	9944-250-PVC-B-031	Architectural dwg of Ball Mill Building	A
48	9944-250-PVC-B-032	Foundations for Gypsum Bleed pump & its drive	A
49	9944-250-PVC-B-033	Foundations for Oxidation Blower and its drive	A
50	9944-250-PVC-B-034	GA of Foundation of Booster Fan	A
51	9944-250-PVC-B-035	RCC Detail of Foundation of Booster Fan	A
52	9944-250-PVC-B-036	GA of Foundation of Ball Mill	A
53	9944-250-PVC-B-037	RCC Detail of Foundation of Ball Mill	A
54	9944-250-PVC-B-038	GA of Foundation of Absorber	A
55	9944-250-PVC-B-041	GA of Foundation of Transformer	A
56	9944-250-PVC-B-042	RCC Detail of Foundation of Transformer	A
57	9944-250-PVC-B-044	GA & RCC Detail of Foundation of Reagent Feed Pump	A
58	9944-250-PVC-B-045	GA & RCC Detail of Foundation of Limestone Preparation Area Sump Pump	A
59	9944-250-PVC-B-046	GA & RCC Detail of Foundation of Recycle Pump	A
60	9944-250-PVC-B-047	GA & RCC Detail of Foundation of Absorber Area Sump Pump	A
61	9944-250-PVC-B-053	GA & RCC Detail of Foundation of Belt Filter Wash Pump	A

62	9944-250-PVC-B-054	GA & RCC Detail of Foundation of Dewatering Area Sump Pump	A
63	9944-250-PVC-B-055	GA & RCC Detail of Foundation of Auxiliary Storage Tank Pump	A
64	9944-250-PVC-B-056	GA & RCC Detail of Foundation of Make-up water Booster Pump	A
65	9944-250-PVC-B-057	GA & RCC Detail of Foundation of Mist Eliminator Water Pump	A
66	9944-250-PVC-B-058	GA & RCC Detail of Foundation of Process (Make-up) Water Pump	A
67	9944-250-PVC-B-059	Detail civil drawings for Road	A
68	9944-250-PVC-B-060	Detail civil drawings for Pavement	A
69	9944-250-PVC-B-061	Detail civil drawings for Drains	A
70	9944-250-PVC-B-062	LAYOUT OF FOUNDATION FOR FGD EQUIPMENT	A
71	9944-250-PVC-B-063	ABSORBER LOAD DATA	A
72	9944-250-PVC-B-064	Foundation Load Data for Auxiliary Storage Tank	A
73	9944-250-PVC-B-065	Foundation Load Data for Reagent Feed Tank	A
74	9944-250-PVC-B-066	Foundation Load Data for Process (Makeup) Water Tank	A
75	9944-250-PVC-B-067	Foundation Load Data for Waste Water Tank	A
76	9944-250-PVC-B-068	Foundation Load Data for Filtrate Water Tank	A
77	9944-250-PVC-B-069	Foundation Load Data for Secondary Hydrocyclone Feed Tank	A
78	9944-250-PVC-B-071	GA & RCC Detail of Booster Fan Outlet to GGH Duct Support Foundation	A
79	9944-250-PVC-B-072	GA & RCC Detail of FDN for Duct Support DS 6 & DS 7 for Stack Inlet Duct	A
80	9944-250-PVC-B-073	GA & RCC Detail of FDN for Duct Support DS 8 & DS 9 for Stack Inlet Duct	A
81	9944-250-PVC-B-074	FDN Load Data with Base Plate & FDN Bolt Detail for DS 8&9	A
82	9944-250-PVC-B-075	Foundation Load Data with base Plate & Foundation Bolt Detail For GGH Support Structure	A
83	9944-250-PVC-B-076	Foundation Load Data with base Plate & Foundation Bolt Detail For Duct Support Structure DS-1	A
84	9944-250-PVC-B-079	Foundation Load Data with base Plate & Foundation Bolt Detail For Pipe & Cable Support Structure	A
85	9944-250-PVC-B-080	Foundation Load Data with base Plate & Foundation Bolt Detail For Recycle Pipe Support Structure	A
86	9944-250-PVC-B-082	GA & RCC Detail of FDN DS 1	A
87	9944-250-PVC-B-083	GA & RCC Detail of FDN DS 2	A
88	9944-250-PVC-B-084	GA & RCC Detail of FDN DS 3	A
89	9944-250-PVC-B-088	Foundation Load Data of Pipe & Cable Tray Support Structure	A
