01	**Item :**	**Gas to Gas Heater with Accessories (GGH)**
02	**Application :** Used to transfer the heat from the Untreated gas to Treated gas in FGD plant of Coal fired Power plant.	
03	**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.	
04	**Sizing Parameters for GGH:**	Refer Annexure-I in pages 06 & 07.
05	**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 85 deg C minimum at Guarantee point load (100% TMCR DC), the treated gas exit temperature of 87 deg C minimum at BMCR-WC and the pressure drop of <110 mmWC at Operating Point-2 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 for all the operating conditions. 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 leakage. Low leakage fan to be located at GGH level. 5.5 Flue gas Booster Fan is applicable and is located upstream to GGH. 5.6 Plant is located at an elevation of 69.5 meter above main sea level. Bottom of GGH elevation is 100.0 meter from 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, 3 Phase, 50 Hz and other equipment to suit 240V, 1 Phase, 50 Hz. Control voltage available is 110V / 240V, AC, 50 Hz. All the motors to meet the Motor specification TECI: LT Motor Rev 02 attached separately. (8 Pages & Drawing no: 3-00-114-39893). 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 3 mm on each side. 5.11.2 Heating elements: Enamelled steel with base metal thickness of 0.75 mm 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.	

Rev.No	Date	Prepared	Checked	Approved	Record of Revisions.
01	23.08.19				Updated clauses: 5.5, 5.10, 5.11.2, 5.13, 6.2, 7.3, 7.10, 7.11, 8.4.1, 8.14, 8.15, 8.16, 10.4. Added: Annexure IV & VI
00	07.02.19	(Sd) SCH	(Sd) KP	(Sd) KP	Fresh issue

5.12 The GGH shall be driven by a peripheral drive with A.C. motor through a reduction gear box. Standby A.C. motor, 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 suitable lining. The material required for drip tray washing pipe is FRP/ Haste alloy C of 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.

6.1.1 GGH Components comprising the following:

a) Enamelled Heating elements with baskets

b) Rotor drive assembly including Stand-by motor & 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**H**

6.1.2 On line Multi-media cleaning device for hot and cold end with 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 that 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. Any other fabricated parts like ducting, pipes of carbon steel / corten steel material 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.

6.2.2 Any 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.

6.2.3 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.

6.2.4 All the items in BHEL scope will be manufactured as per the vendor drawings and quality plan. Stage wise inspection by vendor is not allowed. Final inspection by vendor before dispatch of item shall be at vendor cost.

6.3 Exclusions:

6.3.1 Insulation and lagging materials.

6.3.2 Walkways, Platforms and ladders.

6.3.3 GGH Supporting structure.

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 loading (value as decided by the buyer).

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 for both the design and guarantee point of GGH after placement of PO.

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-V.

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

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:BHAD:FGD:G301(Latest Revsion)

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 ± 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 & dispatch 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 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 08.

9.2 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 temperature of Treated gas from GGH at TMCR-DC. Refer Clause 5.2	Rs 57 Lakhs per deg C.	-1 deg C (Absolute value 84 Deg C)
2.	Leakage at TMCR-DC Refer Clause 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 05i)	Rs 5.84 Lakhs per KW	+1% 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 an other pertinent information.

