



Bharat Heavy Electricals Ltd
Boiler Auxiliaries Plant
Ranipet-632 406

EDC / AIR PREHEATERS
TECHNICAL SPECIFICATION
Effective Date: 06-06-2019

Specification No : RAH- 553

Rev. No : 01

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1.0 Item

Gas to Gas heater with Accessories (GGH)

2.0 Application :

Used to transfer the heat from the Untreated gas to Treated gas in FGD plant of Coal fired Power plant.

3.0 Standards and Regulations :

3.1 Design, Manufacturing, Inspection and Testing of the GGH shall comply with all the currently applicable statutes, regulation and safety codes in the locality where the equipment are to be installed.

3.2 The equipment shall also conform to the latest applicable Indian / British / American / European Standards.

4.0 Sizing Parameters for GGH:

Refer Annexure-I in pages 07 & 08.

5.0 Design Criteria:

5.1 GGH shall be of Rotary Regenerative type with rotating matrix with vertical axis of rotation. Untreated Flue gas flow direction shall be vertically downwards and Treated flue gas direction shall be vertically upwards.

5.2 GGH shall be designed to meet the treated gas exit temperature of 101 deg C minimum at Guarantee point and sufficient to maintain 81 deg C even at 50% Guarantee point with pressure drop of ≤ 112 mmwc at Design point where the flow is maximum.

5.3 GGH shall ensure that leakage through seals does not exceed 1.0% of the Untreated gas inlet flow from 50% of Guarantee point flow to 100% of Design point flow. The leakage shall be guaranteed and demonstrated after 3000 hrs of operation. No shut down or internal adjustment of the seals shall be permitted during the above period.

5.4 On-line Automatic leakage control system (ALCS) may be provided, if the contractor has the previous experience of the same. Contractor shall provide Low leakage fan to minimize the carryover / entrained leakage. Low leakage fan to be located at GGH level.

5.5 Flue gas Booster Fan is not applicable and the ID fan is located before FGD.

5.6 Plant is located at an elevation of 126 meter above mean sea level. Bottom of GGH elevation is 156.60 meter above mean sea level.

5.7 GGH is designed for entire flue gas generated by Boiler at design point and clarified river water is used in FGD scrubber.

5.8 Seal air fans 2x100% with motorized isolation gates at the discharge of each fan shall be provided. Seal Air fan to be located at GGH level.

5.9 The sound level during operation of GGH and its accessories shall be <85 dBA and the same has to be guaranteed.

5.10 The motors shall be suitable for the power supply of 415V, 3phase, 50Hz and other equipment to suit 240V, 1phase, 50Hz. Control voltage available is 110V / 240V, AC, 50Hz. All the motors to meet the Motor specification TECI: LT Motor Rev 02 attached separately (8 pages & Drawing no: 3-00-114-39893).

01	06-06-19			Clauses: 5.2, 5.11.2, 5.13, 6.2.1, 7.10, 8.4, 8.16, 10&2.iv, 3c of page 07, 08&11, 12, 13 updated. Specification revised.	
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- 5.11 The material requirement for the following components shall be as given below.
- 5.11.1 Rotor, Baskets & Gratings : Corten or equivalent material. Rotor plates shall be provided with a minimum corrosion allowance of 3mm on each side.
 - 5.11.2 Heating elements: Enamelled steel with base metal thickness of 0.75mm or higher. Base metal shall be De-carburised steel as per ASTM A424 Type-I / EN 10209 DC04ED. Porcelain enamel suitable for the operating environment as per ISO 28763 for a thickness of 150 microns (Tolerance: -0 +50 microns) on each side of the sheet including edges. NF profile is not acceptable.
 - 5.11.3 Rotor Housing and other components in gas path: Carbon steel lined with Stainless steel or flake glass lining as per proven practice of the contractor.
- 5.12 The GGH shall be driven by a peripheral drive with A.C. motor through a reduction gear box, emergency air motor, with automatic clutching/de-clutching arrangement shall also be provided. GGH shall include the following:
- 5.12.1 Rotor stand-still device with alarm / stoppage alarm.
 - 5.12.2 Minimum Two nos (Mini. 1 for Interlock & Mini. 1 for Alarm) Duplex RTD with Transmitters for each bearing.
 - 5.12.3 Adequate instrumentation in the lube oil system for detection of any malfunctioning.
 - 5.12.4 Observation ports with lights.
 - 5.12.5 Complete facility for removal of basket and placement on ground floor, including removal gear, Electric hoist and runway beams.
 - 5.12.6 Sump lubricated, Oil cooled anti-friction spherical roller bearings.
 - 5.12.7 2x100% Oil circulation system with oil coolers shall be provided for each bearing.
- 5.13 On load Multi-media cleaning device of semi-retractable type to be provided at both hot end and cold end and shall use steam, high pressure water and low pressure water for cleaning. Separate washing manifold for low pressure washing is not acceptable. Low pressure washing to be used when GGH is not in operation. Low pressure and High pressure pumps to be located at ground level and the suction pressure may be taken as 2 to 3 kg/sq.cm. LP pump to cater LP washing & drip tray washing requirement.
- 5.14 High pressure On-line washing is to be done sector by sector sequentially at some intervals. The area of GGH is to be divided equally from outer radius of elements to inner radius of elements. The number of sectors and interval of the washing between each sector is to be decided by Supplier based on their experience.
- 5.15 A drip tray shall be provided to collect most of the washing water. Diagrammatic representation of drip tray is required with its dimensions. Material required for construction of drip tray is FRP or steel with suitable lining. The material required for drip tray washing pipe is FRP/ Hastelloy C or equivalent material. Drip tray is to be washed once per 20 minutes for a duration of 5 minutes during GGH washing.
- 5.16 All motors shall have 10% margin and energy efficient type.

