Sl. No	Description	Required	Offered	Deviation	Remarks

Annexture-I

Scope of Supply of Insulation system, Heating Elements, Instrumentation & Control for USSR-make Electrically Heated Chamber Furnace, Model: 3C45, Plan No. 0-115, Block-2

Furnace Details

Furance Type	**Double Door Chamber Type with a Bogie Hearth**
Application	**Furnace is used for tempering and annealing of welded constructions for stress relieving**
Overall Physical Dimension	**37000 mm x 12960 mm x 10080 mm**
Working Space inside Furnace	**10000 mm x 4500 mm x 4000 mm**
Rating	**1960 KW**
Mains Voltage	**400 V**
Max. Operating Temperature	**1050 ºC**
Charge Weight	**60 T plus 10 T of Hearth plates**
Rate of Rise of Temperature	**80 ºC/Hr.**
Cooling	**Controlled cooling upto 150 ºC and below this natural cooling with doors open**
Number of Zones	**13 Nos.**
Existing arrangement of electrical power distribution in 13 zones	**Hearth - Zone I to III of 159 KW each in Delta** **Side Walls - Zone IV to IX of 154.5 KW each in Delta** **Doors - Zone X & XII of 88.2 KW each in Star and Zone XI & XIII of 189.3 KW each in Delta**

OBJECTIVE:

Objective of the project is to obtain higher number of heating loads/charges by enhancing the reliability of the equipment and ensuring rapid heating up cycles. This shall be achieved with the installation and commissioning of the latest insulation system, modern thyristorised power controllers, state of art instrumentation, overall repair and overhauling of the furnace shell, bogie hearth, doors and the ventilation cooling system of the furnace. Energy losses shall be considerably reduced and total heating element rated power of the furnace is estimated to be limited to about 1600 kW.

Sl. No	Description	Required	Offered	Deviation	Remarks

SCOPE OF SUPPLY

Sl. No	Description	Required	Offered	Deviation	Remarks
1.	**Insulation System :**				
1.1.	**For Side Walls and Doors:**				
(i)	Vacuum formed board, density 200 kg/m^3, suitable for 1200^{0}C in single thickness of 125 mm. Make Kanthal / Kerfa / Rescal	Vendor to confirm and offer the quantity, Sizes & other technical details			
(ii)	Ceramic Fiber Blanket (CFB) 128 Kg/M^3 (RTZ Grade) 100 mm thick. Make: Murugappa-Morgan / Unifrax				
(iii)	Ceramic Fiber Blanket (CFB) 96 Kg/M^3 (RTZ Grade) 100 mm thick. Make: Murugappa-Morgan / Unifrax				
(iv)	Fasteners for mounting items (i), (ii), (iii) as above				
1.2	**For Roof**				
(i)	Vacuum formed board, density 200 kg/m^3, suitable for 1200^{0}C in single thickness of 125 mm. Make Kanthal / Kerfa / Rascal	Vendor to confirm and offer the quantity, sizes & other details			
(ii)	Ceramic Fiber Blanket (CFB) 128 Kg/M^3 (RTZ Grade) 100 mm thick. Make Murugappa-Morgan / Unifrax				
(iii)	Ceramic Fiber Blanket (CFB) 96 Kg/M^3 (RTZ Grade) 100 mm thick. Make Murugappa-Morgan / Unifrax				
(iv)	6 mm MS sheet for welding on the I-beam roof frame of the furnace for mounting of insulation as supplied vide para 1.2 (i), (ii), and (iii)				
(v)	Fasteners for mounting items (i), (ii), (iii) & (iv) as above				
1.3	**Bogie Hearth and Bottom portion of furnace side walls**				
(i)	Layer-I : 115 mm , 55 – 60 % Al_2O_3 shape-bricks of Fe content < 1% and sintering Temp. >1300 $^{\circ}$C	Vendor to confirm and offer the quantity & other details			
(ii)	Layer-II : 115 mm IS8 bricks				
(iii)	Layer-III : 150 mm Cold Face Insulation type bricks				
(iv)	Layer-IV : 40 mm Hysil block				
2.	**Heating Element :**				
(i)	Type : Rod Over Bend (ROB), Non-embedded type	Vendor to			

