An ISO 9001 Company

Bharat Heavy Electricals Limited

(High Pressure Boiler Plant)
Tiruchirappalli – 620014, TAMIL NADU, INDIA
CAPITAL EQUIPMENT / MATERIALS MANAGEMENT

ENQUIRY **NOTICE INVITING TENDER**		Phone: +91 431 257 7653 / 7360 E-mail : karunanidhy@bhel.in ajayasalkar@bhel.in Web : www.bhel.com	
TWO PART BID Tender to be submitted in two Parts	**Enquiry Number:** **2621800001**	**Enquiry Date:** **12.01.2018**	**Due date for submission of quotation:** **06.02.2018**

You are requested to quote the Enquiry number date and due date in all your correspondence. This is only a request for quotation and not an order.

Please note that under any circumstances both delayed offer and late offers will not be considered. Hence vendors are requested to ensure that the offer is reaching physically our office before 14.00 hrs on the Date of tender opening.

Item	Description	Quantity
10	**Robotic TIG Welding System** as per the technical specification & commercial conditions applicable (to be downloaded from web site **www.bhel.com** or **https://eprocure.gov.in/epublish/app**)	**01 No.**

Important points to be taken care during submission of offer.

1. **Compliance Form No: TRY/IMP/01 & TRY/IND/01A to be filled and enclosed along with the offer failing which, the offer will not be considered for evaluation.**
2. **Delivery period required is 6 months from the date of P.O.**
3. **Commissioning and performance prove out shall be done at BHEL Trichy by the supplier.**
4. **Time period required for commissioning and performance prove out shall be 4 WEEKS from the date of intimation by BHEL.**
5. **EMD for this tender is INR 2,00,000/-**
6. **All updates, amendments, corrigenda, etc., (if any), for each tender will be posted only on the above websites from time to time, as and when required, until each tender is opened. There will be no publication of such updates, amendments, corrigenda, etc., through newspapers or any other media.**

BHEL's General guidelines / instructions (refer MM/CE/GENL/001- EMD), compliance form and technical specification can be downloaded from BHEL web site http://www.bhel.com or from the Government tender website https://eprocure.gov.in/epublish/app (public sector units > Bharat Heavy Electricals Limited page) under Enquiry reference.

(This is not an E-tender, please submit your offer in hard copies)

Tenders should reach us before 14:00 hours on the due date.
Tenders will be opened at 14:30 hours on the due date.
Tenders would be opened in presence of the tenderers who have submitted their offers and who may like to be present.

Yours faithfully,
For **BHARAT HEAVY ELECTRICALS LIMITED**

AJAY V.ASALKAR
Sr. MANAGER
MM / Capital Equipment
BHEL, Tiruchirappalli - 620 014.
Sr. Manager / Capital Equipment / MM

PART - A

TENDER REQUIRMENT OF THE SUPPLY OF "Robotic TIG welding System"

SECTION – I: Qualifying Criteria

The BIDDER has to compulsorily meet the Qualification Criteria indicated in Section 1 to get qualified. Otherwise the technical offer will not be considered.

S. No.	TENDER PARTICULARS	VENDOR's RESPONSE
1.1	Only those (OEMs), who have supplied and commissioned at least ONE complete "Welding automation using robotic TIG welding system with filler wire" of the offered model in the past ten years (on the date of opening of Tender). **Vendor to specify**.	
1.2	Only those vendors (OEMs) should quote, who have supplied and commissioned in the last 10 years (as on the original date of tender opening) at least ONE "Welding automation using robotic TIG welding system with filler wire" of the offered model. **EITHER** (i) In at least one country other than the country of origin to establish vendor's global business activity. **OR** (ii) In India; and the referred machines are presently working satisfactorily for more than one year from the date of commissioning (as on the original date of tender opening). The name and contact addresses of the customers to whom the above said machine were supplied to be furnished with details.	
1.3	Vendor has to submit at least ONE PERFORMANCE CERTIFICATE for satisfactory performance of "Welding automation using robotic TIG welding system with filler wire" as referred under clause 1.2 above, for a minimum period of one year from the Date of commissioning	

	(as on the original date of tender opening) from their customers in India or in any other country outside the country of origin, supplied and commissioned in the last 10 years.	
1.4	Performance certificate as Original Certificate of E-mail directly from the customer may be submitted. The original certificate may be returned after verification by BHEL, if required. For furnishing the Performance Certificate, a suggestive format is provided as an enclosure **(ANNEXURE-A).**	
1.5	BHEL reserves the right to verify the information provided by the Vendor for the referred machine at their referred customer's works. It shall be the responsibility of the vendor to facilitate the visit of BHEL's team at their refereed customer works. The Travel, Board, and Lodging expenses for BHEL Personnel shall be borne by BHEL. In case the information provided by vendor is found to be false / incorrect, the offer shall be rejected. BHEL reserves the right to accept or reject the OEM'S based on the assessment of their technical and financial capability.	

SECTION – II

The BIDDER/VENDOR are requested to provide the following information: -

S. No.	TENDER PARTICULARS	VENDOR's RESPONSE
2.1	The BIDDER / VENDOR to furnish Reference List of Customers, with complete address, details of contact person, where "Welding automation using robotic TIG welding system with filler wire" have been supplied in the past	
2.2	Specify details of "Welding automation using robotic TIG welding system with filler wire" supplied to other unit of BHEL, if any (Year of commissioning with details etc).	
2.3	Details on SERVICE –AFTER-SALES Set-up in India including the Address of Agent/Service Centers In India.	
2.4	Any Additional data to supplement the manufacturing capability of the BIDDER for the subject equipment.	

SECTION – III

The BIDDER to note:

S. No.	TENDER PARTICULARS	VENDOR's RESPONSE
3.1	The BIDDER shall submit the offer in TWO PARTS - Technical **[**with **PART A** & **PART B]** & Commercial and Price Bid.	
3.2	The Offer shall contain a comparative statement of Technical Specifications given by BHEL and the Offer Details submitted by the Bidder, against each clause. A just 'CONFIRMED' or 'COMPLIES' or 'YES' or 'NO-DEVIATION' or similar words in the technical comparative statement may lead to disqualification of the Technical Offer. In case of any deviations in any of the technical specifications, such deviations should be clearly specified in the comparative statement. All systems and sub systems proposed in the solution should be detailed in description with illustrations/photographs, if required	
3.3	The BIDDER shall assure a continuous support for SPARES and SERVICE for five	

	years, from the date of commissioning of the equipment at BHEL Works.	
3.4	The Technical Offer shall be supported by Product Catalogue and Data Sheets in ORIGINAL and complete technical details / literature on the QUOTED MODELS of Hot Wire Narrow Gap TIG welding system (s).	
3.5	The Commercial Offer (given with the Technical Offer) shall contain the Scope of Supply and the Un-Priced Part of the Price-Bid, for confirmation for the scope of supply.	
3.6	Earlier performance & field experience (service support) with BHEL (if any) will be a reckoning factor for the technical qualification of the OFFER. Vendor can quote of supply to BHEL units of systems of similar capability.	
3.7	The BIDDER shall assure to provide report on simulation study conducted for the complete robotic work cell to test the reachability and collision detection within 15days from the tender opening date. The vendor should start further course of action after getting the clearance from BHEL Engineers. Report on load distribution on all axes of the selected robot due to TIG torch, ATC, Laser Sensor and other accessories also to be submitted	

ANNEXURE -A

Suggested Format of Performance Certificate

The Performance should be certified by the customer on Customer's Letter Head and submitted along with the offer.