6.0 Scope of supply & Exclusions:

6.1 Scope of supply:

Supplier's scope shall cover Design and engineering of complete GGH, Supply of GGH flange to flange including sub-systems, Special tools, Start-up/Commissioning Spares, Mandatory spares and Supervision for Erection and commissioning as given below except Fabricated components given in clause 6.2 which will be manufactured by BHEL using supplier drawing/information.

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6.1.1 GGH Components comprising the following: a) Enamelled Heating elements with baskets b) Rotor drive assembly including fluid coupling & air motor, Guide bearing assembly, Support bearing assembly, Guide & Support Trunnion/stub-shaft, Oil circulation systems with piping, Automatic leakage control system (if required) with control panel, rotor stoppage alarm, Seals, Drip tray & First fill of lubricants. c) Motor starters, cables for power/control/instrumentation, conduit, local JB etc. up to local JB. d) All Instrumentation (Indicators, Gauges, Switches, Transmitters, RTD etc) and valves required for controlling and Monitoring of GGH. e) Shrouding of carbon steel parts in gas path excluding lined surface, as applicable. f) Any other items required for completeness of the GGH equipment other than the items covered in the clause 6.2.1 and exclusions clause 6.3 6.1.2 On line Multi-media cleaning device for hot and cold end with common control panel. 6.1.3 Low leakage fan (Purge / scavenging) system including fan, motor, dampers, vibration pad/dampener and mounting skid. 6.1.4 Seal air fan system including 2x100% fans with motor and motorized isolation gates, inlet silencer, acoustic enclosure/hood, mounting skid and associated piping. 6.1.5 High pressure pump system including pump, motor, acoustic enclosure/hood, mounting skid, valves, fittings and piping up to GGH. 6.1.6 Low pressure pump system including pump, motor, acoustic enclosure/hood, mounting skid, valves, fittings and piping up to GGH. 6.1.7 Supervision of erection & commissioning: One visit of 10 man days for each GGH. The Supplier shall indicate the Lump sum price & daily rate to account for additional man days if required. 6.1.8 Complete set of all special tools which are necessary for erection, operation and maintenance. Only one set of special tools per Contract shall be offered. 6.1.9 Start-up & commissioning spares. One set for each GGH is required. 6.1.10 Mandatory spares as per Annexure V. Only one set per Contract is required. 6.2 Fabricated components for BHEL manufacturing. 6.2.1 Fabrication components covering Rotor assembly, Rotor post assembly (excluding stub-shaft / Trunnion), Pin-rack assembly, Rotor Housing, transition ducts / integral ducting, Hot end connecting plate & Cold end connecting plate with sector plates or Integral bearing supporting structural steelwork at top and bottom of rotor, Integral platforms near Bearings, Access doors, low leakage fan ducting & Hoist beam shall be included in BHEL's manufacturing scope as per Supplier drawings/documents. However, special materials like Stainless Steel, Teflon, Aluminium, Brass, Special fasteners, Casting & Forgings and minor items like gasket, coupling guard shall be excluded from BHEL scope. 6.2.2 Any other fabricated parts like ducting, pipes of carbon steel / corten steel material excluding the following may also be covered in BHEL scope as decided by the supplier. List of such items with weight to be indicated along with the offer. a) Casting & Forgings, b) Special materials like Stainless Steel, Teflon, Aluminium, Brass etc, and c) Small parts like special fasteners & gaskets. 6.2.3 Assembly & Manufacturing drawings in .dwg format, Manufacturing process sheet, Material list, QA/QC procedures for the above fabrication portion shall be provided by the supplier. 6.3 Exclusions: 6.3.1 Insulation and lagging materials. 6.3.2 Walkways, Platforms and ladders. 6.3.3 GGH Supporting structure.		