Sl. No	Description	Required	Offered	Deviation	Remarks
(ii)	Material : **Fe-Al-Cr** with linear temperature co-efficient, suitable for 1200 °C.	specify and offer the quantity & other details			
(iii)	Make : Kerfa / Kanthal AF				
(iv)	Rating : Party to specify exact KW rating for their system.				
(v)	No. of Zones : 13Nos..				
(vi)	Distribution: Kilowatt rating of zones located on the bogie hearth shall remain comparable to the existing ratings viz. three zones of 159 kW in Delta. Rest of the 10 zones shall be proportionately computed. Party to specify their proposed arrangement of heating elements and kW rating of each zone so as to achieve the heating rate of 80 °C				
(vii)	Holding Arrangement: Non conducting pin of Fe-Al-Cr, suitable to carry the weight of elements also suitable for 1050 °C.				
(viii)	Electrical contact assembly for heating elements				
	(***With the installation of new state of art insulation and plugging of losses, total kW of the furnace may not exceed 1600 kW to meet operating parameters as given in the furnace details. Vendor to submit calculations for computing the actual electrical power required***)				
3.	**Electrical System:**				
3.1	**Temperature Controller (Master):**	**01 No.**			
(i)	Type : P.I.D. Programmable, universal input Controller	Vendor to specify & offer			
(ii)	**Make : Eurotherm/Chino/Yokogawa**				
(iii)	Range : 0 – 1200 ^{0}C.				
(iv)	Input signal : Universal				
(v)	Display : Dual Display, 4 digits				
(vi)	Input Power : 220 V AC through Isolation Transformer				
(vii)	Output Signals : 1) Analog 4 – 20 mA DC 2) Relay type 5 amps, 230VAC				
(viii)	Accuracy : $\pm$ 0.3% FSD				
(ix)	Control Accuracy : $\pm 1^0$C				
(x)	Temp. Repeatability : $\pm$ 0.5^{0}C				

Sl. No	Description	Required	Offered	Deviation	Remarks
(xi)	Alarm setting : 02				
(xii)	Memory : EEPROM				
(xiii)	Ambient Temperature : 0 - 50^{0}C				
(xiv)	Tuning : Auto Tuning				
(xv)	Manual setting of Temp : To be provided for setting the operating temperature of furnace manually in case of failure of the auto mode				
(xvi)	Shall have retransmission feature				
3.2	**Temperature Controller (Slave)**	**12 Nos.**			
(i)	Type : P.I.D. Programmable , Universal input Controller	Vendor to specify & offer			
(ii)	**Make : Eurotherm/Chino/ Yokogawa**				
(iii)	Range : 0 – 1200 ^{0}C.				
(iv)	Input signal : Universal				
(v)	Display : Dual Display, 4 digits				
(vi)	Input Power : 220 V AC through Isolation Transformer				
(vii)	Output Signals : 1) Analog 4 – 20 mA DC 2) Relay type 5 amps, 230VAC				
(viii)	Accuracy : $\pm$ 0.3% FSD				
(ix)	Control Accuracy : $\pm$1^{0}C				
(x)	Temp. Repeatability : $\pm$ 0.5^{0}C				
(xi)	Alarm setting : 02				
(xii)	Memory : EEPROM				
(xiii)	Ambient Temperature : 0 - 50^{0}C				
(xiv)	Tuning : Auto Tuning				
(xv)	Manual setting of Temp : To be provided for setting the operating temperature of furnace manually in case of failure of the auto mode				
(xvi)	Shall have retransmission feature				
3.3	**Over Temperature Controller:**	**13 Nos.**			
(i)	Type : P.I.D. Programmable	Vendor to specify & offer			
(ii)	Make : **Eurotherm/Chino/Yokogawa**				
(iii)	Range : 0 – 1200 ^{0}C.				
(iv)	Input signal : Universal				