PERFORMANCE CERTIFICATE

1.0	Name of the Machine:	
2.0	Suppliers name	
3.0	Make & Model Number of the Welding System, Powersource, Welding Head / Torch and other Major Accessories	
4.0	Month & Year of Commissioning	
5.0	Application for which the Welding System is used	
6.0	MACHINE DTAILS :	
6.1	Size of the jobs performed in the machine	
	a) Plate /Pipe thickness (minimum and maximum) in mm b) Pipe inner diameter (minimum and maximum) in mm c) Materials	
7.0	Performance of the Machine (Please tick the appropriate option)	Satisfactory
		Non Satisfactory
8.0	Service after sales (Please tick the appropriate option)	Satisfactory
		Non Satisfactory
9.0	Other remarks (if any)	
Date:		Signature & Seal of the Authority Issuing the Performance Certificate

PART B

TECHNICAL SPECIFICATIONS FOR "Robotic TIG welding System"

S. No	PARTICULARS AND BHEL SPECIFICATION	VENDOR'S OFFER
1.0	**PURPOSE & APPLICATION**	
1.1	a) It is proposed to automate the existing manual TIG welding process of Header to tube welding ***(please refer the drawing as mentioned in Annexure I)***, with Robotic TIG welding work cell. In this, the header is mounted on three v-block roller supporters (welding positioner) above the ground level where the center line of the header is at 1000mm from the ground level. The header is held in the welding positioner, which rotates the complete header to 0^0, 45^0, & -45^0about its horizontal axis. b) A solid arm 6 axes articulated industrial robot should be used for carrying out the welding. A 90^0 TIG Welding torch with hot wire feeding system may be used for carrying out the welding process. A laser sensor is also required to trace the weld groove prior to welding, in order to make corrections to the robot path to accommodate any alignment mismatches automatically. c) Since, the clearances available between two feeder pipes are less ***(please refer the drawing as mentioned in Annexure II)***, an automatic tool changer (ATC) should be used to manage both laser sensor and TIG Torch setup. Initially the robot should hold the laser sensor with ATC and trace the weld groove and place it at its station location. Then, by using the same ATC it should pick up the TIG torch set up and start doing welding as per the Welding Procedure Specifications (WPS). d) Since, the length of the header is around 15 meters, the entire robot and welding equipment setup should be mounted on a linear travel unit. So that, after each pipe is welded the robot moves to the next pipe. The welding of one circumference of the feeder pipe may be completed in two halves i.e., 5^0 to -185^0 and -5^0 to $+185^0$.	

	e) First, welding of all feeder pipes which are at 180^0 are completed. Then the header is indexed to -45^0. Welding of all feeder pipes at 135^0 are completed. Finally, the header is rotated by 180^0 using overhead crane so that the feeder pipes at 225^0 shall come in front of the robot and welding of feeder pipes at 225^0 are completed (Refer Annexure 1).			
2.0	**JOB DETAILS**			
2.1	a) Inlet Header *(Refer Annexure 1)*	Diameter Thickness Length Weight :-	457 mm 65 mm 15 mtr 12 tons	
	b) Outlet Header *(Refer Annexure 1)*	Diameter Thickness Length Weight :-	508 mm 65 mm 15 mtr 15 tons	
	c) 1) Feeder pipes (Tubes) *(Refer Annexure 1)* 2) Types of feeder pipes (tubes) *(Refer annexure 2)*	No. of feeder tubes Length of tubes Location of tubes Three Types:	108 nos. 1 mtr 3 locations (135^0 ,180^0 & 225^0 center row has straight & other row has bend tubes) 50 NB, 65 NB & 100 NB	
	d) Feeder tube 50 NB *(Refer annexure 3)*	**Type: Straight** Max Diameter: 69.55 mm Length: 893 mm Weight:12 kg **Type: Bend**		

		Max Diameter: 69.55mm Length: 997 mm Weight: 12.9 kg	
	e) Feeder tube 65 NB *(Refer annexure 4)*	**Type: Straight** Max Diameter: 81.4 mm Length:893 mm Weight:16 kg **Type: Bend** Max Diameter: 81.4 mm Length: 994 mm Weight: 17 kg	
	f) Feeder tube 100 NB *(Refer annexure 5)*	**Type: Straight** Max Diameter: 116.5 mm Length: 855 mm Weight: 32 kg **Type: Bend** Max Diameter: 116.5 mm Length: 971 mm Weight: 33 kg	
2.2	MATERIAL		
	a) Inlet header b) Outlet header c) Feeder pipes (tubes)	SA350LF2 SA350LF2 SA333Gr6	
2.3	Welding Consumable		

	a) Filler wire specification b) Filler wire diameter c) Filler wire spool size	ER 70S-2 1.2 mm 300 mm dia (15 kg spool)	
2.4	PRE-HEATING, INTERPASS TEMPERATURE		
	a) Preheating temperature b) Interpass Temperature	Room Temperature 200^0 C	
2.5	MAINDATORY CLAUSE: - 3-D SIMULATION	The vendor should provide report on simulation study conducted for the complete robotic work cell to test the reachability and collision detection within 15days from the tender opening date. The vendor should start further course of action after getting the clearance from BHEL Engineers. Report on load distribution on all axes of the selected robot due to TIG torch, ATC, Laser Sensor and other accessories also to be submitted.	
2.6	Credentials	Supplier has to furnish references of similar work (TIG/MIG) carried out in India in the last 5 years. Contact references of their clients to be provided for getting feedback on the system performance. The origin of the manufacturing country of major components in the total scope of delivery like Servo Drives, PLC, Gears and Conduits etc. has to be clearly mentioned.	
3.0	**SCOPE OF SUPPLY**		
3.1	Six axis solid wrist articulated industrial robot with latest controller, Operator Panel (Teach Pendent) & Programming Software	1 Set	

3.2	Linear travel unit, which can be synchronized to robot controller	1 No	
3.3	Hot Wire TIG Welding equipment with 90 ^{0} TIG torch with suitable wire feed, cooling unit ,wire feed mechanism, external gas control unit and data acquisition system	1 set	
3.4	Laser sensor with suitable mounting bracket, cooling unit and should communicate directly to the robot controller to make necessary robot path corrections automatically	1 set	
3.5	Automatic Tool changer suitable to the robot flange, TIG Torch and Laser sensor	1 set (1 Robot side tool changer and 2 tool side tool changers for torch and laser sensor)	
3.6	Header Rotating unit with drive mechanism (Welding Fixture /Positioner)	1 set	
3.7	Suitable 3 phase, 415 V +/- 10 % , AC servo based voltage stabilizer and isolation transformer (power conditioning unit) for the complete system	1 set	
3.8	Interconnection cable for all components	For all connection	
3.9	Machine spares and consumables	For 2 years	
3.10	Equipment Inspection and Acceptance at Vendors Place	As per below	
3.11	Documentation	3 set soft and hard copy	
3.12	Equipment Installation, Commissioning & training at BHEL	3 – 4 week min	
3.13	Guarantee	As per below	
3.14	General Points	As per below	