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	6.3.4 Glass flake Lining, Air receiver, Electric hoist for element handling & Hydraulic jack system for bearing maintenance. 6.3.5 GGH controls & all cables between Local junction box to control room.	
7.0	The following documents shall be submitted along with the offer. 7.1 GGH Performance data to be Filled-in Annexure-I 7.2 Filled in guarantee values as per Annexure-II. 7.3 Confirmation to Scope of supply. If any deviation is found the Buyer reserves the right to either reject the offer or accept the offer with the penalty. 7.4 Equipment data sheet for GGH indicating the materials of construction for various parts like rotor, post, elements, various seals, housing, connecting plates, sector plates etc and size of equipment, rotor rpm, element details, cleaning device details, leakage control equipment detail, area & thickness of insulation, element handling electric hoist capacity, Hydraulic jack capacity etc. 7.5 Equipment data sheets for sub-systems including i) HP & LP pumps with motors, ii) Seal air system fan & motor, iii) Low leakage system fan, motor and dampers etc. Supplier shall indicate type/model, make, quantity, KW, rpm, weight, pressure etc. 7.6 Equipment drawing with overall dimensions and the inlet and outlet flange connection details. 7.7 Utility requirements i.e. consumption of power, compressed air, Service/Cooling water, steam, etc as per Annexure-III. 7.8 Complete P & I diagram showing all the components / instruments/valves with necessary write-up and electrical drive list. 7.9 Loading details (static and dynamic) indicating the loading points for GGH and all auxiliary equipment of GGH. 7.10 Complete weight schedule of the GGH equipment and accessories with scope split between BHEL and Vendor in-line with total GGH weight shall be filled in Annexure-VI. 7.11 List of those items in supplier scope which needs assembly at BHEL works to be furnished with approximate weight. 7.12 Lining area, lining thickness and list of components to be lined. 7.13 Detailed calculations and data to meet the efficiency requirements of both at design and guarantee point of GGH. 7.14 List of special tools and Start-up & Commissioning spares. 7.15 List of Recommended spares for 3 years operation over and above the Mandatory spares list given in Annexure-IV. 7.16 Manufacturing quality plan for GGH and other Major bought out components. 7.17 Sub-vendor List for Major Bought out items. 7.18 List of lubricants with quantity for initial filling. 7.19 Company and Product Brochure. 7.20 Any other details pertaining to GGH. 7.21 Filled-up GGH Technical Data sheet as per Annexure-IV to be submitted along with offer.	