90	9944-250-PVC-B-089	GA & RCC Details of Pipe & Cable Support Foundations mkd. F3 to F5	A
91	9944-250-PVC-B-091	Foundation Load Data with Base Plate and Anchor Bolt detail for GGH Stair	A
92	9944-250-PVC-B-092	GA & RCC Details of GGH Stair Foundation	A
93	9944-250-PVC-B-095	GA & RCC Detail of External Recycle Pipe Support Foundation	A
94	9944-250-PVC-B-096	GA & RCC Detail of Cooling Water Pump	A
95	9944-250-PVC-B-097	GA & RC Details of Air Receivers	A
96	9944-250-PVC-B-098	Detail civil drawing for sewerage system	A
97	9944-250-PVC-B-101	FGD Chimney-General Arrangement	A
98	9944-250-PVC-B-102	FGD Chimney- Foundation Details (Main Reinforcement)	A
99	9944-250-PVC-B-103	FGD Chimney- Foundation Details (Shell Dowels)	A
100	9944-250-PVC-B-104	FGD Chimney- Foundation Details (Duct Pedestals)	A
101	9944-250-PVC-B-105	FGD Chimney- Shell Profile and Details of Main Reinforcement	A
102	9944-250-PVC-B-106	FGD Chimney- Details of Construction Openings in Shell	A
103	9944-250-PVC-B-107	FGD Chimney- Details of Door & Miscellaneous Openings in Shell below EL (+) 10.00 M	A
104	9944-250-PVC-B-108	FGD Chimney- Details of Openings in Shell for Ducts	A
105	9944-250-PVC-B-109	FGD Chimney- Details of Recesses in Shell for Platform No. 1	A
106	9944-250-PVC-B-110	FGD Chimney- Details of Recesses in Shell for Platform No. 2	A
107	9944-250-PVC-B-111	FGD Chimney- Details of Recesses in Shell for Platform No. 3	A
108	9944-250-PVC-B-112	FGD Chimney- Details of Recesses in Shell for Platform No.4	A
109	9944-250-PVC-B-113	FGD Chimney- Details of Air Outlet Openings in Shell below Roof	A
110	9944-250-PVC-B-114	FGD Chimney- Details of Recesses in Shell for Roof Platform	A
111	9944-250-PVC-B-115	FGD Chimney- Details of Roof Platform	A
112	9944-250-PVC-B-116	FGD Chimney- Details of Platform No.4	A
113	9944-250-PVC-B-117	FGD Chimney- Details of Platform No. 3	A
114	9944-250-PVC-B-118	FGD Chimney- Details of Platform No. 2	A
115	9944-250-PVC-B-119	FGD Chimney- Details of Platform No. 1	A
116	9944-250-PVC-B-120	FGD Chimney- General Arrangement of Liner	A
117	9944-250-PVC-B-121	FGD Chimney- Details of Liner / Can Type-A	I
118	9944-250-PVC-B-122	FGD Chimney- Details of Liner / Can Type - F & G	I
119	9944-250-PVC-B-123	FGD Chimney- Details of Liner / Can Type - E & H	I
120	9944-250-PVC-B-124	FGD Chimney- Details of Liner / Can Type - B & C	I
121	9944-250-PVC-B-125	FGD Chimney- Details of Liner / Can Type - D	I
122	9944-250-PVC-B-126	FGD Chimney- Details of Manholes in Liners	I
123	9944-250-PVC-B-127	FGD Chimney- Fixing Details of Liner Insulation	I
124	9944-250-PVC-B-128	FGD Chimney- Details of Liner Support Beams and Hanger	A
125	9944-250-PVC-B-129	FGD Chimney- Details of Liner Restraint	A
126	9944-250-PVC-B-130	FGD Chimney- Details of Liner Expansion Joints	A
127	9944-250-PVC-B-131	FGD Chimney- Details of Mini-Shell	A
128	9944-250-PVC-B-132	FGD Chimney- Layout of Staircase	I
129	9944-250-PVC-B-133	FGD Chimney- Details of Staircase	I
130	9944-250-PVC-B-134	FGD Chimney- Details of Ladders, Hatches and other Miscellaneous Items	I
131	9944-250-PVC-B-135	FGD Chimney- Details of Roof Slab	A
132	9944-250-PVC-B-136	FGD Chimney- Details of Grade Level Slab	A
133	9944-250-PVC-B-137	FGD Chimney- Scheme for Aviation Obstruction Markings	A
134	9944-250-PVC-B-138	FGD Chimney- Layout and Details of Strakes	A
