Annexure - I

TECHNICAL SPECIFICATIONS FOR WIRE ARC ADDITIVE MANUFACTURING AND WELDING SYSTEM

End Use: The following equipment and accessories consist primarily of welding power sources, robotic manipulators, welding positioner, welding table, cooling units, wire feeders, etc., which will be used systematically for wire arc additive manufacturing research. The same system can be also used for the robotic welding and refurbishing work if necessary.

S. No.	Parameter	Required Specification
1.0	**Manufacturers Credentials**	Manufacturer must be ISO 9001 certified. Please enclose Certificate
		Manufacturer may be ISO 14001 certified. Please enclose certificate
		Manufacturer may be ISO 45001 certified. Please enclose certificate
		Bidder if not the manufacturer, must provide **Manufacturer's Tender Specific Authorization** that the bidder is authorized sales & service provider.
		No Deviation will be allowed in Major Specification & Parameters. For every numerical point, manufacturer must have to write the exact value of their system; "complied", "agreed", "accepted" such words will not be allowed & such tender will be disqualified.
Major Components of the system		**Two Welding power sources, two robotic manipulator, one positioner/turn table and one nitrided welding table of following specifications must be provided.**
2.0	**Power source**	**Two MIG/MAG power source with following specifications must be provided**
2.1	Mains voltage	3x 400 V
2.2	Mains voltage tolerance	+/- 15 %
2.3	Mains frequency	50 / 60 Hz
2.4	Power factor	Must be 0.99
2.5	Welding current range in MIG/MAG	10 - 400 A
2.6	Welding current at 10 min / 40°C (104°F)	400A @ 40% D.C. 320A @ 100% D.C.
2.7	Output voltage range in MIG/MAG	14.5 V - 34.0 V
2.8	Open circuit voltage	70-90V
2.9	Type of Cooling	Water Cooled torch
2.10	Degree of protection	IP 23
2.11	Overvoltage category	III
2.12	Pollution level according to IEC60664	3
2.13	EMC device class	A
2.14	Safety symbols	S, CE
2.15	The Insulated Gate Bipolar Transistor	Completely Digital Microprocessor controlled IGBT inverter based WAAM power source with Six Axis Robot system capable of performing Wire Arc Additive manufacturing (WAAM) operations.
2.16	Welding characteristics	i. Dynamic Characteristic for high welding speeds with concentrated arc. ii. Machine must have one knob Synergic welding process. iii. Root Characteristic for root passes with powerful arc even with root gap of 8-10 mm in MS welding without using back strips. iv. The welding process must ensure molten metal transfer to weld pool forcefully instead of pinching effect. v. The welding process must ensure short-circuit with every drop of metal transfer though out the process window. vi. The welding process must incorporate forward as well as backward wire movement during welding. vii. Pulse and Double Pulse Controlled Spray arc for Direct transition from the