4.0	SIX AXIS SOLID WRIST ARTICULATED INDUSTRIAL ROBOT WITH LATEST CONTROLLER		
4.1	Arm type	Articulated	
4.2	Number of Axes	6	
4.3	Payload	Minimum 15 Kgs is required. However, by considering the overall weight of ATC, TIG torch, connectors and other accessories, it is the sole responsibility of the supplier to choose the payload capacity of the robot. The torch Centre of gravity and Load distribution on all robot axis to be studied in detail by the supplier before offering the suitable robot.	
4.4	Supplementary Load on robot arm	Minimum 20 Kgs (at base unit/ Joint 1) Minimum10 Kgs (at arm/ Joint 3)	
4.5	Repeatability	<= 0.1 mm	
4.6	Linear Max. Speed	>= 1.5 Mtrs./Sec	
4.7	Minimum Axes Range and Minimum Speed required	Joint 1 320^0 (150 deg/s) Joint 2 190^0 (140 deg/s) Joint 3 125^0 (150 deg/s) Joint 4 400^0 (330 deg/s) Joint 5 240^0 (330 deg/ s) Joint 6 700^0 (450 deg/s)	
4.8	Max Reach	Minimum 1500 mm is required. However, it is complete responsibility of the supplier to offer suitable robot so that it is able to reach the required weld groove position.	
4.9	Mounting Position	Floor (Should be mounted on a linear travel unit)	

4.10	Noise Level	Max 80 dB	
4.11	Motor	AC Servo Motor for all 6 axes	
4.12	Position detection	Absolute position sensing with encoders / resolvers	
4.13	Ambient Temperature	10^0 C to 55^0C	
4.14	Relative humidity	Max 95%	
4.15	MTBF (Mean Time between failure)	Minimum 50,000 hours	
4.16	Brakes	Electrical/ Mechanical brakes in all axes	
4.17	Main Applications	Multi pass, continuous arc welding (TIG welding)	
4.18	Safety regulations	Should fulfill one or more of the following standard industry applicable safety regulations like EN60204-1:2006 ,ISO 10218-1:2006, ANSI/ RIA R 15.06, UL 1740	
4.19	Pedestal	Suitable pedestal for the robot to reach the weld joint as the job (header) center line is 1000 mm above the floor level. If required	
4.20	Mastering / presetting of all robot axis	Should be done Electronically all axes	
CONTROLLER			
4.21	Version	Latest Robot OEM's controller version to be offered	
4.22	Drive System	AC Servo Drive	
4.23	Number of controlled Axes	6 axes	
4.24	Provision for additional axes	Minimum 3 numbers (As Linear Travel unit should be synchronized and controlled from Robot controller only)	
4.25	Processor	Multi-core processor system preferably with PCI bus	

4.26	Operating system	Well proven real time operating system	
4.27	Programming Language	User friendly programming through Teach pendant and Robot programming language	
4.28	Program Memory capacity	Hard disk for mass memory at least 500 MB, expansion and additional back-up facility will be preferred.	
4.29	External Storage	RW CD/ DVD drive/USB	
4.30	Other requirements	1. USB memory interface 2.Energy back-up power failure handling	
4.31	Control functions	Should be able to synchronize all operations of Robot motion, Linear Travel unit, Welding controller, ATC, Laser Sensor etc.,	
4.32	External Interfaces	Profinet /Device net/ Profibus/Interbus/Ethernet /Ether CAT	
4.33	Number of I /O points	Minimum 256 digital inputs and 256 digital outputs (Should be expandable)	
4.34	Communication Ports	RS 232 / RS 485 / Ethernet port	
4.35	Protection	IP65	
4.36	Input Voltage	415V +/- 10%, AC 3phase	
OPERATOR'S PANEL (Teach Pendent)			
4.37	Cable length (from teach pendent to controller)	5m and above	
4.38	Basic Switches	Lockable type Emergency, Reset, Power On/Off, Mode selector, and other functional keys as required, Joystick/6D Mouse for robot axes moment	
4.39	Visual Display	At least 6 '' or larger color screen on Teach pendent	
SOFTWARE			

4.40	Welding technology software (Basic and Advance versions)	Robot OEM's Arc welding technology packages for multipass, continuous welding (TIG) to generate arc weld programs by defining process parameters such as Torch Angle, work angle and spin angles, seam and weave data, wire feed, velocity, speed, current, voltage and gas flow etc.,	
4.41	Robot technology packages	1. Package for easy user inputs 2. Package for Multi-layer welding 3. Package for Arc welding (Basic & advance versions) 4. Package for Laser Seam Track and Finding 5. Robot OEM's Simulation software package 6. Package for Robot Sensor Interface for AVC (Automatic Voltage Control) function control	
MAKE			
4.42	Preferably	KUKA,ABB,FANUC,KAWASAKI,MOTOMAN	
5.0	**LINEAR TRAVEL UNIT, WHICH CAN BE SYNCHRONIZED TO ROBOT CONTROLLER**		
5.1	No of axis	Single axis positioner	
5.2	Drive	Servo controlled drive, should be compatible to Robot's main controller and should be able to synchronize with the robot motions	
5.3	Payload	Min 250 Kgs. Supplier has to offer suitable linear travel unit with payload capacity by considering	

		the overall weight of Robot, welding equipment and other systems, as the complete system mounted on it and to be travelled across the header length of 15 meters. It is the sole responsibility of the supplier to check the payload carrying capacity of the linear travel unit by considering the weight of all components.	
5.4	Mounting position	Floor	
5.5	Travel Length	Min 18 meters Supplier has to offer sufficient travel length by considering the overall length of the job, robot reach and other constraints.	
5.6	Position detection	Absolute position sensing with encoders / resolvers	
5.7	Repeatability	<=0.1mm	
5.8	Make	Preferably KUKA,ABB,FANUC,KAWASAKI,MOTOMAN	
6.0	**Hot wire TIG WELDING EQUIPMENT WITH 90 ^{0} TIG TORCH WITH SUITABLE HOTWIRE FEEDING SYSTEM, COOLING UNIT ,WIRE FEED MECHANISM, EXTERNAL GAS CONTROL UNIT AND DATA ACQUISITION SYSTEM**		
	Important Note: The vendor has to quote a suitable TIG welding unit with wire feeder for the specifications as mentioned below. The controller of TIG welding unit should be compatible to the robot controller. The weld parameters shall be controlled directly from the robot program itself with suitable communication interfaces like Device net/Profibus/Ether CAT etc.,. Hence, the vendor is requested to take necessary care in this regard. It is purely the vendor's responsibility in case of any communication compatibility problem arises between the welding setup and the robot controller.		
6.1	Process	TIG DC (Digital Inverter based)	
6.2	Output	500A (Max)	
6.3	Mains Voltage	3 phase , 415V +/- 15%	

6.4	Mains line protection	35 A MCB/MCCB	
6.5	Primary Continuous power	15 KVA	
6.6	Cos Phi	0.99	
6.7	Welding current range	3-500 A	
6.8	Welding current range electrode	10-500 A	
6.9	Duty Cycle at 10 Min/40 deg C	40% DC at 500 A	
6.10	Duty Cycle at 10 Min/40 deg C	100% DC at 350A	
611	Open-circuit voltage	>= 60V	
6.12	Protection	IP23	
6.13	Working Voltage	10-30V	
6.14	Type of cooling	Vendor to specify	
6.15	Insulation class	Vendor to specify	
6.16	Conformity	Vendor to specify	
6.17	Safety	Vendor to specify	
6.18	Arc Ignition	Spark Ignition and Contact ignition	
6.19	Automatic cooling unit shutdown	Yes	
6.20	Automatic gas post-flow time	Yes	
6.21	Anti-stick function	Yes	
6.22	Digital welding process control	Yes	
6.23	Earth fault monitor	Yes	
6.24	Energy-saving inverter technology	Yes	
6.25	Hose pack holder	Yes	
6.26	Microprocessor controlled	Yes	
6.27	Non-Contact ignition (HF)	Yes	
6.28	Operating hours counter	Yes	
6.29	Over temperature protection	Yes	
6.30	Temperature controlled fan	Yes	
6.31	Touch down ignition	Yes	

