Annexure A
TECHENICAL SPECIFICATION
30Ton ELECTRIC VERTICAL SHAFT FURNACE, CFFP, BHEL, HARIDWAR, INDIA

Work: Renovation and up-gradation of 30Ton Electric Vertical Shaft furnace

The scope of work includes dismantling, Design and Engineering, supply, Erection and commissioning of electrically heated 30Ton Vertical shaft furnace installed in Heat Treatment area of medium forge shop CFFP, BHEL, Haridwar.

1.0 The details of existing system are:-

S.No.	Description / parameters	Values
1.	Diameter at entry point	1800mm
2.	Maximum height of heating	10200mm
3.	Maximum weight of charge including fastening	32 Tonnes
4.	Maximum dimension of piece	
	Diameter	1600mm
	Length (including test piece)	9200mm
	weight	30 Tonnes
5	Maximum Furnace Working temperature	1000 °C
6.	Temperature homogeneity	±5 °C as holding the furnace from 600degree Celsius
7.	Rate of rise of temperature	Minimum 10 °C/Hour Maximum 100 °C/Hour
8.	Slow cooling rate	5 to 10 °C/Hour
9.	Maximum fast cooling rate	150 °C/Hour
10.	Sealing	Sand
11.	Number of zones	6
12.	Power rating	1000Kw
13.	Skin Temperature	Walls 40°C above ambient Lid 80°C above ambient Bottom 50°C above ambient
14.	Mode of temperature control	Three position Delta/Star/Off
15.	Electrical power supply characteristic	415V,3 phase,50Hz,3 wire, ±5% voltage fluctuation
16.	Furnace Lining consisting of	
	Walls	230mm : Hot face insulation IS-8 & High Alumina 115mm: Insulation 90mm : Spintex

	Bottom	230mm: IS-8 230mm: Insulation
	Lid	130mm: Insulation 70mm: mineral fiber
	Throat	Castable
17	Heating Element	80/20 Ni./Cr. Strips on supporting hangers

2.0 Desired system after Renovation and up-gradation/acceptance criteria

S.No.	Description / parameters	Values
1.	Diameter of entry	1800mm
2.	Maximum height of heating	10200mm
3.	Maximum weight of charge including fastening	32 Tonnes
4.	Maximum dimension of piece	
	Diameter	1600mm
	Length (including test piece)	9200mm
	weight	30 Tonnes
5	Maximum Furnace Working temperature	1100 °C
6.	Temperature homogeneity	±5 °C at 800 °C and above
7.	Rate of rise of temperature	Minimum 10 °C/Hour Maximum 100 °C/Hour
8.	Slow cooling rate	5 to 10 °C/Hour
9.	Maximum fast cooling rate	150 °C/Hour or higher
10.	Sealing	Sand
11.	Number of zones	6
12.	Power rating	Minimum 900Kw (As per design requirement)
13.	Skin Temperature	Walls 40°C above ambient Lid 80°C above ambient Bottom 50°C above ambient
14.	Mode of temperature control	Automatic temperature control in Star /Delta mode & Thyristor mode by PID temperature Controllers with over temperature/safety controllers in each

		Zone. **Dual Control for each zone**: In case of failure of any thyristor unit, provision will be made to switch to contactor based ON/OFF star/delta operation of the entire furnace. The instrumentation control supporting this contractor system should match the star /delta operation and the matching controller of each zone should have two set points for high and low heating for each zone.
15.	Electrical power supply characteristic	415V,3 phase,50Hz, 3 wire, ±5% voltage fluctuation
16.	Furnace Lining consisting of	
	Walls	Vacuum formed FIBROTHAL module Grade – F17/LS quality; Density – 200 kg/m3; Classification Temp. – 1400 0C; Continuous duty temp – 1300 0C; Thickness – 125 mm backed up with ceramic fiber blanket of suitable grade of 175 mm thickness of wall lining = 300 mm to keep the skin temp
	Bottom	230 mm thick 45% Al2O3 bricks backed by 230 mm thick insulation brick. Total Thickness of Insulation 460 mm
	Lid	225 mm thick ceramic fiber module of 190 kg/m3 density backed by 25 mm thick ceramic fiber blanket of 128 kg/m3 density.
	Throat	Castable
17	Heating Element	KANTHAL APM in ROB Design (Rod Over Bend)
18	Thermocouples in each Zone	One simplex thermocouple for each zone for graph recorder. One duplex thermocouple for each zone for chamber PID controller as well as for excess temperature on/off controller. One Retractable contact thermocouple in each zone for graph recorder.