Sl. No	Description	Required	Offered	Deviation	Remarks
(v)	Display : Dual Display, 4 digits				
(vi)	Input Power : 220 V AC through Isolation Transformer				
(vii)	Output Signal : Relay type 5 amps, 230VAC				
(viii)	Accuracy : $\pm$ 0.3% FSD				
(ix)	Control Accuracy : $\pm 1^0$C				
(x)	Temp. Repeatability : $\pm$ 0.5^{0}C				
(xi)	Alarm setting : 02				
(xii)	Memory : EEPROM				
(xiii)	Ambient Temperature : 0 - 50^{0}C				
3.4	**Temperature Recorder :**				
3.4.1	**Temperature Recorder for Furnace** : One no. 20 channel paperless graphic digital temperature recorder with USB port of **Eurotherm/Chino/ Yokogawa -make only**	Vendor to confirm, specify and submit complete details of the recorders and the Laser Printer			
(i)	Type : Graphic Recorder (Paperless)				
(ii)	Display : Minimum 12" TFT colour display				
(iii)	No. of Inputs : 20				
(iv)	Type of Input : Universal field Programmable				
(v)	Data Memory : Compact flash card & USB memory stick of minimum 1GB				
(vi)	Accuracy : ±0.1% or better				
(vii)	Recorder shall have LAN Network Capability				
(viii)	No. of Colours : Six different for all different inputs				
(ix)	Data Screen : User Programmable- Real-Time Trends or Data Screen or Bar graph screen or Dual trend screen etc				
(x)	Display Type : Touch Screen. However programming facility with Touch Screen & Key Pad also				
(xi)	Burn Out : Up/Down				
(xii)	Scale & Range : Field Selectable				
(xiii)	Power Supply : 230 Volt ±20%				
(xiv)	Back up Battery :Support time minimum 1 year with recorder unpowered				

Sl. No	Description	Required	Offered	Deviation	Remarks
(xv)	Multi Point Analyzing/Data Acquisition Application Software must be supplied along with recorder to see/view the data on PC as & when required				
(xvi)	Response Time: 125 ms or better				
3.4.2	**Temperature Recorder for Job** : One no. 6 channel paperless digital temperature recorder with USB port having specifications similar to those defined in para 3.4.1/(i) to (xvi) of **Eurotherm/Chino/ Yokogawa-make only**				
3.4.3	Colour Laser printer of HP/Canon-make only				
3.5	**Thyristor/IGBT Power Controller:**	**13 Nos.**			
(i)	**Make :** Eurotherm / AEG	Vendor to specify Make/Model/Rating details of the thyristor controller & offer			
(ii)	**Current Rating :** As per zone requirement (Party shall ensure that the current ratings of Thyristor controllers for all the 13 zones is preferably same or at the most two- different types- one rating for thyristor controllers for bogie hearth and the other for rest of the furnace zones.)				
3.6	**Thermocouples:**	Vendor to confirm & offer with make and other details			
	Thermocouples 'K' type conforming to tolerance of relevant ASTM as per IPTS 90 standards will be supplied by party				
(i)	Duplex type Thermocouples for control and recording	13 Nos.			
(ii)	Simplex type Thermocouples for over temperature (safety) control	13 Nos.			
(iii)	Simplex type Thermocouples Flexible with stainless steel sheathing for job temperature measurement	06 Nos.			
	The outer projecting tube shall be made out of recrystallised Alumina (KER710).				
3.7	**Compensating Cables:**	Vendor to specify Qty. & offer			
	Type : K-type Compensating Cable for all thermocouples for furnace and job temperature measurement				