10.5 Sea-worthy packing shall be considered for the items from other countries.

Annexure – I

Sl. No.	Description	Unit	BMCR WC	TMCR DC	Operating Point - 1	Operating Point - 2
			-	**Guarantee Point**	-	**Design Point**
1.	**Gas Flow Quantities per GGH**					
	i. Untreated Gas In (wet)	Nm3/hr	9,84,600	9,81,000	1,060,200	1,064,160
	ii. Untreated Gas In (wet)	kg/hr	1,298,687	1,293,939	1,398,404	1,403,627
	iii. Untreated Gas Out (wet)	Nm3/hr	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
	iv. Treated Gas In (wet)	Nm3/hr	1,033,434	1,034,116	1,121,233	1,124,661
	v. Treated Gas In (wet)	kg/hr	1,343,464	1,344,351	1,457,603	1,462,059
	vi. Treated Gas Out (wet)	Nm3/hr	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
2.	**Temperature**					
	i. Untreated Gas In	°C	140.5	154.9	164.5	167.5
	ii. Untreated Gas Out	°C	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
	iii. Treated Gas In	°C	52.8	53	53.5	53.3
	iv. Treated Gas Out	°C	≥ 87	≥ 85	Bidder to Fill	Bidder to Fill
3. a	**Untreated Gas Inlet Pressure**	mmH2O	247.8	260.02	309.0	315.09
3. b	**Pressure drop**					
	i. Untreated gas side	mmH_2O	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
	ii. Treated gas side	mmH_2O	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
	iii. Total pressure drop	mmH_2O	Bidder to Fill	Bidder to Fill	Bidder to Fill	<110.12
3.c	**Pressure drop across Absorber**	mmH2O	117.26	119.30	138.68	140.00
4.	**Leakage**					
	Untreated to treated gas leakage	%	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
	Without seal air in service	%	Bidder to Fill	Bidder to Fill	Bidder to Fill	Bidder to Fill
5.	**Untreated gas composition**					
	i. SO_2 (dry basis)	ppm	1048	827	827	527
	ii. SO_3 (dry basis)	ppm	6	9	14	12
	iii. H_2O (wet basis)	% by vol	9.87	9.63	9.66	9.58
	iv. CO_2 (wet basis)	% by vol	14.05	13.72	13.78	13.74
	v. O_2 (wet basis)	% by vol	4.36	4.32	4.25	4.26
	vi. N_2 (wet basis)	% by vol	71.63	72.26	72.23	72.37
	vii. Dust concentration (dry)	mg/Nm^3	200 @ 6% O_2	32.5	32.6	32.6
6.	**Treated gas composition**					
	i. SO_2 (dry basis)	ppm	27	29	30	33
	ii. SO_3 (dry basis)	ppm	3.6	5.4	8.4	7.2
	iii. H_2O (wet basis)	% by vol	13.67	13.81	14.15	14.01
	iv. CO_2 (wet basis)	% by vol	13.47	13.08	13.10	13.04
	v. O_2 (wet basis)	% by vol	4.21	4.17	4.08	4.10
	vi. N_2 (wet basis)	% by vol	68.64	68.94	68.67	68.84
	vii. Dust concentration (dry)	mg/Nm^3	80 @ 6% O_2	13	13.04	13.04
	Note: 1) GGH design should be capable of handling inlet dust burden of 50 to 200 mg/Nm^3 2) GGH shall withstand the maximum untreated flue gas temperature of 175 deg C and a short term excursion temperature of 300 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	-	-	-
1.	**Gas Flow Quantities per GGH**					
	i. Untreated Gas In (wet)	Nm3/hr	9,17,280	-	-	-
	ii. Untreated Gas In (wet)	kg/hr	1,209,892			
	iii. Untreated Gas Out (wet)	Nm3/hr	Bidder to Fill	-	-	-
	iv. Treated Gas In (wet)	Nm3/hr	9,62,923	-	-	-
	v. Treated Gas In (wet)	Kg/hr	1,251,800			
	vi. Treated Gas Out (wet)	Nm3/hr	Bidder to Fill	-	-	-
2.	**Temperature**			-	-	-
	i. Untreated Gas In	°C	139.9	-	-	-
	ii. Untreated Gas Out	°C	Bidder to Fill	-	-	-
	iii. Treated Gas In	°C	52.7	-	-	-
	iv. Treated Gas Out	°C	≥ 87	-	-	-
3. a	**Untreated Gas Inlet Pressure**	mmH_2O	246.77	-	-	-
3. b	**Pressure drop**			-	-	-
	i. Untreated gas side	mmH_2O	Bidder to Fill	-	-	-
	ii. Treated gas side	mmH_2O	Bidder to Fill	-	-	-
	iii. Total pressure drop	mmH_2O	Bidder to Fill	-	-	-
3.c	**Pressure drop across Absorber**	mmH_2O	109.10	-	-	-
4.	**Leakage**			-	-	-
	Untreated to treated gas leakage	%	Bidder to Fill	-	-	-
	Without seal air in service	%	Bidder to Fill			
5.	**Untreated gas composition**			-	-	-
	i. SO_2 (dry basis)	ppm	1042	-	-	-
	ii. SO_3 (dry basis)	ppm	6	-	-	-
	iii. H_2O (wet basis)	% by vol	9.85	-	-	-
	iv. CO_2 (wet basis)	% by vol	14.02	-	-	-
	v. O_2 (wet basis)	% by vol	4.39	-	-	-
	vi. N_2 (wet basis)	% by vol	71.64	-	-	-
	vii. Dust concentration (dry)	mg/Nm^3	32.3	-	-	-
6.	**Treated gas composition**			-	-	-
	i. SO_2 (dry basis)	ppm	27	-	-	-
	ii. SO_3 (dry basis)	ppm	3.6	-	-	-
	iii. H_2O (wet basis)	% by vol	13.63	-	-	-
	iv. CO_2 (wet basis)	% by vol	13.44	-	-	-
	v. O_2 (wet basis)	% by vol	4.25	-	-	-
	vi. N_2 (wet basis)	% by vol	68.67	-	-	-
	vii. Dust concentration (dry)	mg/Nm^3	12.92	-	-	-