135	9944-250-PVC-B-139	FGD Chimney-Supporting Arrangement for Gas Analyzer Panels & Details of Sampling Ports in Liner	A
136	9944-250-PVC-B-201	GENERAL DRAWINGS/DOCUMENTS : GA of 24M Standard Gallery for Double Conveyor For LHP	A
137	9944-250-PVC-B-202	GENERAL DRAWINGS/DOCUMENTS : GA of 24M Standard Gallery for Double Conveyor For LHP (TYPE-II)	A
138	9944-250-PVC-B-203	GENERAL DRAWINGS/DOCUMENTS : Design for 21 M Standard Gallery for Double Conveyor For LHP	A

139	9944-250-PVC-B-204	GENERAL DRAWINGS/DOCUMENTS : Design for 21 M Standard Gallery for Double Conveyor For LHP	A
140	9944-250-PVC-B-205	GENERAL DRAWINGS : Typical Architectural Details for Conveyor Galleries For LHP & GHP	A
141	9944-250-PVC-B-206	GENERAL DRAWINGS : Typical Architectural Details for TP For LHP	A
142	9944-250-PVC-C-011	TRUCK UNLOADER UNIT : GA of Plans and Sectional Elevations	A
143	9944-250-PVC-C-012	TRUCK UNLOADER UNIT : RC Details of Raft, Walls & Counterforts,Ramp	A
144	9944-250-PVC-C-013	G H STOCK YARD : Layout & Details	A
145	9944-250-PVC-C-015	G H STOCK YARD SHED : GA of Sectional and Elevations	A
146	9944-250-PVC-C-016	G H STOCK YARD SHED : Side Runners and Purlin Details	A
147	9944-250-PVC-C-018	G H STOCK YARD SHED : RC Details of Foundation	A
148	9944-250-PVC-C-019	G H STOCK YARD SHED : Architectural details	A
149	9944-250-PVC-C-021	L S CRUSHER HOUSE : GA of Floors	A
150	9944-250-PVC-C-022	L S CRUSHER HOUSE : GA of Sectional and Elevations	A
151	9944-250-PVC-C-023	L S CRUSHER HOUSE : Side Runners and Purlin Details	A
152	9944-250-PVC-C-025	L S CRUSHER HOUSE : RC Details of Foundation	A
153	9944-250-PVC-C-025A	L S CRUSHER HOUSE : GA & Pile layout	A
154	9944-250-PVC-C-027	L S CRUSHER HOUSE : GA & RC Details of Floor Slabs	A
155	9944-250-PVC-C-028	L S CRUSHER HOUSE : RC Details of L S CRUsher Deck for Vibration Isolation System	A
156	9944-250-PVC-C-029	L S CRUSHER HOUSE : Architectural details	A
157	9944-250-PVC-C-031	LTP-1: GA Details for Elevations	A
158	9944-250-PVC-C-032	LTP-1: GA Details for Floors	A
159	9944-250-PVC-C-033	LTP-1: Side Runners and Purlin Details	A
160	9944-250-PVC-C-035	LTP-1: GA & RC Detail of Foundation	A
161	9944-250-PVC-C-035A	LTP-1: GA & Pile Layout	A
162	9944-250-PVC-C-036	LTP-1: GA & RC Details of Floors	A
163	9944-250-PVC-C-037	LTP-1: Architectural details	A
164	9944-250-PVC-C-039	LC1A/B : GA and Details of Gallery & Trestles	A
165	9944-250-PVC-C-041	LC1A/B : GA & RC Details of Foundation System for Trestles	A
166	9944-250-PVC-C-043	LC2A/B : GA and Details of Gallery & Trestles	A
167	9944-250-PVC-C-045	LC2A/B : GA & RC Details of Foundation System for Trestles	A
168	9944-250-PVC-C-047	LC3A/B : GA and Details of Gallery & Trestles	A
169	9944-250-PVC-C-049	LC3A/B : GA & RC Details of Foundation System for Trestles	A
170	9944-250-PVC-C-051	LC4A/B : GA and Details of Gallery & Trestles	A
171	9944-250-PVC-C-053	LC4A/B : GA & RC Details of Foundation System for Trestles	A
172	9944-250-PVC-C-055	G C 1 A/B: GA and Details of Gallery & Trestles	A
173	9944-250-PVC-C-057	G C 1 A/B: GA & RC Details of Foundation System for Trestles	A
174	9944-250-PVC-C-059	LIME SILOS - GA OF SUPER STRUCTURE	A
175	9944-250-PVC-C-060	LIME SILOS - Details of Staircase & Platforms	A
176	9944-250-PVC-C-061	LIME SILOS - R/F Details of Foundation	A