6.32	Displays	• Operating mode • Overtemperature • Sequence status • Welding current (actual value) • Welding voltage	
6.33	Adjustable Parameters	• Downslope • Electrode diameter • Final (i.e. "end") current • Gas post-flow time • Gas pre-flow time • Hot start • Start arc current • Stepless welding power • TAC (tacking according to program) • Upslope	
6.34	AVC (Automatic Voltage Control)	Yes	
	WIRE FEEDER		
6.35	Wire feeder Mechanism	4 roll powered	
6.36	Connection hose pack	Min 5 Meters	
6.37	Wire feed speed	0.1 to 6 meters/min	
6.38	Functions	Forward, Reverse and inching	
	Filler wires		
6.39	Diameter	0.8 to 1.2 mm dia	
	WIRE SPOOL		
6.40	Max dia/	300 mm	
6.41	Wire feed speed	0 – 18 m/min	
	WATER COOLING UNIT		
6.42	Tank Volume	3 - 5 Lit	
6.43	Cooling capacity	1.0 - 1.25 KW	

6.44	Max flow	4 lit/ min	
6.45	Max Pressure	4 bar	
	TIG TORCH		
6.46	TIG torch	Should be able to reach the center line (feeder tubes at 180^0) feeder tube weld groove dimension with hot wire feeding. The groove dimensions may be referred in the attached drawings (refer drawing). The Torch should be suitable to the robot being selected for this project. The weight of the TIG torch including the accessories for feeding the filler wire, should be within the payload capacity of the robot.	
6.47	Features required	Screw able gas nozzle Adjusting device for electrode Holding clamp Wire feeding tube rotatable with locking mechanism Exact digital speed regulation Wire feed forward/Back button	
6.48	Welding current	Vendor to specify	
6.49	Duty Cycle	100% at 350A	
6.50	Electrode diameter	1.6 to 3.2mm	
6.51	Cooling system	Water cooled	
6.52	Wire feed tube/Nozzle	Should have necessary accessories to feed the filler wire into the weld pool and should be attachable to the Torch.	
	OTHER ACCESSORIES		

6.53	Carriage Trolley	Suitable carriage trolley for mounting welding power source	
6.54	Earth Cable with Clamp	Earth cable (suitable length) with clamp	
6.55	Argon Gas regulator	Argon gas pressure regulator with flow meter and suitable length gas hose	
6.56	Wire coil mounting system	Suitable wire coil mounting system	
6.57	Collision sensor and Adapter flange	Suitable Robot wrist mechanical collision sensor with robot adapter flange	
6.58	External Gas Control Unit	External Gas controller suitable for 5-30 Liters/ min The welding should automatically cut off	
	MAKE		
6.59	Preferably	Fronius, Miller, Lincoln	
7.0	**LASER SENSOR WITH SUITABLE MOUNTING BRACKET, COOLING UNIT AND SHOULD COMMUNICATE DIRECTLY TO THE ROBOT CONTROLLER TO MAKE NECESSARY ROBOT PATH CORRECTIONS**		
	Note:- The Laser sensor to be mounted to the robot as described in the scope of work for tracing the weld groove prior to welding, so that any corrections to the robot trajectory is done automatically. The vendor has to select a suitable sensor which can be used with the robot using ATC (Automatic Tool changer) facility. The sensor should be integrated to the robot controller using suitable communication protocol like Ethernet/ Profibus etc., in such a way that the corrections to the robot trajectory is done automatically without any manual intervention. Proper integration of the laser sensor with robot system is sole responsibility of the supplier. The sensor should be compact in size, light in weight, water cooled with necessary cooling hoses and other accessories.		
7.1	Sensor Field of view	Min 30mm	
7.2	Sensor depth of view	Min 55mm	
7.3	Sensor nominal standoff distance	Max 100 mm	
7.4	Horizontal pixel resolution (at nominal standoff distance)	Min 0.03mm at nominal standoff	

7.5	Vertical pixel resolution (at nominal standoff distance)	Min 0.05mm at nominal standoff	
7.6	Sensor width	Max 50mm	
7.7	Sensor height	Max 150mm excluding spatter tongue connectors	
7.8	Sensor depth	67mm	
7.9	Sensor cooling	water cooled	
7.10	Camera Frame rate	Min 50 FPS	
7.11	Camera image sensor technology	CMOS or better	
7.12	Laser structure	Single Stripe	
7.13	Laser Wavelength	600-700 nm	
7.14	Laser safety class	class (3B)	
7.15	cable length from sensor to robot controller	Suitable length	
7.16	External Monitoring Device	Min 12" color touch screen	
7.17	Provision to connect external computer/laptop	yes	
7.18	Interface to Robot Controller	yes	
7.19	Power Input	Preferably 230V +/- 10% ,50Hz, Single Phase	
8.0	**AUTOMATIC TOOL CHANGER(ATC) SUITABLE TO THE ROBOT FLANGE, TIG TORCH AND LASER SENSOR**		
8.1	Suitable ATC unit which works on Pneumatic supply, should have one robot side tool changer suitable to the robot flange and two numbers of tool side tool changers which are used to hold TIG Torch unit and Laser sensor respectively. The supplier has to supply suitable mounting brackets for TIG torch unit and Laser sensor.		
9.0	**HEADER ROTATING UNIT WITH DRIVE MECHANISM (WELDING FIXTURE /POSITIONER): To hold the header (where center line of header is at 1000 mm from the ground level) and to rotate the header at 0^0, 45^0, -45^0 about its horizontal axis**		

9.1	Fixtures to support the header across the length	The welding fixture should have at least three numbers of V Block (preferably) type fixtures with motor driven rollers equally spaced along the length of the header (Please refer Annexure 4)	
9.2	Roller dimensions	Min 150 mm width, 250mm diameter. The rollers should be hardened and with a rough finish on outside diameter.	
9.3	Bearings	The rollers should be fitted with heavy duty roller bearings.	
9.4	Drive mechanism	Motor driven with VFD to allow rotational inching	
9.5	Motion	All motors to be driven synchronously in both directions	
9.6	Placement of the header	The center line of the header will be 1000mm from the floor	
9.7	Position detection	Absolute positioning using Encoder/ resolvers	
9.8	Display of operating panel	Min 4 inch HMI	
9.9	Electrical controls	Floor stand Electrical panel, containing the electrical for VFD, PLC, SMPS and Operating buttons	
9.10	Operating mode	Preferably using a PLC	
9.11	Fixture alignment	The three V block type fixtures to be aligned in a straight line on the floor using the laser centering unit provided on each fixture	
10.0	**SUITABLE 3 PHASE, 415 V +/- 10 % , AC SERVO BASED VOLTAGE STABILIZER AND ISOLATION TRANSFORMER (POWER CONDITIONING UNIT) FOR THE COMPLETE SYSTEM**		