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8.0	GENERAL 8.1 Supplier shall use the MKS / SI units in their documents. 8.2 Control logic, Test procedure, Erection manuals with drawings required for the erection and maintenance of the equipment and O&M manuals shall be submitted after the award of the contract. 8.3 Filled-in data sheets for GGH, LT Motors (refer LT Motor spec for format), Pump, and Blowers/fans, Instrumentation, Cables etc shall be submitted for approval after the award of the contract. 8.4 Painting : 8.4.1. Refer painting schedule of Quality as per PS : Panki : FGD : R4U2 (Latest Revision). 8.5 General arrangement drawing of GGH, PID drawing in .dwg format & Manufacturing QPs shall be submitted for approval after the award of the contract. 8.6 Drawings and documents shall be in English and supplied both in hard and soft copies. 8.7 All the bought-out items supplied shall be of reputed make and shall confirm to applicable Indian / International standards. Sub vendor list for major bought out items to be submitted for our approval after purchase order. 8.8 Despatchable units / Shipping components details indicating quantity, weight and size shall be submitted after the award of the contract. 8.9 Glass flake Lining parts drawings shall be provided by supplier during contract execution stage. 8.10 Price to be quoted separately for i) GGH and Accessories excluding BHEL fabrication portion, ii) Supervision charges for Erection & commissioning, iii) Special tools, iv) Start-up & Commissioning spares, v) Mandatory spares, vi) Recommended spares & vii) Packing and forwarding charges. Item wise price shall be indicated for Mandatory spares and Recommended spares. 8.11 Loading and Tender Evaluation: Variation in the weight of BHEL fabricated portion and lining area among the suppliers will be levelled by loading Rs 140 per Kg + tax for Fabricated component cost and Rs 9000 per Sq.mtr + tax for Lining cost. Tender will be evaluated on Total cost including GGH and Accessories, Supervision charges for Erection & Commissioning, special tools, Start-up & Commissioning spares, Mandatory spares & Loading for variation in the weight of BHEL fabricated portion & Lining area and loading on Auxiliary power consumption at the rate of LD based on lowest value quoted by the Supplier. 8.12 Supplier shall indicate the weight split for BHEL and Supplier portion with $\pm 5\%$ variation. Any increase in weight of BHEL portion and Lining area during contract stage will be charged to supplier account at rate of loading charges indicated above. 8.13 Supplier to pack & despatch those components which need to be assembled in BHEL fabricated portion like ALCS, to BHEL/Ranipet. List of such items with weight shall be furnished along with the offer. 8.14 Vendor to submit filled in Customer Technical data sheet given in Annexure-VII to be submitted during contract stage. 8.15 Vendor to participate in the Performance Guarantee test at their cost. 8.16 Auxiliary power consumption for GGH shall not exceed sum of rated capacity of the motors.	
9.0	Guarantee Parameters & Liquidated damages. 9.1 Supplier shall guarantee the equipment performance, auxiliary power consumption, Noise level and utility consumption as per Annexure II in page 09. If the performance guarantee(s) specified at Clause 5.2, 5.3 & Annexure-II clause 04 & 05 i) are not met by the supplier even after the modifications and/or replacements but are achieved within stipulated Acceptable Shortfall limit as indicated in this clause. BHEL will accept the equipment after levying LD as indicated here under, however, if the demonstrated guarantee	

continues to be more than the acceptable shortfall limits, the employer may at his discretion reject the equipment and recover the payment already made or accept the equipment after levying LD which shall be deducted from the contract price. Suppliers aggregate performance liability of LD shall not exceed 10% of the contract price. Pro-rata will be applicable for fractions for LD.

S.No	Guarantee	Rate of LD per GGH	Acceptable shortfall limit
1.	Gas out temp of Treated gas from GGH. Refer Cl.5.2.	Rs 57 Lakhs per deg C.	-1 deg C (Absolute value 101 Deg C for Guarantee point & 81 Deg C for 50% Guarantee point.)
2.	Leakage at TMCR-DC Refer Cl.5.3	Rs 89 Lakhs per 1% of Leakage.	+ 0.2 % above guaranteed value.
3.	Pressure drop. Refer Annexure-II clause 04	Rs 2.9 Lakhs per mmwc	+5 mmwc above guaranteed value.
4.	Auxiliary power consumption Refer Annexure-II clause 05 i)	Rs 5.84 Lakhs per KW	+1% of above guaranteed value.

10.0 INSPECTION

- 10.1 By BHEL / Customer at Supplier's works.
- 10.2 Necessary Material, Test & Guarantee Certificates shall be furnished. Type Test certificates as applicable shall also to be furnished.
- 10.3 Enamelled element testing shall include Adherence test, High voltage porosity test, Sulphuric acid test and Thermal shock test as per ISO 28763 & ISO 2746.
- 10.4 The Vendor must provide data sheet for sheet thickness, enamel thickness, drawing with dimensions including basket details, weight of each type of basket, total weight of element, inspection report and other pertinent information.
- 10.5 Sea worthy packing shall be considered for the items from other countries.