177	9944-250-PVC-C-061B	LIME SILOS - GA & Pile Layout	A
178	9944-250-PVC-C-062	LIME SILOS - GA & Details of Floor & Roof	A
179	9944-250-PVC-C-064	Weigh Bridge : GA & RCC details	A
180	9944-250-PVC-C-066	BUCKET ELEVATOR : GA & RCC details	A
181	9944-250-PVC-C-067	RCC DESIGN OF CRUSHER DECK	A
182	9944-250-PVC-C-068	GA AND RCC DETAIL OF CRUSHER DECK	A
183	9944-250-PVC-C-070	LTP-2: GA Details for Elevations	A
184	9944-250-PVC-C-071	LTP-2: GA Details for Floors	A
185	9944-250-PVC-C-072	LTP-2: Side Runners and Purlin Details	A
186	9944-250-PVC-C-074	LTP-2: GA & RC Detail of Foundation	A
187	9944-250-PVC-C-075	LTP-2: GA & RC Details of Floors	A
188	9944-250-PVC-C-076	LTP-2: Architectural details	A
189	9944-250-PVC-U-001	Structural Design Basis - Civil	A
190	9944-250-PVC-U-002	Civil Design Basis	A
191	9944-250-PVC-U-003	Design Calculation for Tank foundations	I
192	9944-250-PVC-U-005	Design Basis Report	A
193	9944-250-PVC-U-006	GENERAL DRAWINGS/DOCUMENTS : Design for 24M Standard Gallery for Double Conveyor For LHP	A
194	9944-250-PVC-U-007	GENERAL DRAWINGS/DOCUMENTS : Design for 24M Standard Gallery for Double Conveyor For LHP (TYPE-II)	A
195	9944-250-PVC-U-010	Design calculation for GGH support structure foundation	I
196	9944-250-PVC-U-011	TRUCK UNLOADER UNIT : Design of Structure	A
197	9944-250-PVC-U-012	Design calculation for Duct support foundation	I
198	9944-250-PVC-U-014	Design calculation for Pipe Rack structure foundation	I
199	9944-250-PVC-U-015	G H STOCK YARD SHED : Design of Super Structure	A
200	9944-250-PVC-U-016	Design Calculation for Electrical equipments & control Building foundation	I
201	9944-250-PVC-U-017	G H STOCK YARD SHED : Design for PE CIVIL foundations	A
202	9944-250-PVC-U-018	Design Calculation for Electrical equipments & control Building Superstructure	I
203	9944-250-PVC-U-019	L S CRUSHER HOUSE : Design for Super Structure	A
204	9944-250-PVC-U-020	Design Calculation for Gypsum Dewatering Building foundation	I
205	9944-250-PVC-U-021	Calculation Report of Dewatering Building Superstructure	I
206	9944-250-PVC-U-024	Design Calculation for Recycle Pump & Oxidation Blower bldg foundation	I
207	9944-250-PVC-U-025	L S CRUSHER HOUSE : Design for PE CIVIL foundations	A
208	9944-250-PVC-U-026	L S CRUSHER HOUSE : Design of RC Floor Slabs	A
209	9944-250-PVC-U-028	Design Calculation for Ball Mill Building foundation	I
210	9944-250-PVC-U-029	LTP-1: Design of Super Structure	A
211	9944-250-PVC-U-030	Calculation Report of Ball Mill Building Superstructure	I
212	9944-250-PVC-U-033	LTP-1: Design of Foundations	A
213	9944-250-PVC-U-034	Design Calculation for Booster Fan foundation	A
214	9944-250-PVC-U-036	Design Calculation for Ball Mill foundation	I
215	9944-250-PVC-U-037	LC1A/B : Design of Gallery & Trestles	A
216	9944-250-PVC-U-038	Design Calculation for Absorber foundation	I
217	9944-250-PVC-U-039	LC2A/B : Design of Gallery & Trestles	A
218	9944-250-PVC-U-040	LC1A/B : Design of Foundation for Trestles	A

219	9944-250-PVC-U-041	Design Calculation for Transformer Foundation	A
220	9944-250-PVC-U-042	Design Calculation for Reagent Feed Pump Foundation	I
221	9944-250-PVC-U-043	Design Calculation for Pumps foundation	I
222	9944-250-PVC-U-044	Calculation Report of Waste Water Tank Foundation	I