10.1	Suitable 3 phase, 415 V +/- 10 % , AC servo based voltage stabilizer and isolation transformer for the complete system	Vendor to confirm
11.0	**INTERCONNECTION CABLE FOR ALL COMPONENTS**	
11.1	All necessary interconnection, communication, earth cable etc. of required quantity should be supplied along with system.	Vendor to confirm
11.2	All necessary hoses both for water flow and gas flow, gas regulators etc. to be supplied as part of the system.	Vendor to confirm
11.0	**MACHINE SPARES AND CONSUMABLES**	
11.1	All necessary mechanical, electrical and electronic spares used in the machine in sufficient quantity as per recommendation of Vendors for 5 years of trouble free operation on three shift continuous running basis shall be suggested by vendor. The list to include following, in addition to other recommended spares	Vendor to confirm
11.2	**Mechanical Spares**: All types of pumps, valves pressure switches, rollers, transducers, flow switches, filters, seals, O rings, water cooled hose, wire feed rollers and wire pressing rollers, fasteners, sprockets, gears, cams, bearing etc if any to be provided.	Vendor to confirm
11.3	**Electrical / Electronic Spares** : All types of printed circuit boards, relays, contractors, Proximity switches, push buttons, semiconductors, fuses, special fuses, circuit breakers, main power switch, encoders indication lams, spares for microprocessor based system, servo motors for feed drivers, power module & control cards for drives etc.	
11.4	**Welding Consumables** : Nozzle, Gas cup, Gas filters, Tungsten Tip, wire liner etc. to be included	Vendor to confirm & enlist
11.5	Recommended set of spares for all attachment are to be suggested with details.	Vendor to confirm
11.6	All types of spares for total machine and accessories shall be available for at least ten years after supply of the machine. If machine or control is likely to became obsolete in this period, the vendor should inform BHEL sufficiently in advance and provide drawing of parts/details of spares & suppliers to enable BHEL to procure these in advance, if required	Vendor to confirm
11.7	Vendor to confirm that complete list of spares for machine and accessories, along with item part no/specification/type model, and name and address of the spare supplier shall be furnished along with documentation to be supplied with the machine.	Vendor to confirm

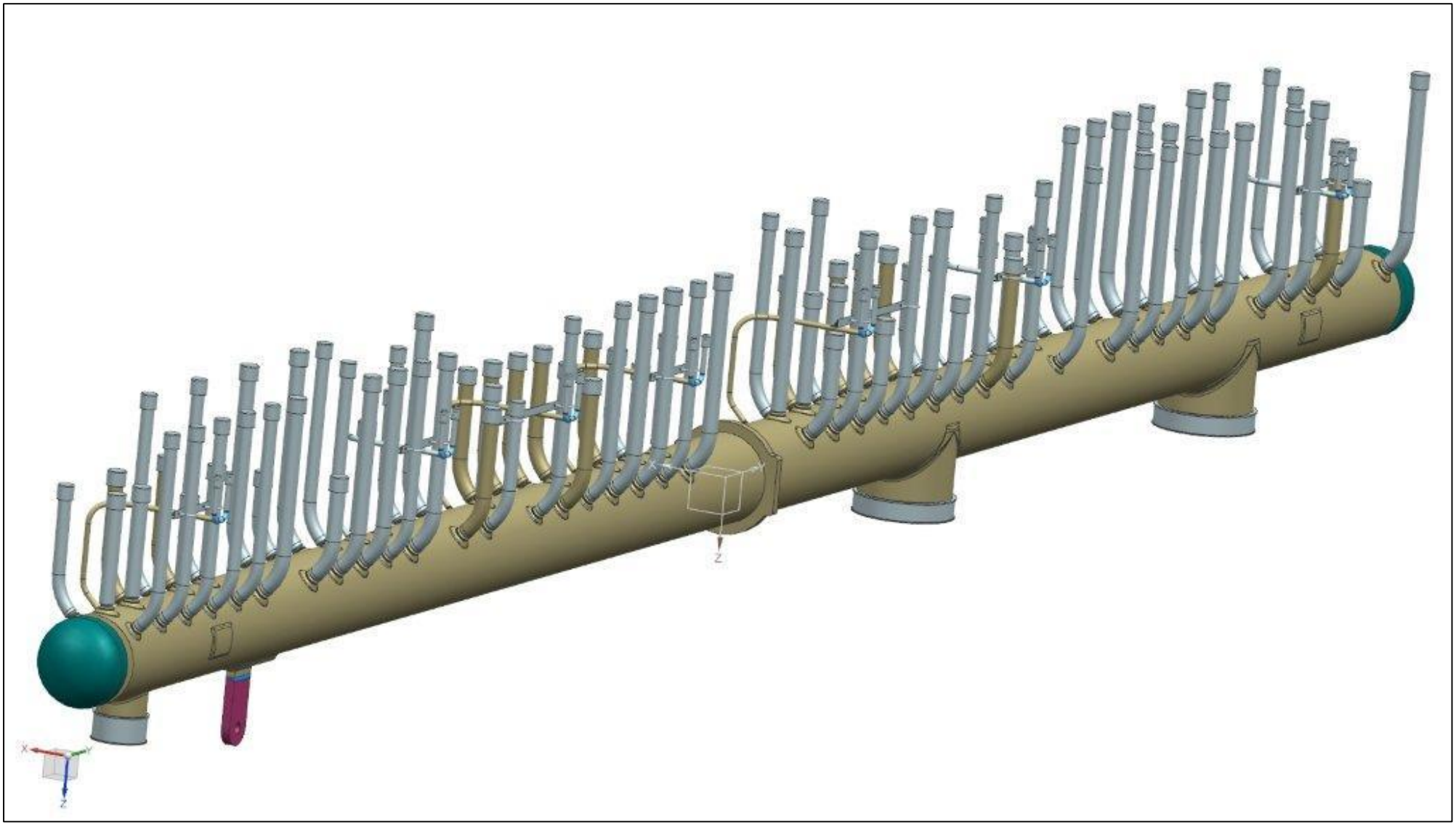
12.0	EQUIPMENT INSPECTION AND ACCEPTANCE AT VENDORS PLACE	
12.1	1. The Welding robot, Controller, welding equipment, welding positioner , linear positioner, Laser sensor, ATC and Accessories, before dispatch the system, the complete pre-dispatch inspection will be carried out by the team of BHEL executives (it involves from WRI, Production and M&S representative) at the manufacturer's site which included carrying out all the functional test, welding trials & acceptance of the same. 2. During the functional test vendor has to demonstrate reach and smooth movement of Robotic TIG torch around the tube weld groove, without any collision to adjacent tubes or header surfaces. 3. The welding trials shall be carried out on any standard Carbon Steel pipe material, instead of header to stub actual job. A big pipe can be used as the header with 10 feeder tubes of same size and pitch as per the drawing. 4. The welding parameters should be able to send from the robot program itself. 5. The synchronous motion between Robot and Two axis positioner to be demonstrated. 6. Welding Arc on and Arc off to be demonstrated. 7. The work cell is meant for continuous arc and multi-layer welding. The supplier has to demonstrate these two functionalities with user friendly robot OEM's add-on software packages. 8. The supplier should demonstrate AVC (Automatic Voltage control) functionality, adjusting and controlling the AVC parameters from the robot program. 9. Functioning of Laser Sensor for seam finding to be demonstrated. 10. Functioning of ATC to be demonstrated. 11. Functioning of Welding fixture to be demonstrated. 12. The minimum 2 numbers of continuous weld joint should be welded in presence of BHEL executives. 13. All the materials and consumable needed for the trials shall be arranged by the vendors only 14. The confirmation will be given only based on the acceptance of above mentioned welding trials.	Vendor to confirm