Annexure – I

Sl. No.	Description	Unit	Design Point	Guarantee Point	Operating Point-1	Operating Point-2
1.	Gas Flow Quantities per GGH					
	i. Untreated Gas In (wet)	Nm ³ /hr	2494800	2159640	2381040	2378520
	ii. Untreated Gas In (wet)	kg/hr	3243240	2807532	3095352	3092076
	iii. Untreated Gas Out (wet)	Nm ³ /hr	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
	iv. Treated Gas In (wet)	Nm ³ /hr	2575341	2224539	2451374	2452234
	v. Treated Gas In (wet)	kg/hr	3347943	2891900.7	3186786.2	3187904.2
	vi. Treated Gas Out (wet)	Nm ³ /hr	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
	vii. Purge air flow	kg/hr	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
2.	Temperature					
	i. Untreated Gas In	°C	140	135	130	133
	ii. Untreated Gas Out	°C	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
	iii. Treated Gas In	°C	50.8	50.9	48.5	47
	iv. Treated Gas Out (Uncorrected)	°C	≥ 101	≥ 101	Bidder to Fill	Bidder to Fill
	iv. a) Treated Gas Out (Corrected)		Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
3. a	Untreated Gas Inlet Pressure	mmH ₂ O	380	354.4	360.8	360
3. b	Pressure drop					
	i. Untreated gas side	mmH ₂ O	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
	ii. Treated gas side	mmH ₂ O	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
	iii. Total pressure drop	mmH ₂ O	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
3.c	Pressure drop across DeSOx plant	mmH ₂ O	112	93	103	103
4.	Leakage					
	Untreated to treated gas leakage	%	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
	Without purge air fan in service	%	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
5.	Untreated gas composition					
	i. SO ₂ (dry basis)	ppm	653	681	561	577
	ii. SO ₃ (dry basis)	ppm	5	4	3	3
	iii. H ₂ O (wet basis)	% by vol	9.83	10.08	8.7	7.73
	iv. CO ₂ (wet basis)	% by vol	11.82	12.20	12.05	12.74
	v. O ₂ (wet basis)	% by vol	5.83	5.35	5.88	5.91
	vi. N ₂ (wet basis)	% by vol	72.46	72.30	73.32	73.57
	vii. Dust concentration (wet)	mg/Nm ³	<200 @ 6% O ₂	<30	<30	<30
6.	Treated gas composition					
	i. SO ₂ (dry basis)	ppm	24	25	25	25
	ii. SO ₃ (dry basis)	ppm	3	2.5	2	2
	iii. H ₂ O (wet basis)	% by vol	12.44	12.47	11.10	10.29
	iv. CO ₂ (wet basis)	% by vol	11.51	11.91	11.75	12.41
	v. O ₂ (wet basis)	% by vol	5.67	5.22	5.73	5.75
	vi. N ₂ (wet basis)	% by vol	70.38	70.4	71.41	71.54
	vii. Dust concentration (wet)	mg/Nm ³	<70	<30	<30	<30
	Note: 1) GGH design should be capable of handling inlet dust burden of 50 to 200 mg/Nm ³ @ 6% O ₂ 2) GGH shall withstand the maximum untreated flue gas temperature of 175 deg C and a short term excursion temperature of 350 deg C for a period of 30 minutes. 3) Leakage of Untreated to treated gas shall not exceed 1.0% of the Untreated gas flow. Also refer Clause 5.3.					

Annexure-I Contd

Sl. No.	Description	Unit	Operating Point-3	50% Guarantee Point	-	-
1.	Gas Flow Quantities per GGH					
	i. Untreated Gas In (wet)	Nm ³ /hr	2019960	1125000	-	-
	ii. Untreated Gas In (wet)	kg/hr	2625948	1462500		
	iii. Untreated Gas Out (wet)	Nm ³ /hr	Bidder to fill	Bidder to fill	-	-
	iv. Treated Gas In (wet)	Nm ³ /hr	2079616	1157300	-	-
	v. Treated Gas In (wet)	Kg/hr	2703500	1504490		
	vi. Treated Gas Out (wet)	Nm ³ /hr	Bidder to fill	Bidder to fill	-	-
	vii. Purge air flow	kg/hr	Bidder to Fill	Bidder to Fill		
2.	Temperature				-	-
	i. Untreated Gas In	°C	130	120	-	-
	ii. Untreated Gas Out	°C	Bidder to fill	Bidder to fill	-	-
	iii. Treated Gas In	°C	47.4	50.2	-	-
	iv Treated Gas Out (Un corrected)	°C	Bidder to fill	≥ 81	-	-
	iv.a) Treated Gas Out(Corrected)	°C	Bidder to fill	Bidder to fill		
3. a	Untreated Gas Inlet Pressure	mmH ₂ O	310	260	-	-
3. b	Pressure drop				-	-
	i. Untreated gas side	mmH ₂ O	Bidder to fill	Bidder to fill	-	-
	ii. Treated gas side	mmH ₂ O	Bidder to fill	Bidder to fill	-	-
	iii. Total pressure drop	mmH ₂ O	Bidder to fill	Bidder to fill	-	-
3.c	Pressure drop across DeSOx plant	mmH ₂ O	112	93	-	-
4.	Leakage				-	-
	Untreated to treated gas leakage	%	Bidder to fill	≤1	-	-
	Without purge air fan in service	%	Bidder to Fill	Bidder to Fill		
5.	Untreated gas composition				-	-
	i. SO ₂ (dry basis)	ppm	615	681	-	-
	ii. SO ₃ (dry basis)	ppm	3	1	-	-
	iii. H ₂ O (wet basis)	% by vol	8.10	10.03	-	-
	iv. CO ₂ (wet basis)	% by vol	13.57	12.13	-	-
	v. O ₂ (wet basis)	% by vol	4.96	5.44	-	-
	vi. N ₂ (wet basis)	% by vol	73.32	72.33	-	-
	vii. Dust concentration (wet)	mg/Nm ³	<30	<30	-	-
6.	Treated gas composition				-	-
	viii. SO ₂ (dry basis)	ppm	27	25	-	-
	ix. SO ₃ (dry basis)	ppm	2	1	-	-
	x. H ₂ O (wet basis)	% by vol	10.48	12.07	-	-
	xi. CO ₂ (wet basis)	% by vol	13.23	11.85	-	-
	xii. O ₂ (wet basis)	% by vol	4.85	5.36	-	-
	xiii. N ₂ (wet basis)	% by vol	71.44	70.71	-	-
	xiv. Dust concentration (wet)	mg/Nm ³	<30	<30	-	-