223	9944-250-PVC-U-045	Calculation Report of Process (Make up) Water Tank Foundation	I
224	9944-250-PVC-U-046	Calculation Report of Secondary HC Feed Tank Foundation	I
225	9944-250-PVC-U-047	Calculation Report of Filtrate Water Tank Foundation	I
226	9944-250-PVC-U-048	Design Calculation of Auxiliary Storage Return Pump & Gypsum Bleed Pump	I
227	9944-250-PVC-U-049	Design Calculation of Gypsum Bleed Pump	I
228	9944-250-PVC-U-050	LC4A/B : Design of Gallery & Trestles	A
229	9944-250-PVC-U-051	LC2A/B : Design of Foundation for Trestles	A
230	9944-250-PVC-U-052	LC4A/B : Design of Foundation for Trestles	A
231	9944-250-PVC-U-053	LC3A/B : Design of Foundation for Trestles	A
232	9944-250-PVC-U-054	G C 1 A/B: Design of CONV. of Gallery & Trestles	A
233	9944-250-PVC-U-056	G C 1 A/B: Design of Foundation for Trestles	A
234	9944-250-PVC-U-057	LC3A/B : Design of of Gallery & Trestles	A
235	9944-250-PVC-U-058	LIME SILOS - Design of Super Structure	A
236	9944-250-PVC-U-061	LIME SILOS - Design of Foundation	A
237	9944-250-PVC-U-063	WEIGH BRIDGE: Design of Weigh Bridge Foudnation	A
238	9944-250-PVC-U-065	BUCKET ELEVATOR: Design of Foudnation for Bucket Elevator	A
239	9944-250-PVC-U-069	LTP-2: Design of Super Structure	A
240	9944-250-PVC-U-070	Calculation Report for Booster Fan Inlet Duct Support Foundation	I
241	9944-250-PVC-U-071	Calculation Report for Booster Fan Outlet to GGH Duct Support Foundation	I
242	9944-250-PVC-U-073	LTP-2: Design of Foundations	A
243	9944-250-PVC-U-083	Calculation Report of Duct Support Foundation DS-2	I
244	9944-250-PVC-U-084	Design Calculation for Duct Support Foundation DS3	I
245	9944-250-PVC-U-085	Calculation of Foundation of Oxidation Blower	I
246	9944-250-PVC-U-086	Calculation Report of GGH Stair Foundation	I
247	9944-250-PVC-U-101	FGD Chimney-Design basis report for chimney	I
248	9944-250-PVC-U-102	FGD Chimney-Analysis and design of raft foundation for chimney	I
249	9944-250-PVC-U-103	FGD Chimney-Analysis & design of RCC shell	I
250	9944-250-PVC-U-104	FGD Chimney-Design of platform beams of Roof Platform	I
251	9944-250-PVC-U-105	FGD Chimney-Design of platform beams of Platform No. 4	I
252	9944-250-PVC-U-106	FGD Chimney-Design of platform beams of Platform No. 3	I
253	9944-250-PVC-U-107	FGD Chimney-Design of platform beams of Platform No. 2	I
254	9944-250-PVC-U-108	FGD Chimney-Design of platform beams of Platform No. 1	I
255	9944-250-PVC-U-109	FGD Chimney-Analysis and design flue liner	I
256	9944-250-PVC-U-110	FGD Chimney-Design of extra reinforcement around openings	I
257	9944-250-PVC-U-111	FGD Chimney-Design of extra reinforcement around recesses for platforms	I
258	9944-250-PVC-W-001	Standard Details for Concrete Works	A
259	9944-250-PVC-W-002	Standared Notes for Concrete Works	A
260	9944-250-PVC-W-003	Soil Investigation Report	A
261	9944-250-PVC-W-004	Location Plan , Site Office, Stores & Access Road	A
262	9944-250-PVC-W-101	FGD Chimney - wind tunnel test procedure	A
263	9944-250-PVC-W-102	FGD Chimney - wind tunnel test report	A
264	9944-250-PVC-Y-101	FGD Chimney- GA of expansion compensator	I
265	9944-250-PVC-Y-102	FGD Chimney- Datasheet for expansion compensator	I
266	9944-250-PVC-Y-103	FGD Chimney- Datasheet for thermal insulation	I
267	9944-250-PVE-B-002	GA. Datasheet, Terminal Box arrangement and Curves of Gas cooling Pump Motor	A