Sl. No	Description	Required	Offered	Deviation	Remarks
3.8	**Cabinets for Instrumentation, Control and Power:**	Vendor to specify, offer and confirm			
	All the new control, power and instrumentation cabinets shall be accommodated with in the space vacated by the old panels.				
(i)	Thickness of Steel used: 2 mm thick. Cold Rolled Steel sheet.				
(ii)	Cable Entry: Bottom entry in the cabinet floor.				
(iii)	Degree of Protection : IP54				
(iv)	Paint Shade: Powder-coated Siemens Gray.				
(v)	Cabinets fitted with the following and completely wired: • Mains incoming supply via bus bars properly supported in the panel with insulating bush. • Bottom entry for Zone supply cables to be terminated at bus bar ends. • MCCB and power contactor for each zone • Thyristor power controllers as above (as per Para 3.5). • Semiconductor Fuses for the thyristor-controllers • Siemens PLC system with required no. of inputs & outputs, including thermocouple inputs and outputs • 1 no. Voltmeter 0-500 VAC with 3 phase selector switch for monitoring line voltage. • Separate Ammeters for monitoring line currents for each phase in each zone. • Auxiliary contactors, relays, MCB's, Fuses, LED-type Indicating lamps etc. for furnace control. • Isolation cum control transformer of suitable rating for Furnace Control Circuit • Isolation transformer of suitable rating for Instruments. • Individual MCB's of appropriate rating for Instruments. • Energy Meter with CTs for recording total energy consumption of the furnace.				
(vi)	Power cabinet shall be divided into separate sections for each zone. Power cabinet shall be fitted with panel Air Conditioner of adequate rating for proper cooling of the panel. There shall be no				

Sl. No	Description	Required	Offered	Deviation	Remarks
	condensation inside the cabinet.				
(vii)	Separate cabinet for all the Instrumentation, instrumentation switchgear and 20 channel temperature recorder				
(viii)	Separate cabinet for electrical control and PLC system for overall furnace operation including Furnace Cooling system, Bogie hearth movement and door operations.				
(ix)	Industrial-type dust-proof and vermin-proof control desk with all operating push buttons, handles & annunciations for overall operation of furnace including the doors, Bogie hearth and the Ventilation cooling system shall be installed and erected **at the side of each door** to enable furnace operation from either door side**. Suitable interlocks shall be provided for safe operation and disabling of a control desk when the other is being used.**				
3.9	**Electrical contact devices for supply of power to Bogie Hearth Elements**				
	New identically designed split contact devices (**3 sets**) to be fixed on the Hearth & doors for supplying electrical power to the furnace zones located on the Bogie Hearth.	Party to ensure better than 90% contact and good alignment of the split contact devices			
3.10	**Cables**				
(i)	Single core multi-strand flexible heat-resistant power cables of Lapp/Sab/Igus-make suitable for 110 °C for connection of each zone in the bogie hearth, side walls and the doors with the busbars in the electrical cabinet. (Cable laying arrangement in the refurbished furnace shall be maintained similar to the existing layout). Length of the supplied cables shall be as per need and actual requirement.	Vendor to specify the cross section and make of the cables.			
(ii)	Multi-strand flexible Control cables of Lapp/Sab/Igus-make of cross section 1.0 sq mm. required for interconnections within the cabinets & the operator desk and for connection of furnace control elements like limit switches, pressure switches etc.	Vendor to confirm			