3.0 ELECTRICAL PANEL

3.1	The power panel will consist of one Incomer Panel ,one instrument panel along with six similar panels one for each zone. The panels shall be made of 2.0mm thick sheet steel painted first with corrosive resistant paint and then with industrial grade shade. All cables shall be bottom entry. Bolted type bottom plate shall be provided for ease of cabling.
3.2	The incomer panel will consists of an ACB of 2000A or above, electrically draw out type, with O/L, Short Circuit protection & E/F protection. The panel should also have three Led indicators for live power supply, Digital Energy Meter, Digital Voltmeter ,Digital Ammeter.(Ammeter and Volt Meter should be three each without selector switch).Led indicators for breaker ON,OFF,Trip.
3.3	Each Thyristor panel will have an incomer MCCB with O/L & Short Circuit protection along with rotary handle drive. An e-power Thyristor drive with power contactors at both ends of drive continuously controlled via PID controllers. A STAR DELTA contactor based power control system continuously controlled via PID controllers. In case of failure of any thyristor unit, provision will be made to switch to contactor based ON/OFF star/delta operation of the entire furnace or any particular zone. The instrumentation control supporting this contractor system should match the star /delta operation and the matching controller of each zone should have two set points for high and low heating for each zone.
3.4	Each Thyristor panel should have selector switch for selection of mode of operation ie thyristor/star-delta, thyristor on/off, star delta on/off, trip reset, over temp acknowledge. Led Indicators for zone on/off, mode of operation, trip, Over temperature. Digital Ammeter And Volt meter with selector switch.
3.5	The panel should also contain starters for blowers, dampers, Pneumatic actuators, modulating motors etc. as per the design requirement.
3.6	Indicators of incandescent lamp type not to be used
3.7	The instrument and control panel should have Six Microprocessors based PID Temperature controllers one master and others as slave. Six Indicating type Excess temperature controllers. Two, Six point microprocessor based temperature recorders. These items should be properly mounted and wired to communicate with the zone power controllers and field devices.
3.8	Copper wires used for power wiring should have current density 2.0A/Sqmm or less. Aluminum conductors/cables not to be used.
3.9	Panel Power wiring less than 4sq-mm should not be used.
3.10	Proper laying of cables & wires their arrangement/dressing, marking/numbering/feruling, proper termination of wires and cables with lugs/thimble is to be ensured during the panel manufacturing process.

3.11	All Power contactors selected must be 150% of design calculated current rating.
3.12	All starters must have run, stop and trip LED indications
3.13	Aluminum Bus bar current density 1A/Sq-mm or less Copper Bus bar current density 1.6A/Sq-mm or less
3.14	Copper wires for Control wiring 1Sqmm or more.
3.15	Control Transformer 415/220 with tappings, minimum 3KVA for control supply.
3.16	Panel should have provision sufficient cooling & illumination

4.0 FIBROTHAL INSULATION AND HEATING ELEMENT SYSTEM

4.1	FIBROTHAL Vacuum formed modules should be used for side wall insulation backed by ceramic fiber blanket of proper thickness so as to withstand working temperature of 1100 °C.
4.2	The terminal rod material should withstand temperature up to 1260 deg C on continuous duty. The mounting assemblies are to be in the Fibrothal modules to a depth of 25 – 30 mm from the hot face, and should be covered with fiber plug, there by not exposing the stud to the element temperatures. Provision should be made to terminate the cables to terminal rods through flexible busbar jumpers. Cables are not to be terminated directly to terminal rods.
4.3	The heating elements will be made from KANTHAL APM. The material is to be designed to have higher creep and elongation strengths at elevated temperatures coupled with better oxidation properties, which results in extended life of the heating elements. The elements will be designed in the Rod Over Bend form (R.O.B.) to give higher radiation compared to other element designs and easy maintenance.
4.4	FIBROTHAL Vacuum formed module cut pieces/slices will not be acceptable.