Annexure – II

Schedule of Guarantees

Sl. No.	Parameters	Guaranteed Value per GGH
01	Outlet temperature of treated gas , ºC at TMCR-DC	
02	Outlet temperature of untreated gas, ºC at TMCR-DC	
03	Maximum Leakage from Untreated to treated side in % considering all the load conditions specified in Annexure I i) during initial operation ii) including drift after 3000 hrs of operation.	
04	Total pressure drop at TMCR-DC 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/cm^2 (a) pressure and 290 deg C temp.	
07	Compressed Air consumption, Nm^3/hr @ 6 kg/cm^2 (g)	
08	Service Water Consumption, m3/hr a) On Line @ 200 kg/cm^2 (g) b) Off line @ 5 kg/cm2 (g)	
09	Cooling Water Consumption, m^3/hr @ 5 kg/cm^2 (g)	
10	Noise level at 1mtr away from equipment and 1.5 meter from ground level in dBA.	
11	Duration of Guarantee for the complete GGH system	12 months from Commissioning

Note : Vendor to indicate the exact values wherever applicable.

Annexure-III

Schedule of Utilities required for GGH

Sl No	Requirements	No / GGH	
Equipment			**Qty / GGH**
Cooling water at 5 kg / cm^2 (g)			**m^3 / hr**
01	Guide & Support Bearing Oil Coolers		
Service water at low Pressure 5 kg / cm^2 (g) at GGH level			**m^3 / hr**
02	Water Washing - Hot & Cold End		
Service water at high Pressure 200 kg/cm^2(g)			**m^3 / hr**
03	Water Washing - Hot & Cold End		
Service air at 6.0 kg / cm^2 (g)			**Nm^3 / min**
04	Auxiliary drive - Air Motor		
Steam at 16 kg/cm^2 (a) & 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 Bearing		
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

Sl 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-DC (Guarantee Point)	
25	Maximum % Leakage at 50% to 100% load range	
26	Total pressure drop at TMCR-DC (Guarantee Point)	
27	Total pressure drop at Operating Point - 2 (Design point)	
28	Noise level in dBA	

Annexure-V

MANDATORY SPARES LIST

Sl. No.	Description for GGH Components	Quantity/Contract
a.	Support Bearing	2 Nos.
b.	Guide Bearing	2 Nos.
c.	Lubricating System of Support & Guide Bearing	
	i. Pressure regulator	2 Nos. of each type
	ii. Filters	2 Nos. of each type
d.	Radial Seals	2 Sets
e.	Axial Seals	2 Sets
f.	Circumferential of Bypass Seals	2 Sets
g.	Rotor Post Seals	2 Sets
h.	Speed Reducer Bearings	2 Sets
i.	Speed Reducer Seals & Gaskets	2 Sets

Note : One set shall mean complete replacement of 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 (^oC) (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 elementa)		
	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

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)
	d)	Oil tanks	(Yes / No)

Annexure-VII Contd

TECHNICAL DATA SHEET

	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

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)	