13.0	**DOCUMENTATION**	
13.1	The following documents in English language should be supplied along with the machine: - Hard Copies: 3 sets Soft Copies: 3 Set 1. Operating manuals of Robot, Robot Controller, software, welding power source, controller, rotator, chilling unit, welding torch, data acquisition system etc. 2. Operation and Maintenance manual of all accessories 3. Programming manual of the machine & Robot 4. Maintenance manuals with all assembly drawing of machine assemblies. sub-assemblies with parts list 5. Electrical wiring Drawing – power & control circuits. 6. Maintenance & Interface manuals for machine control system 7. Microprocessor / complete printed circuit board schematic indication check points for electronic controls. 8. Complete list of alarm log, error code, error messages and remedies and on line fault diagnostic to be provided by the vendors, 9. Specification ratings of all bought out items 10. Catalogs', O&M manuals for all bought out items used in the machine 11. Trouble shooting chart for main and all sub-system 12. Parameter selection software, file handling and display recording. Serial and USB ports to be ensured. 13. Preventive maintenance check list for Electrical and mechanical system. 14. Complete list of spares for machine, along with item part no/ specification/type /model and make and adders of the sub-vendor.	Vendor to confirm
14.0	**MACHINE ERACTION, COMMISSIONING & TRAINING AT BHEL**	
14.1	The manufacturer shall be responsible for the installation of the machine at the site and its subsequent start up at the site.	Vendor to confirm
14.2	All handling tools and mechanical / electrical help required for the installation and commissioning shall be provided by the BHEL.	-----

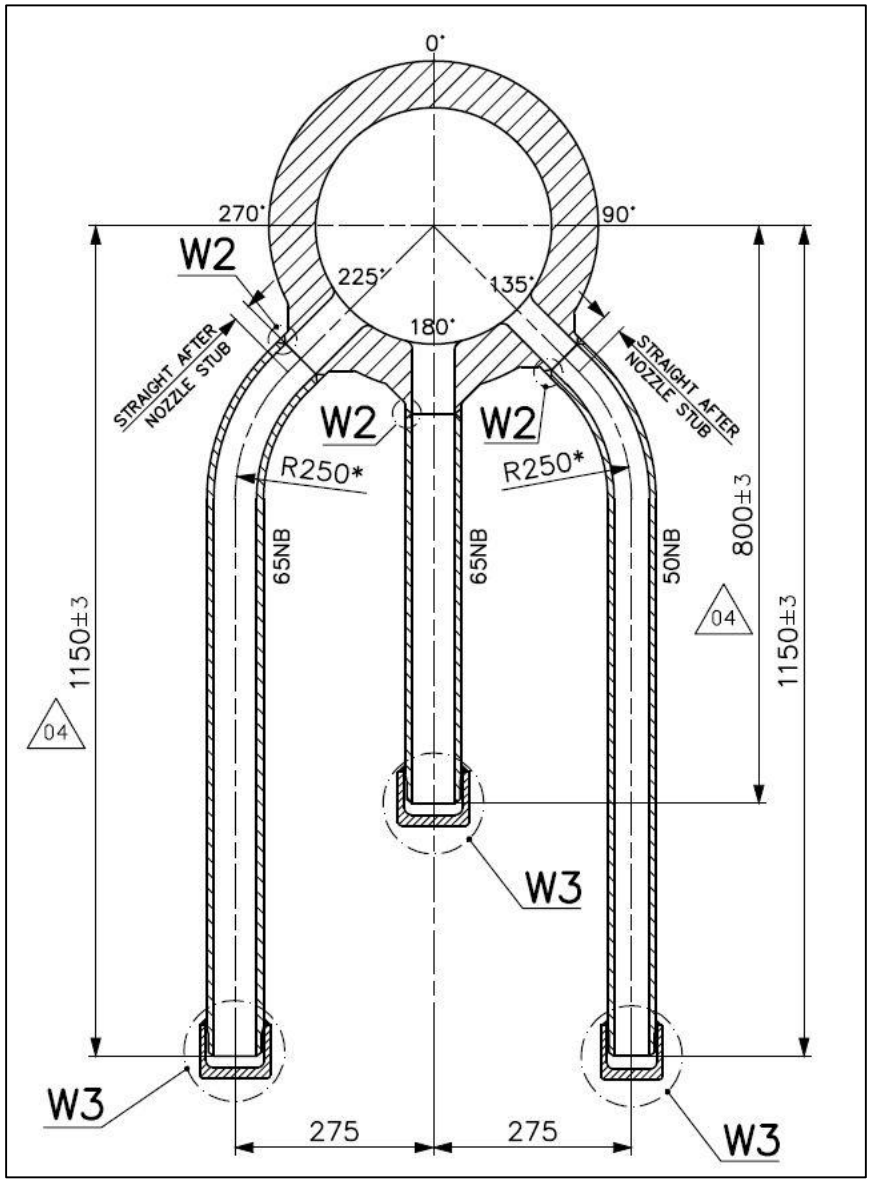
14.3	The required material and consumable for carry out prove out trials at site will be provided by the BHEL	-----
14.4	After successfully commissioning of the welding system capability and prove out welding trials to be carried out considering actual application. BHEL will provide the similar mockup of 1 mtr header with 12 – 15 stub in tack condition, Vendor has to perform the prove out trials over the header. For the confirmation trials minimum 4 -5 mock-up joint will be welded under the guidance of vendors	Vendor to confirm
14.5	Vendor has to assist BHEL for fine tuning of welding parameters to achieve quality weld joints which passes LPI, MPI and 100% UT for complete penetration as per ASME sec IX.	Vendor to confirm
14.6	The supplier shall impart training to BHEL's machine operator and maintenance crew in operation and maintenance during commissioning of the machine at BHEL works, for 5 working days. It includes Safety, Operational of the machine PC based System & Operation, Trouble – Shooting, software application, all special features of the machine, electrical/mechanical/ electronics system etc.	Vendor to confirm
14.7	The manufacturer shall be responsible for providing the technical assistance for the machine during commissioning & training through its welding expert only.	Vendor to confirm
14.8	Tools, Tackles, Test Mandrels, instruments and other necessary equipment required to carry out all above activities should be brought by the Vendor	Vendor to confirm
15.0	**GUARANTEE**	
15.1	Guarantee for complete Robot, Robot Controller, welding equipment, software and all supplied accessories/equipment's for 12 months from the date of final acceptance of the Robot after successful E&C of the Robot at BHEL Trichy. Any spares required during commissioning period (before final acceptance of the Robot) shall have to be arranged by the vendor at free of cost and duty levied have to be borne by the vendor.	Vendor to confirm
15.2	The supply shell also quote the extended warranty for two years as optional	Vendor to specify
16.0	**GENERAL POINTS**	
16.1	Vendor has to provide the complete machine make, model Number and other related details	Vendor to specify
16.2	Total connected Load (in kVA)	Vendor to specify