5.0 COOLING SYSTEM

5.1	: Accelerated cooling arrangement consisting of blower, cooling air supply duct with adequate nos. of injectors, air suction duct with hood, butter fly type cooling damper, modulating motors etc. must be designed and supplied to meet the slow and fast cooling requirements of the furnace along with for excess heat removal during heating.

6.0 SCOPE OF WORK

6.1	Dismantling of complete furnace refractory, elements, rods, connectors, lid cover. Collecting all the material at a particular place in the shop near the furnace. Cleaning of shell and its repair/fabrication along with Lid Assembly & Collar.

6.2	Painting of outer shell & cover with 400 °C grade aluminum paint.
6.3	Dismantling of Power and Control panels.
6.4	Laying and termination of control cables from panel to respective furnace zones field devices.
6.5	Installation of complete refractories & Insulation lining on wall, bottom, throat and lid of furnace.
6.6	Installation of complete Heating element system, with their allied Terminal , braids ,Insulation plates/ Syndhanium , collar tube, Porcelain , Terminal cover etc.
6.7	Erection and Commissioning of new Supplied Electrical panel in control room.
6.8	Installation of cooling system consisting of ducts, blower, actuators, valves, motors, dampers etc.
6.9	Installation of new hardware and software.
6.10	System Tuning as a whole.
6.11	On load trials.

7.0 **SCOPE OF SUPPLY**

7.1	Vacuum formed Fibrothal F17/LS GRADE Modules, Density: 200 Kg/m3, Classification Temperature – 1400 0C for walls only. Module thickness 125 mm – 1 Lot *(In accordance to clause no.2.0 &4.0)*
7.2	Ceramic Fibre blankets -1 Lot*(In accordance to clause no.2.0 &4.0)*
7.3	Refractory lining material consisting insulation & fire bricks, castable etc. for hearth lining-1 Lot*(In accordance to clause no.2.0 &4.0)*
7.4	Accelerated cooling arrangement consisting of 1 no. cooling blower, 1 no. cooling air supply duct with adequate nos. of injectors, 1 no. cooling air suction duct with hood, 1 no. butter fly type cooling damper, modulating motors etc. *(In accordance to clause no.2.0 & 5.0)*
7.5	Kanthal APM Heating element along with accessories. *(In accordance to clause no.2.0 &4.0)*
7.6	Electrical Panel -1 Set *(In accordance to clause no.2.0 &3.0)*
7.7	Thermocouple 6 nos. K type Simplex thermocouple with inconel sheath. 6 nos. K type Duplex thermocouple with inconel sheath. 6 nos. K type Retractable thermocouple with inconel sheath *(In accordance to clause no.2.0 &3.0)*
7.8	Cables and other accessories for inside panel work & Control cables for field wiring.
7.9	400 °C grade aluminum paint.

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8.0 **COMPULSERY SPARES**

S.NO.	MATERIAL	QUANTITY
8.1	Controller	2 (of each type)
8.2.	Thyristor	1 (complete module of each type)
8.3.	Modulating motor	2
8.4	Led indicators	10 (of each colour)
8.5	Selector switch	05 of each type
8.6	Push button	05