268	9944-250-PVE-B-003	GA. Datasheet, Terminal Box arrangement and Curves of Oxidation Blower-Motor	A
269	9944-250-PVE-B-004	GA. Datasheet, Terminal Box arrangement and Curves of BALL MILL Motor	A
270	9944-250-PVE-B-005	GA. Datasheet, Terminal Box arrangement and Curves of Booster fan Motor	A
271	9944-250-PVE-B-007	GA DRG & BOQ FOR LOCAL MOTOR STARTER	A
272	9944-250-PVE-B-009	Drawing for VFD Panels	A
273	9944-250-PVE-B-010	GA AND LIST OF FITTINGS,R&D plate, HV/LV termination details, bushings GA of oil filled trf. for each rating of oil filled transformer	I
274	9944-250-PVE-B-010	CABLE GLANDS Catalogue	I
275	9944-250-PVE-B-011	CABLE TREFOIL CLAMPS - DETAILS, DRAWINGS & MANUFACTURER CATALOGUE FOR HT POWER CABLES & LT POWER CABLES.	I
276	9944-250-PVE-B-012	GA DRAWINGS & DETAILS OF CABLE TRAY & ACCESSORIES.	I
277	9944-250-PVE-B-013	CABLE TRAY SUPPORT SYSTEM - DETAILS & DRAWINGS FOR CHANNELS, ARMS, BRACKETS AND OTHER HARDWARE.	I
278	9944-250-PVE-B-014	JUNCTION BOXES ( FRP TYPE) - OUTLINE DIMENSION DRAWING/GA DRAWINGS	I
279	9944-250-PVE-B-015	RIGID STEEL CONDUITS & ACCESSORIES - OUTLINE DIMENSION, GA DRAWINGS & DATASHEET	I
280	9944-250-PVE-B-016	RECEPTACLES-BOXES (RB TYPE)- OUTLINE DIMENSION DRAWING/GA DRAWINGS & DATA SHEET	I
281	9944-250-PVE-B-017	RECEPTACLES-BOXES (RC TYPE)- OUTLINE DIMENSION DRAWING/GA DRAWINGS	I
282	9944-250-PVE-B-018	LIGHTING FIXTURES & ACCESSORIES - DATA SHEET & GA DRAWINGS .	I
283	9944-250-PVE-B-019	JUNCTION BOXES (TYPE F) - OUTLINE DIMENSION DRAWING/GA DRAWINGS & DATA SHEET	I
284	9944-250-PVE-B-020	GA & SLD FOR 11kV FGD TIE SWITCHGEAR	A
285	9944-250-PVE-B-021	LIGHTING FIXTURES & ACCESSORIES - MOUNTING DETAIL DRAWINGS .	I
286	9944-250-PVE-B-022	220V DC BATTERY CHARGER (FLOAT CUM BOOST CHARGER)- DATA SHEET, GA AND SLD.	A
287	9944-250-PVE-B-023	220V BATTERY - DATA SHEET AND GA.	A
288	9944-250-PVE-B-024	Dry Type Transformer - GA of H.V.Cable box- each type & rating	A
289	9944-250-PVE-B-025	RECEPTACLES-BOXES (RA TYPE)- OUTLINE DIMENSION DRAWING/GA DRAWINGS & DATA SHEET	I
290	9944-250-PVE-B-026	DG SETS - FOUNDATION DRAWING & DETAILS FOR ACOUSTIC ENCLOSURE	A
291	9944-250-PVE-B-027	DG SETS - LAYOUT DRAWINGS & SECTIONAL DETAILS	A
292	9944-250-PVE-B-028	DRY TYPE TRANSFORMER - GA DRAWINGS- each type & rating	A
293	9944-250-PVE-B-029	DRY TYPE TRANSFORMER - RATING AND DIAGRAM PLATE each type & rating	I
294	9944-250-PVE-B-030	GA OF EARTHING TRUCK	I

295	9944-250-PVE-B-031	Dry Type Transformer - GA of L.V.Bus duct termination.- each type & rating	A
296	9944-250-PVE-B-032	Dry Type Transformer - GA & Schematic of Marshalling Box.- each type & rating	A
297	9944-250-PVE-B-033	Outline Gen. Arrangement (OGA) and list of Fittings/Accessories - 12.5 MVA, 11/3.45KV	A
298	9944-250-PVE-B-034	Loading Gauge Drg. (Transportation Drg.) & Twin Bidirectional Roller - 12.5MVA, 11/3.45KV	A
299	9944-250-PVE-B-035	HV & LV Busduct/Cable Termination details - 12.5MVA, 11/3.45KV	A
300	9944-250-PVE-B-036	Bilingual Rating & Diagram Plate - 12.5MVA, 11/3.45KV	I
301	9944-250-PVE-B-037	GA Bushing Drawings (HV, LV & Neutral) - 12.5MVA, 11/3.45KV	A
302	9944-250-PVE-B-038	GA & Schematic Diagram for Marshalling Box - 12.5MVA, 11/3.45KV	A