Annexure - II

Schedule of Guarantees

Sl No	Parameters	Guaranteed Value per GGH
01	Outlet temperature of treated gas , °C at Guarantee Point	:
02	Outlet temperature of untreated gas, °C at Guarantee Point	:
03	Maximum Leakage from Untreated to treated side in % at 50% load flow to Design Point i) during initial operation ii) including drift after 3000 hrs of operation.	: : :
04	Total pressure drop at Guarantee Point in mmwc	:
05	i) GGH Auxiliary Power Consumption for continuously running equipments: Main drive motor, Oil circulation Motor, seal air fan motor, low leakage fan motor, ALCS motors (if applicable) control panels etc in Kw (list to be furnished in Utility requirements)	:
	ii) Power consumption for other GGH Accessories: Cleaning device motors, high pressure pump motor, LP pump motor, etc in Kw (list to be furnished in Utility requirements)	:
	iii) Total power in KW	:
06	Steam consumption in kg/hr at 16 kg/sq.cm (ata) pressure and 290 deg C temp.	
07	Compressed Air consumption, Nm ³ /hr @ 6 kg/cm ² (g)	:
08	Service Water Consumption, m ³ /hr a) On Line @ 200 kg/cm ² (g) b) Off Line @ 5 kg/cm ² (g)	: :
09	Cooling Water Consumption, m ³ /hr @ 5 kg/cm ² (g)	:
10	Noise level at 1mtr away from equipment and 1.5 mtr from ground level in dBA	:
11	Duration of Guarantee for the complete GGH system	: 12 months from Commissioning.

Annexure-III

Schedule of Utilities required for GGH

Sl No	Requirements	No/ GGH	
Equipment			Qty / GGH
Cooling water at 5 kg / cm² (g)			m³ / hr
01	Guide & Support Bearing Oil Coolers		
Service water at low Pressure 5 kg / cm² (g) at GGH level			m³ / hr
02	Water Washing - Hot & Cold End		
Service water at high Pressure 200 kg/cm²(g)			m³ / hr
03	Water Washing - Hot & Cold End		
Service air at 6.0 kg / cm² (g)			N m³ / min
04	Auxiliary drive - Air Motor		
Steam at 16 kg/cm² (ata) & 290°C			kg / hr
05	Cleaning devices - Hot & Cold End		
	(Cleaning Duration : ____ minutes per pass)		
Electrical			Rating
L T Motors : 415 V, 3 Ph, 50 Hz, AC			KW
06	Main Drive Motor / Stand-by motor		
07	Oil Circulation Motors –Support & Guide Brg		
08	Multimedia Cleaning device Motors – Hot & cold end		
09	Seal Air Fan Motor		
10	Low leakage System Fan Motor		
11	High Pressure Pump Motor		
12	Low Pressure Pump Motor		
Other Equipment : 240 V, 1 Ph, 50 Hz, AC			KW
13	Light Assembly		
14	Rotor Stoppage Alarm		
15	Solenoid Valve		
16	Control panel for Multimedia Cleaning device		
17	Control panel for ALCS (if ALCS applicable)		
18	Any other item		