9.0 **MAKE OF ITEMS**

9.1	Panel	Rittal, Schneider
9.2	Thyristor Drive	Eurotherm
9.3	Controllers	Eurotherm
9.4	Modulating motors	Honeywell
9.5	Recorders	Chino Laxons, Eurotherm,
9.6	Heating Element	Kanthal
9.7	Relays	Phoenix, Siemens, L&T
9.8	Cables, Wires	Lapp, Igus, Finolax (only copper)
9.9	Connectors, Terminal blocks	Phoenix, wago
9.10	Limit Switches	Siemens, BCH
9.11	Switches, Push Buttons	Siemens, Schneider, L&T
9.12	LED indicators	Siemens, Schneider, L&T
9.13	Potentiometer/Variable Resistor	Siemens, Bourn,
9.14	MCB,MCCB	Siemens, Schneider, L&T
9.15	Contractors	Siemens,L&T
9.16	Fuse Base and Fuse	Siemens,L&T
9.17	Selector switch	Siemens, kaycee, L&T
9.18	CT	AE,KAPPA (Resin Cast)
9.19	AMMETER	AE,Meco
9.20	VOLTMETER	AE,Meco
9.21	Ceramic Lining	Reputed
9.22	Proximity Switches	Reputed

10.0 DRAWING AND DOCUMENTATION

(In English Language only, to be submitted after Erection and commissioning)

10.1	Complete Electrical drawing including layout, wiring diagram, bill of material, itemized product catalogue and details, interlocks and alarms hardcopy in leather bonded folders.
10.2	The documents should not be photocopies but good quality printouts.- Five Sets
10.3	Operation and Maintenance Manual-Five Sets
10.4	Alarm list and fault diagnostic manual-Five Sets
10.5	A soft copy of above documents(1,2,&3) in one Flash Drive- Five Sets
10.6	Thyristor drive CD and communication cable

11.0 DRAWING APPROVAL

11.1	All materials included in scope of supply should be submitted with technical details for approval.
11.2	Panel/electrical, Layout/scheme, wiring drawings, calculations, and bill of material along with supporting data should be approved by BHEL before manufacturing.
11.3	All the technical details, features & model of thyristor, switch gear, to be submitted with drawing for approval by BHEL before manufacturing.
11.4	All drawings with complete details and supporting data should be submitted in one lot.
11.5	Delay on account of incomplete drawing/data will be on vendors account.
11.6	Time of approval will be four weeks after receipt of drawings from vendor in one lot.

12.0 ACCEPTANCE CRITERIA

12.1	Compliance of 2.0 (Desired system after Renovation and up-gradation)
12.2	Compliance of 8.0 (Drawing and documentation)
12.3	Three successful, on load, trial runs.

13.0 EXCLUSIONS/BHEL SCOPE

13.1	Services like oxygen, water, compressed air, cranes, welding machine, in plant material transportation and electrical supply
13.2	Dismantling, supply, laying and termination of power cables from panel to respective furnace zones. (size and rating to be provided by vendor during design)
13.3	Dismantling, supply, laying and termination of compensating cables from panel to respective furnace zones thermocouple. (size and rating to be provided by vendor during design)
13.4	Raw material ie. Steel, welding machine, welding rod etc. for shell repair

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14.0 **WARRANTY/ GUARANTEE**: Vendor has to provide a guarantee of 12 months from the date of commissioning. Guarantee period less than 12 months is not acceptable and offers quoting guarantee period less than twelve months will be rejected.

15. The **time period for Dismantling, Erection and Commissioning** will be three months. The furnace will be handed over to the vendor within three months after receipt of material at CFFP, BHEL, Haridwar.

16. **Commissioning Spares** to be provided by vendor.

17. The **Project will be turnkey basis** including Design, dismantling, erection, commissioning, cold trial and hot trial. All the man and material require for successful dismantling, erection and commissioning is to be arranged and supplied by vendor.

18. Any **other item/material required** for the proper functioning or to attain desired features and not included in scope of supply will be supplied by vendor free of cost

19. The **vendors are advised to visit the site** before quoting their offer to get a clear picture of the existing system and to avoid any undue assumptions.

20. The **vendor is required to submit all the nine pages** with "Agreed and Accepted" remarks.