303	9944-250-PVE-B-039	GA AND LIST OF FITTINGS,R&D plate, HV/LV termination details of dry type trf- for each rating of dry type transformer	A
304	9944-250-PVE-B-040	Datasheet/Drawing for Junction Box (24way, 48way, 72way, 96way)	A
305	9944-250-PVE-B-041	General Arrangement, Layout, Termination details, Foundation and support structure details, Technical datasheet, Type test reports and wall frame assembly drawings of SPBD	A
306	9944-250-PVE-B-044	HT CABLE JOINTING & TERMINATIONS KIT- DATA SHEET, DETAILS & DRAWINGS.	A
307	9944-250-PVE-B-060	GA & SLD FOR 3.3 kV FGD SWITCHGEAR	A
308	9944-250-PVE-B-061	Datasheet, GA and curve of Vacuum pump motor	A
309	9944-250-PVE-B-063	Outline Gen. Arrangement (OGA) and list of Fittings/Accessories - 40MVA, 400/11.5KV	A
310	9944-250-PVE-B-064	Loading Gauge Drg. (Transportation Drg.) & Twin Bidirectional Roller - 40MVA, 400/11.5KV	A
311	9944-250-PVE-B-064	HV & LV Busduct/Cable Termination details - 40MVA, 400/11.5KV	A
312	9944-250-PVE-B-065	Bilingual Rating & Diagram Plate - 40MVA, 400/11.5KV	I
313	9944-250-PVE-B-066	GA Bushing Drawings (HV, LV & Neutral) - 40MVA, 400/11.5KV	A
314	9944-250-PVE-B-067	GA & Schematic Diagram for Marshalling Box - 40MVA, 400/11.5KV	A
315	9944-250-PVE-B-068	OLTC drawings of 40 MVA transformer	A
316	9944-250-PVE-B-081	NGR-GA, FOUNDATION, DATA SHEET & TYPE TEST REPORTS---3.45 KV	A
317	9944-250-PVE-B-082	NGR-GA, FOUNDATION, DATA SHEET & TYPE TEST REPORTS---11 KV	A
318	9944-250-PVE-B-151	GA DRG FOR LOCAL PUSH BUTTON STATION	I
319	9944-250-PVE-B-201	400 kV CT - GA of equipment supporting structure	A
320	9944-250-PVE-B-202	400 kV CVT - GA of equipment supporting structure	A
321	9944-250-PVE-B-203	400 kV ISOLATOR - GA of equipment supporting structure	A
322	9944-250-PVE-B-204	400 kV LA - GA of equipment supporting structure	A
323	9944-250-PVE-B-205	400 kV POST INSULATOR - GA of equipment supporting structure	A
324	9944-250-PVE-B-206	400 kV WAVE TRAP - GA of equipment supporting structure	A
325	9944-250-PVE-B-207	Structural Drawing for 400 kV GIRDER & Gantry Tower	A
326	9944-250-PVE-B-208	400 kV Foundation & Cable Trench Layout	A
327	9944-250-PVE-B-209	Outdoor Cable Trench section details	A
328	9944-250-PVE-B-210	400 kV Circuit Breaker - Drawings & Data sheet	A
329	9944-250-PVE-B-211	400 kV CT - Drawings & Data sheet	A
330	9944-250-PVE-B-212	400 kV CVT - Drawings & Data sheet	A
331	9944-250-PVE-B-213	400 kV ISOLATOR - Drawings & Data sheet	A
332	9944-250-PVE-B-214	400 kV LA - Drawings & Data sheet	A
333	9944-250-PVE-B-215	400 kV POST INSULATOR - Drawings & Data sheet	A
334	9944-250-PVE-B-216	400 kV WAVE TRAP - Drawings & Data sheet	A
335	9944-250-PVE-B-217	Bay Marshalling Kiosk, CT & CVT Junction Box - Drawings & Data Sheet	A
336	9944-250-PVE-B-218	Over-all architecture diagram of SAS for Switchyard	A
337	9944-250-PVE-B-219	400 kV String Hardware - GA , Part Drawings & Data Sheet	A
338	9944-250-PVE-B-220	400kV Clamps & Connectors - Drawings & Datasheets	A
339	9944-250-PVE-B-221	AC Kiosk Drawings & Data Sheet	A
340	9944-250-PVE-B-222	ACSR conductors Drawing & Data Sheet	A
341	9944-250-PVE-B-223	IPS AI Tube Drawing & Data Sheet	A
342	9944-250-PVE-B-224	Mandatory Maintenance Equipments	I
343	9944-250-PVE-B-225	GA , BOM & Schematics ofCRP	A
344	9944-250-PVE-F-001	FGD Electrical cum Control Building Equipment Layout with transformer layout	A