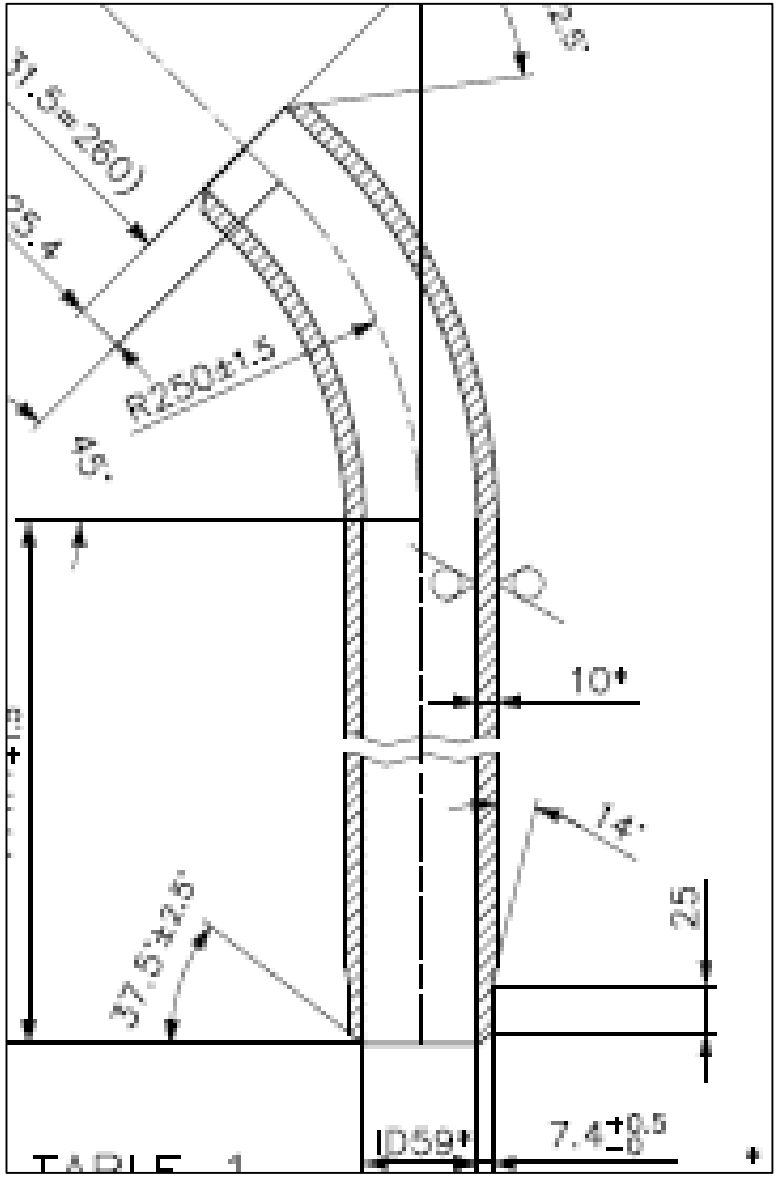
16.3	Total weight of the machine & Accessories	Vendor to specify
16.4	General Arrangement drawings	Vendor to provide
16.5	Calibration certificates for all machines, meters and equipment	Vendor to confirm
16.6	Civil & foundation details if any, for the equipment shell be provided 3 months before shipment of equipment	Vendor to confirm
16.7	Sea worthy & rigid packing for all items of complete machine, control system, all accessories and other supplied items to avoid any damage / loss in transit. When machined is dispatch in container, all small loose items shall be suitably packed in boxes	Vendor to confirm
16.8	The system shall have equipped with a control panel in his machine though which the power supply will be distribute to various sub-assemblies. (BHEL will provide the single3-phase AC supply (without Neutral) at single point near the machine)	Vendor to confirm
16.9	The equipment must have the feature of Remote diagnosis facility by which the machine can be diagnosed from a remote location through Internet.	Vendor to confirm
17.0	**OPTIONAL REQUIREMENT**	
17.1	Portable type tungsten grinder :- Qty 4 numbers	Vendor to specify the make and model of the same
17.2	The vendor shall quote separately for Annual maintenance contract (AMC) for the equipment, beyond the expiry of guarantee period. This should be on yearly basis for a minimum period of 3 years which may be extended, if required.	Vendor to specify