Sl. No	Description	Required	Offered	Deviation	Remarks
4.	**Ventilation Cooling System:**	Vendor to specify & Offer			
(i)	New Insulation system for air duct walls (presently having glass wool)				
(ii)	Insulation lining for periphery of manually operated six nos. air plugs on the roof				
(iii)	Pneumatic cylinders, valves, pressure switches, piping and control system along with moisture separator & lubrication unit for operating dampers of both the blowers (Note : Pneumatic pressure available in shop floor is 4 bar)				
(iv)	V-belts for blower fans of Fenner/Dunlop/Yule/Goodyear-make				
5.	**Other Items:**	Vendor to confirm, specify & Offer			
(i)	Terminals of suitable rating for connecting heater studs outside the furnace.				
(ii)	All required Lugs for power and control wiring (of Dowell's-make only)				
(iii)	All required limit switches (of Euchner/Baluff/Honeywell-make) for both the doors and bogie hearth including new cams / dogs				
(iv)	All the material required for repairing and restoring the existing shell, Doors and the bogie to original condition.				
(v)	Paint and putty for painting the furnace from outside with heat resistant silver aluminum paint.				
(vi)	Support for Heater cables and clamps				
(vii)	Silicon carbide plates of 25 mm thickness for placement over heating elements of the bogie hearth. It should be convenient for maintenance personnel to remove the silicon plates during the repair work of hearth.				
(viii)	A three-tiered indicating lamp tower for the purpose of display of furnace status viz. RED lamp for serious fault causing furnace shutdown, ORANGE lamp for furnace operation with limited failure of one or two zones and GREEN for fully healthy operation.				

Sl. No	Description	Required	Offered	Deviation	Remarks
(ix)	***Any other item not spelled out and envisaged in the above specifications but essentially required for efficient control and modernization of the furnace as per the objective of the project may be offered by the vendor.*** ***No changes shall be permissible after the placement of P.O.***				
6.	**Documents** :	3 sets of each document			
6.1	Operation and maintenance manual of the furnace, giving all details like electrical circuit diagram, Instrumentation schematics, details of zones & heating elements, mechanical assembly drawings etc.				
6.2	Commissioning and service manuals of following				
(i)	Thyristor Controller				
(ii)	Master Temperature Controller				
(iii)	Slave Temperature Controller				
(iv)	Over Temperature Controller				
(v)	Temperature Recorder(s)				
(vi)	PLC program in soft and hard copy				
6.3	List & catalogues of all bought out items				
7.	**Spares**:				
7.1	Party shall submit priced offer for following spares separately :				
(i)	Vacuum formed board	10 nos			
(ii)	Heating Elements for the side walls	4 nos.			
(iii)	Heating Elements for the doors	4 nos			
(iv)	Heating Elements for the bogie hearth	4 nos			
(v)	Heating element supporting pins	100 nos.			
(vi)	Electrical contact for heating elements	100 nos.			
(vii)	Thyristor module used in controllers	10 nos.			
(viii)	OEM Semiconductor Fuses used inside the thyristor controllers	15 nos.			
(ix)	MCCB used in Zone control	3 nos.			
(x)	Power Contactors for zones	2 nos.			
(x)	Complete thyristor controllers for bogie hearth zones	2 nos.			
(xi)	Complete thyristor controllers for other furnace zones	2 nos			

Sl. No	Description	Required	Offered	Deviation	Remarks
(xii)	One no. control transformer of each type used in system.	1 Set			
(xiii)	Duplex type Thermocouples for control and recording	2 nos.			
(xiv)	Simplex type Thermocouples for over temperature control	2 nos.			
(xv)	Simplex type Thermocouples Flexible for job temperature measurement	2 nos.			
(xvi)	PLC CPU	1 no.			
(xvii)	PLC output card	1 no.			
(xviii)	PLC input card	1 no.			
(xix)	Ammeter	4 nos.			
(xx)	Master Temperature controller	1 no.			
(xxi)	Slave Temperature controller	2 nos.			
(xxii)	Over Temperature controller	2 nos.			
7.2	All types of spares for furnace and accessories should be available from the Party for at least ten years from the date of successful commissiong of the furnace at site.	Vendor to accept & confirm			
7.3	Complete list of spares for Furnace and accessories, along with specification / type / model and name & address of spare supplier (Indian supplier/agent for imported items) shall be furnished.	Vendor to confirm			