345	9944-250-PVE-F-004	Detail Cable Routing Plan for complete FGD Area & Limestone & Gypsum Handling area	A
346	9944-250-PVE-F-005	Illumination Layout and Road / Area Lighting layout for complete FGD Area & Limestone & Gypsum Handling area	A
347	9944-250-PVE-F-006	Earthing Layout for complete FGD Area & Limestone & Gypsum Handling area	A
348	9944-250-PVE-F-007	Lightning Protection Layout for complete FGD Area & Limestone & Gypsum Handling area	A
349	9944-250-PVE-F-010	Foundation & Loading gauge, Roller& GA & SCHEMATIC DIAGRAM FOR M. BOX oil filled trf-for each rating of oil filled transformer	A
350	9944-250-PVE-F-031	Earthing & lightning protection layout-Main electrical building with transformer yard	A
351	9944-250-PVE-F-032	Cable tray layout -FGD Electrical cum Control Building with transformer yard	A
352	9944-250-PVE-F-033	GPYSUM MCC Control Room - Equipment Layout	A
353	9944-250-PVE-F-034	Earthing & lightning protection layout-Gypsum Dewatering building (with MCC Room)	A
354	9944-250-PVE-F-035	Cable tray layout-Gypsum Dewatering building (with MCC Room)	A
355	9944-250-PVE-F-036	Cable tray Layout for complete FGD area including Gypsum and limestone handling area	A
356	9944-250-PVE-F-037	Overall Below grid Earthing Layout for complete FGD Area & Limestone & Gypsum Handling area	A
357	9944-250-PVE-F-241	400 kV Circuit Breaker Foundation Drawing	A
358	9944-250-PVE-F-242	400 kV CT Foundation Drawing	A
359	9944-250-PVE-F-243	400 kV CVT Foundation Drawing	A
360	9944-250-PVE-F-244	400 kV ISOLATOR Foundation Drawing	A
361	9944-250-PVE-F-245	400 kV LA Foundation Drawing	A
362	9944-250-PVE-F-246	400 kV POST INSULATOR Foundation Drawing	A
363	9944-250-PVE-F-247	400 kV WAVE TRAP Foundation Drawing	A
364	9944-250-PVE-F-248	Foundation Drawing for 400 kV Gantry Tower	A
365	9944-250-PVE-F-249	Air Conditioned Kiosk - Foundation Drawing	A
366	9944-250-PVE-F-250	400 kV Circuit Breaker Foundation Design	A
367	9944-250-PVE-F-251	400 kV CT Foundation Design	A
368	9944-250-PVE-F-252	400 kV CVT Foundation Design	A
369	9944-250-PVE-F-253	400 kV ISOLATOR Foundation Design	A
370	9944-250-PVE-F-254	400 kV LA Foundation Design	A
371	9944-250-PVE-F-255	400 kV POST INSULATOR Foundation Design	A

372	9944-250-PVE-F-256	400 kV WAVE TRAP Foundation Design	A
373	9944-250-PVE-F-257	Foundation Design for 400 kV Gantry Tower	A
374	9944-250-PVE-F-258	Transformer Foundation Design	A
375	9944-250-PVE-F-259	Air Conditioned Kiosk - Foundation Design	A
376	9944-250-PVE-F-260	400 kV Layout Plan & Section	A
377	9944-250-PVE-F-261	400 kV Structure Layout Plan & Section	A
378	9944-250-PVE-F-262	400 kV EKD - Plan, Section & BOM	I
379	9944-250-PVE-F-263	400 kV Clearance Check Diagram	I
380	9944-250-PVE-F-264	Earthmat Layout - 400 kV Switchyard	I
381	9944-250-PVE-F-265	Equipment Earthing Philosophy & Details	A
382	9944-250-PVE-H-001	Cable schedule for power & control Cables	I
383	9944-250-PVE-H-011	Control Cable Schedule	I
384	9944-250-PVE-H-012	Power Cable Schedule	I
385	9944-250-PVE-L-001	Electrical Key Single line diagram for FGD system	A
386	9944-250-PVE-L-004	Control Scheme for each type of LT Swgr module	A
387	9944-250-PVE-L-005	RELAY CONFIGURATION & SETTINGS FOR LT SWITCHGEAR	I
388	9944-250-PVE-L-009	DETAILS OF INTERNAL LIGHTING-Chimney	I