			concentrated pulse to a short spray arc. The advantages of pulse and standard arcs combined in single Characteristic. viii. The machine must produce Minimal spatter even in CO_2 welding in low spatter dip transfer Arc mode. ix. Arc voltage feedback system. Low spatter Control. x. Arc Length Stabilizer. - Arc length must remain constant up to a torch up-down movement of 35 mm. xi. Upgradable to Advanced welding Processes/custom make programs. xii. Arc-Current free metal transfer mode for wire arc additive manufacturing with continuous welding speed up to 1.0 Mtr / Min and must be capable of doing WAAM in all weldable materials (All grades of MS, SS, Al, Copper, Inconel alloy, Monel Alloy, Duplex & Super Duplex, Ti, etc.)
2.17	General System Specifications	i.	The overall system must ensure stable operation with provision to accommodate backward movement of wire during welding.
		ii.	The system must be based on Push-Pull mechanism of wire feeding.
		iii.	The system must be adaptable and modular for the following hardware options a. Gas Flow sensor b. Thermo-flow sensor for coolant c. Level sensor for coolant d. Gas test & wire inch function on wire feeder (in case of manual application)
		iv.	The system must be capable to add welding processes and other functionality as and when required.
		v.	In interconnection cable, the end connection of power cable must be mushroom head type and screw-able instead of regular bayonet type to ensure maximum contact surface for proper current transfer.
		vi.	The system must have Ethernet port to connect with LAN/PC.
		vii.	Every system must have its own IP address.
		viii.	The system must have a web Brower based app to access the system on PC through LAN, wherein one can access a. the entire configuration of the system, b. real time parameters, c. Saved parameters for a particular Job and an option to edit the saved parameter. d. Historical data of parameter during welding, downloading the historical parameter in PDF format and an option to download in .csv format.
		ix.	The system must be capable of Single knob operation with adequately sized control panel.
		x.	The rollers must be colour coded as per wire size for trouble free identification and it must be of universal type i.e., same set of rollers must be used for hard wire and soft wire for one wire size.
		xi.	The system must ensure precise wire feeding with the use of encoder.
		xii.	The system must have tabular log format for all the events which must record all the welding operation with following details: a. Date b. Time c. Duration of weld d. Current used e. Voltage used f. Wire-feed speed used g. Heat input h. Errors, if any
		xiii.	The power source must have an option to highlight, alert in-case of violation of set parameter beyond the permissible limit.

		xiv.	The power source must have a functionality, wherein it allows the system to operate at two different wire-feed speed, one after the other in sequential manner.
		xv.	The system must have functionality to save 500 (min.) different job parameter in the system.
		xvi.	The system must make use of full text instead of abbreviation to communicate with the user.
		xvii.	The system must have a provision to create different user role with only those access rights, which are required for the role, like Welder, Maintenance supervisor, Production Supervisor etc.
		xviii.	Power source must be compatible for the Industry 4.0 needs.
		xix.	Robotic communication must be Industry 4.0 technology software communication only and all the welding machine parameters will be controlled via robot controller only.
		xx.	Minimum 30 days data documentation must be available in welding system and can capable of transfer the data thru Ethernet cable, via Internet and Via USB slot
		xxi.	Welding machine must be capable of data transfer via Wi-fi /industry network.
		xxii.	Inbuilt Robotic teach mode (Auto retraction of welding wire during teaching), Arc sensing, touch mode, high accuracy magnetic collision system, RFID protected user management system.
		xxiii.	The OEM must submit literature the details of the required software and benefits to make use of Industry 4.0 capability and also possibility must exist to make use of API OPC-UA and MQTT.
		xxiv.	System must have the provision to activate the facility to give an alarm in case of desired heat input is increased or decreased during welding for special applications.
		xxv.	System must have the provision to activate the facility to give an alarm in case of desired welding time is not achieved for the seam for special applications.
		xxvi.	System must have facility to give an alarm in case of desired motor force is not being performed, this can intimate the feeding issue.
		xxvii.	System must have capability to perform the Wire Arc Additive Manufacturing/3D/Rapid Proto typing processes.
		xxviii.	System must have facility to remotely diagnose it the faults & failure to avoid the major breakdown time in case of National Emergencies - like Lockdown or etc.
		xxix.	Earth cable of 4m long 70 mm^2 Copper cable fitted with earth clamp.
2.18	Wire Feeder	i.	4-roll; 2 motor driven Wire Feeder. Easier pressure dipper with single arm attachment.
		ii.	Wire diameter – 1mm, 1.2mm & 1.6mm must be supported
		iii.	Wire Speed: 1-25 m/min
		iv.	Torch End Connector: Power Pin
		v.	Operating Voltage: 24 V DC - 60 V DC
		vi.	Degree of protection: IP21
		vii.	Storage Temperature range: -42- +60
		viii.	Inbuilt with wire feeder control card.
		ix.	Weight of wire feeder: To be specified by supplier Motor plate & feed rolls: Motor plate made of Al-Cast Self-opening swing lever.
		x.	Feed rolls with color marking for wire diameter.
2.19	Cooling Unit	i.	Closed circuit circulating unit.
		ii.	Tank capacity: 3.0 - 4.0 liters.
		iii.	Flow rate: 1 - 3.5 lpm (min).
		iv.	Max. Pump Pressure: 4 bar (min.)
		v.	Max. rise: 35 m