Annexure - IV

GGH Technical Data sheet

SI No	Parameters	Value per Boiler
01	GGH SIZE / Model Number	
02	GGH Rotor Diameter in mtr	
03	No of GGH per Boiler	
04	No of Heating element layers	
05	Heating Element Depth in mm	
06	Heating Element Profile name	
07	Element thickness in mm	
08	Element material with Standard	
09	Effective Heating surface area in sq.mtr (Untreated Gas or Treated GAS side only)	
10	Lining area in sq.mtr	
11	Shrouding area with Material if applicable	
12	Insulation Area in sq.mtr including low leakage fan with ducting and seal air fan ducting.	
13	Auxiliary Power consumption for continuously running equipments including Oil circulation motors & control panels in KW.	
14	ALCS provided or not	
15	Pressurised Entrained leakage control system provided?	
16	Pressurised Direct leakage control system provided?	
17	Total GGH with Accessories weight in Tons	
18	GGH weight in Tons	
19	Supplier Portion weight in Tons	
20	BHEL portion weight in Tons	
21	Weight of items to be sent to BHEL for assembly	
22	Weight of Mandatory spares in kgs	
23	Weight of BHEL portion in Mandatory spares if any in kgs	
24	Treated gas exit temperature in deg C at TMCR (Guarantee Point)	
25	Maximum % Leakage at 50% to 100% load range	
26	Total pressure drop at TMCR (Guarantee Point)	
27	Total pressure drop at BMCR-DC (Design point)	
28	Noise level in dBA	

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Annexure-V

MANDATORY SPARES LIST

Sl No	Description of GGH Components	Qty/Contract
1)	GGH Electric Motor complete	1 no
2)	Support bearing	1 no
3)	Guide bearing	1 no
4)	Lubricating system of support & guide bearing	
	i. Pump assembly	1 no of each type
	ii. Pump motor	1 no of each type
	iii. Pressure regulator	1 no of each type
	iv. Filters	2 no of each type
	v. Pump motor coupling	1 no of each type
5)	Radial seals	1 set*
6)	Axial seals	1 set*
7)	Circumferential or bypass seals	1 set*
8)	Rotor post seals	1 set*
9)	Heating Element	1 set*
10)	Air Motor	1 no
11)	Solenoid Valves	2 no
12)	GGH Cleaning Device	
	i. Lance and Nozzle	1 no
	ii. Drive assembly including Gearbox and motor	1 no
	iii. Valve assembly with actuator	1 no
	iv. Pump & Motor assembly	1 no

Note: * One set shall mean complete replacement for one GGH.

Annexure-VI

Weight Split details between BHEL & Vendor Scope

No.	Components Description	BHEL Scope	Vendor Scope	Unit Weight [kg]	Qty. per GGH Set/No.	Weight per GGH [kg]	Remarks
1		✓					
2			✓				
3		✓					
4		✓					
.			✓				
.		✓					
.			✓				
.							
.			✓				
.		✓					
.							
.							
.		✓					
	Grand Total Weight (kg)	X1	X2			X1+X2	
	Special tools						
	Start-up & commissioning spares						
	Mandatory spares						

Annexure-VII
CUSTOMER TECHNICAL DATA SHEET

2.05	Gas-Gas heater			
	2.05.1	Regenerative Gas heater		
	i)	Manufacturer		
	ii)	Type		
	iii)	No. of GGH per boiler		
	iv)	Mounting		
	v)	Flue gas temperature at GGH Cold Gas Outlet (°C) (Corrected)		
	vi)	Acid dew point for Dirty Gas and Clean Gas (Furnish curves)		
	vii)	Material Specification and thickness (mm)		
	a)	Cold end elements		
	b)	Intermediate elements		
	c)	Upper hot element		
	d)	Shaft		
	e)	Seals		
	f)	Sector Plate		
	g)	Casing		
	h)	Rotor		
	i)	No. of Baskets		
	ii)	Height of elements (mm)		
	iii)	Description		
	iv)	Thickness (mm)		
	viii)	Elements thickness / height (mm / mm) details for GGH		
	a)	Cold end elements		
	b)	Intermediate elements		
	c)	Upper hot element		
	ix)	Areas of elements		
	a)	Hot end (m ²)		
	b)	Intermediate (m ²)		
	c)	Cold end (m ²)		
	x)	Total effective heating surface (m ²)		
	xi)	Pressure drop at Design Point (mmWC)	Design Point	Guarantee Point
	a)	Hot Gas Side		
	b)	Cold Gas Side		
	xii)	Type of radial seals		
	a)	Hot end		
	b)	Cold end		
	xiii)	Type of circumferential seals		
	xiv)	Type of axial seals		