ANNEXURE 01

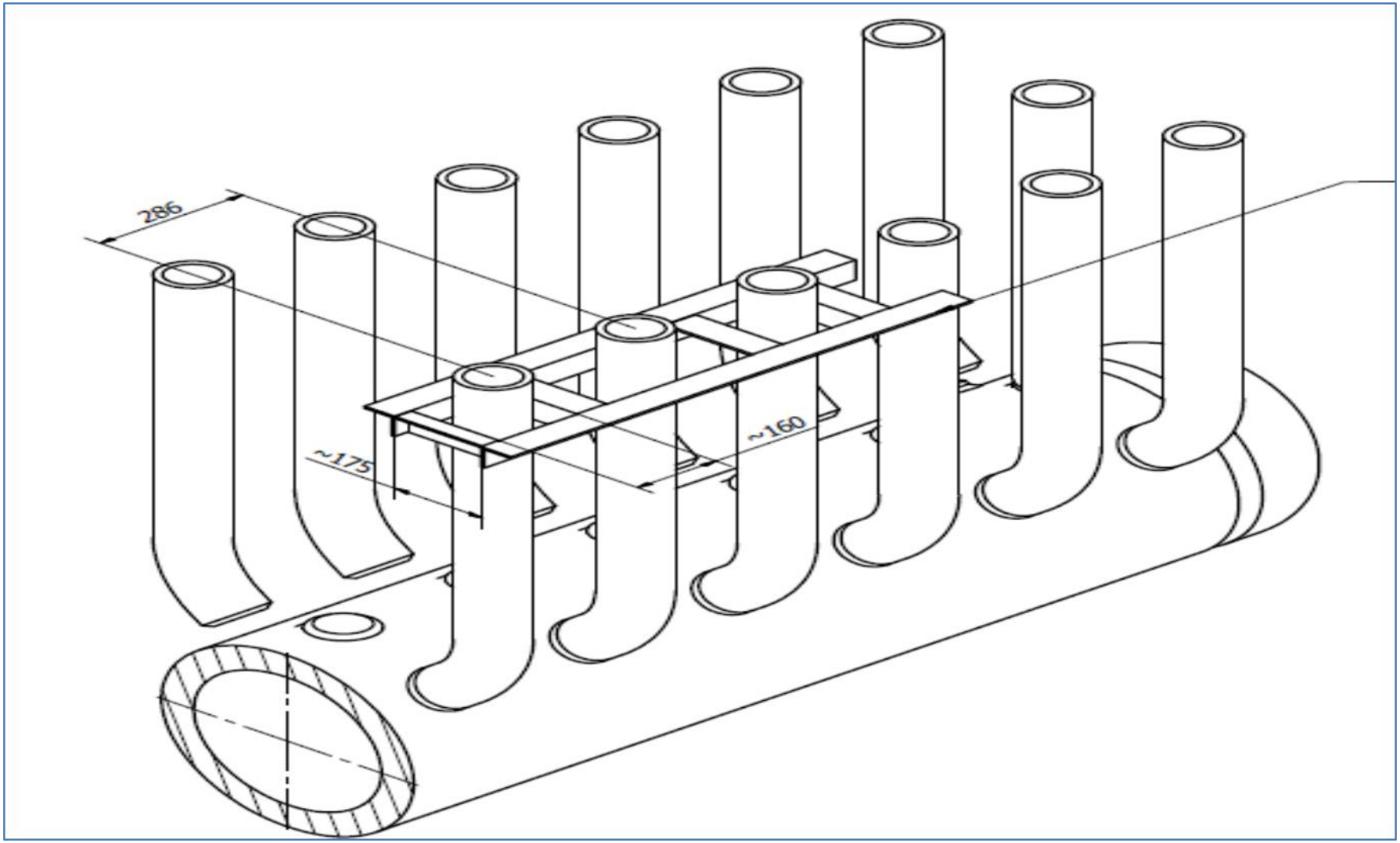


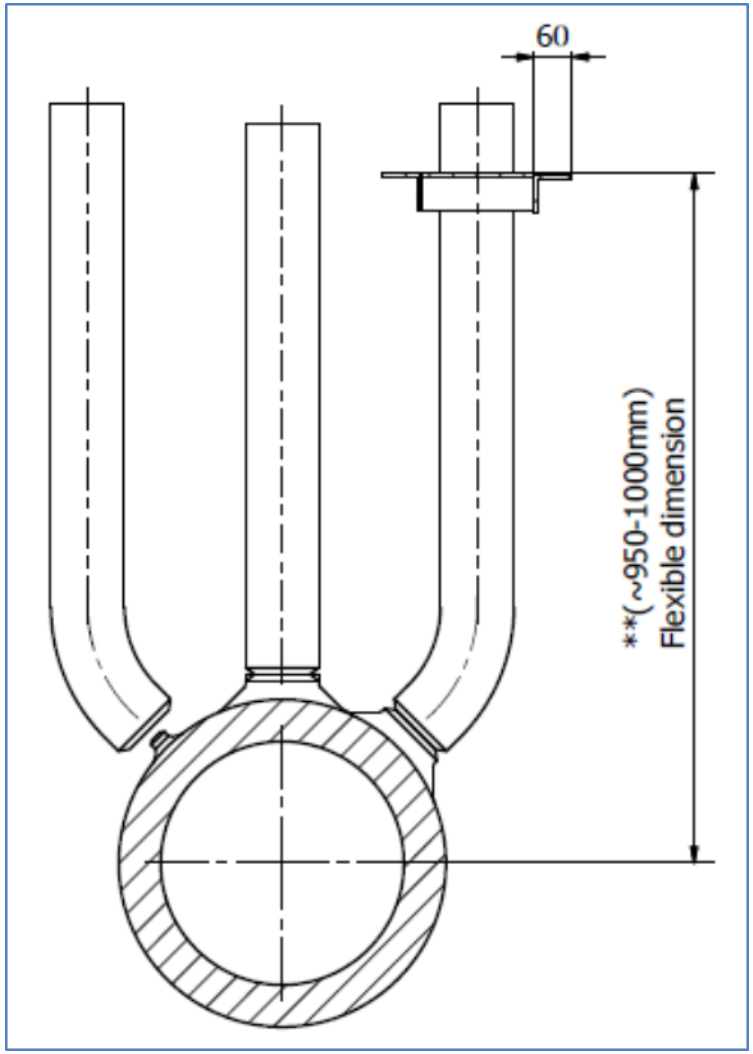
ANNEXURE 02


0°
270°
90°
225°
135°
180°
W2
W2
W2
STRAIGHT AFTER NOZZLE STUB
STRAIGHT AFTER NOZZLE STUB
R250*
R250*
65NB
65NB
50NB
800±3
1150±3
1150±3
04
04
W3
W3
W3
275
275


R250±1.5
45°
10
14°
25
37.5°±2°
ID59
7.4
TABLE 1

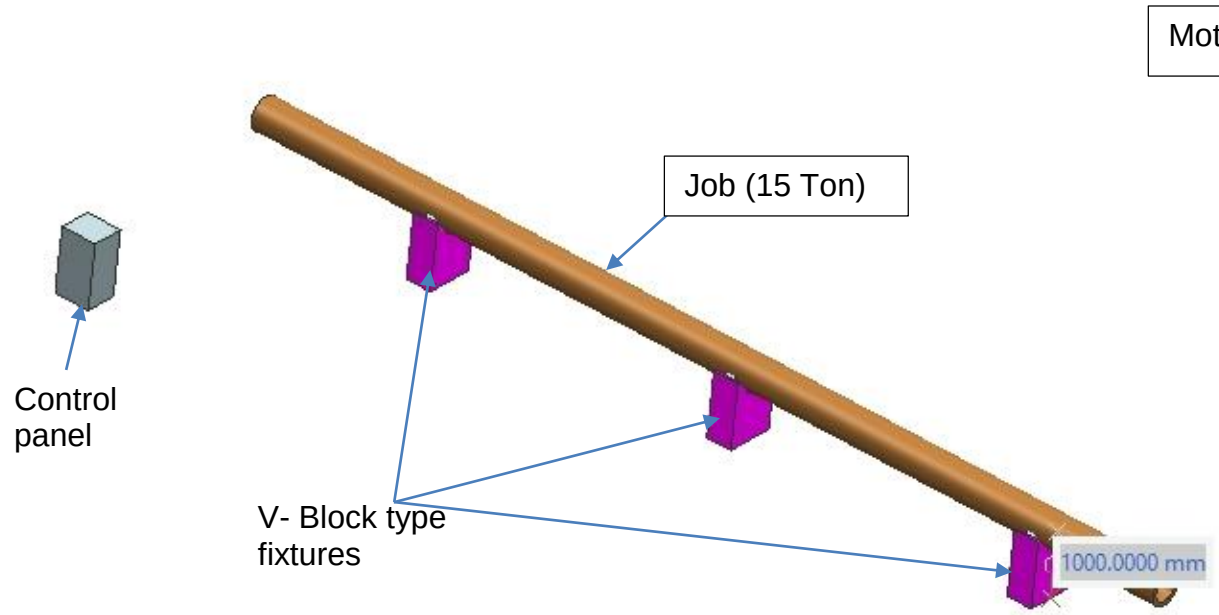
ANNEXURE 3

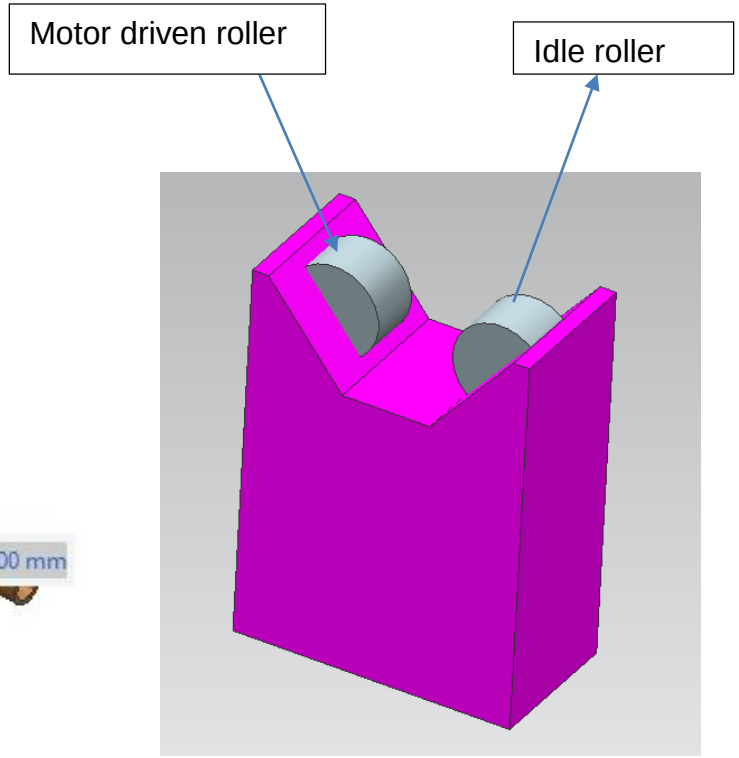



60
**(~950-1000mm)
Flexible dimension

ANNEXURE 4

WELDING FIXTURE





Note: The three motor driven rollers of three v-block type fixtures are VFD synchronized (Synchronous motion)