Annexure-VII Contd
CUSTOMER TECHNICAL DATA SHEET

xv)	Net free area for	
a)	Hot Gas flow (m ²)	
b)	Cold Gas flow (m ²)	
xvi)	Electric motor drive	
a)	Motor speed (rpm)	
b)	Motor nameplate rating (kW)	
xvii)	Speed reducer	
a)	Type	
b)	Speed ratio	
c)	Shaft power (kW)	
d)	Manufacturer	
xviii)	Emergency drive	
a)	Type	
b)	Shaft power (kw)	
c)	Speed (rpm)	
d)	Pressure (kg/cm ²) (abs) and flow requirement of air (m ³ /sec)	
xix)	Bearings	
a)	Manufacturer	
b)	Type	
c)	Type of lubrication	
d)	Lube oil circulation ratio	
xx)	Bearing Cooling Water requirement (m ³ /hr)	
a)	Quantity (m ³ /hr)	
b)	Inlet pressure (Kg/cm ²)	
c)	Pressure drop (kg/cm ²)	
d)	Temperature rise (deg. C)	
xxi)	Construction features	
a)	Seal plate adjustment external	(Yes / No)
b)	Automatic Seal Plate Adjustment	(Yes / No)
c)	Coupling : Flexible	(Yes / No)
d)	Lubrication : Forced	(Yes / No)
e)	Rotor guide bearing : Hot end	(Yes / No)
f)	Drive : Motor/Manual	(Yes / No)
xxii)	Accessories provided	
a)	Lube oil pumps	(Yes / No)
b)	Oil coolers	(Yes / No)
c)	Oil filters	(Yes / No)

Annexure-VII Contd
CUSTOMER TECHNICAL DATA SHEET

	d)	Oil tanks	(Yes / No)
	e)	Oil pumps	(Yes / No)
	f)	Support legs & foundation bolts	(Yes / No)
	g)	Coupling guards	(Yes / No)
	h)	Solenoid valve (air motor)	(Yes / No)
	i)	Air pressure adjusting device	(Yes / No)
	j)	Relief valve	(Yes / No)
	k)	Pressure gauges	(Yes / No)
	l)	Temperature gauges	(Yes / No)
	m)	Differential pressure gauges	(Yes / No)
	n)	Sight flow fittings	(Yes / No)
	o)	Main drive motor	(Yes / No)
	p)	Air motor	(Yes / No)
	q)	Valves	(Yes / No)
	r)	Barring device	(Yes / No)
	s)	Recommended maintenance tools	(Yes / No)
xxiii)		Seal Air Fans (if provided)	
	a)	Make/Model	
	b)	Rated Flow (mmWC)	
	c)	Rated Head (mmWC)	
	d)	Rated Power (KW)	
	e)	Motor Rating (MW)	
xxiv)		GGH Leakage with Seal Air Fans in service (%)	
	xxv)	GGH leakage without seal air fan in service (%)	
	xxvi)	Reference drawing Nos	
2.05.3 GGH Cleaning			
i)		On load cleaning	
	a)	Type of blower	
	b)	Single/multiple nozzle	
	c)	Type of drive (sweep action/ retractable)	
	d)	Pressure of steam jet (Kg/cm ²) (abs)	
	e)	No. of blowers	
	f)	Blower head material	
	g)	Blowing Medium	
	h)	Blowing pressure in (Kg/cm ²) (abs)	
	i)	Location	
ii)		Off load cleaning	Water jet / Air Jet
	a)	Provision made for off load cleaning	

Annexure-VII Contd
CUSTOMER TECHNICAL DATA SHEET

	b)	Type of drive	
	c)	Medium used (water/air)	
	d)	Pressure of water/air required in (kg/cm ²)(abs)	
	e)	Quantity of water/air required in (m ³ /hr)	
iii)		Material of construction for the cleaning device	
	a)	Links	
	b)	Seal plates	
	c)	Soot blower lance	
	d)	Water jet wash head	
	e)	Worm gear	
	f)	Swivel joint	
	g)	Nozzles (steam/water)	
	h)	Air motor impeller	
	i)	Air motor casing	
	j)	Air motor shaft	
	k)	Coupling	
iv)		HP & LP Pump (if provided)	
	a)	Make / Model	
	b)	Flow (m ³ /hr)	
	c)	Pressure (kgf/cm ²)	