		vi. Cooling capacity at 40°C: 1000 W and above is preferable. vii. Coolant pump: centrifugal type. Hoses and fittings with bypass valve. Pressure switch for feedback. viii. Thermal sensor in the return flow to measure the return temperature of the coolant.	
2.20	Welding Torch	i. Torch Bend neck angle – 22 Degree or less ii. Cooling Type – Water Cooled iii. Duty Cycle at 10 min / 40°C (104°F) – 400A @ 100% iv. Collision Sensor must be present to protect the Torch head	
2.21	Welding Helmet – 01	Auto darkening helmet must 1/1/1/2 EN379 classification and shade level must 9-13 DIN.	
3.0	**Welding Table – 01 no.**	i. 3000 mm x 2000 mm (min.) nitrided welding table. ii. All type of clamps and holding devices must be provided.	
4.0	**Robotic manipulator**	**Two 6-axis robotic manipulator with following specifications must be provided**	
4.1	**Robot specification**	i. Type	Floor Mounted Welding Robot
		ii. Number of controlled Axis	6
		iii. Rated Payload	4 Kg and above
		iv. Rated Armload	10 Kg and above
		v. Protection	IP40 or IP54
		vi. Robot Reach	Min 1400mm and above
		vii. Positional repeatability	0.04mm - 0.05 mm
		viii. Wrist Design for cables	Hollow
		ix. Input Power Supply	Three-Phase 400V
		x. Power Consumption	ISO Cube 0.6 kW or less
		xi. Controller	Must be compatible with Robot, thus both robots can be operated from one PC and both robot can work on the same job simultaneously.
		xii. Robot controlling Software	PC interface software package (perpetual type) with all the necessary features required in additive manufacturing operation. Software must be able to directly communicate with the controller.
		xiii. Safety	Double circuit with supervision, emergency stops and safety functions. 3 positions enable device.
		xiv. PC interface protocol	TCP/IP based PC interface protocol for PC based communication with robot controllers must be available.
		xv. Pedestal for robot	Suitable pedestals not less than 800 mm in height must be provided for the installation of the robots.
5.0	**Backup and Data Communication**	i. UPS	Suitable UPS with at least 60 minutes back up for the communication system.
		ii. Communication system	• Processing Unit: 2.8GHz. Or better, Intel Core i7 (seventh generation or newer) or equivalent; • Memory: 1TB or higher, • RAM: 16 GB or higher • Graphics card, • USB front port: minimum 2 • Display: 23" or higher Color LED Monitor; • Operating system: Windows 10

		iii. Communication software	• Any other items or software's necessary, other than the mentioned above, for the proper installation and commissioning of the WAAM system as well as its hassle- free functioning must be specified in the pre-bidding meeting by the vendor. • If found to be suitable, those additional items or software's must also be quoted and supplied by the vendor.
6.0	**Turn Table/positioner Specification – 01 no.**	i. Type	2 Axes Floor Mounted
		ii. Handling capacity	500 Kg or above
		iii. Max continuous torque	650 Nm or above
		iv. Repetitive accuracy	± 0.05
		v. Max rotation speed (°/s) Axis 1	90 or above
		vi. Max rotation speed (°/s) Axis 2	150 or above
		vii. Degree of tilting	45° or above
		viii. Height from floor to Job table	700mm or above
		ix. Synchronization	This Two Axes Turn Table must synchronise with one of the above 6 Axis robots.
7.0	**Warranty**	2 Year's warranty for robot and all the above-mentioned items for the smooth and trouble-free working after installation and commissioning.	
8.0	**Performance Credential**	The bidder has to provide the documents as a reference of similar product supplied at-least in two or more premier Govt. institutes like CSIR labs, IITs, NITs etc. on a Pan-India basis.	
9.0	**Training**	On-site hands-on training for at least 7 working days covering all aspects of equipment, operation and maintenance within two weeks of installation.	
10.0	**Support**	After warranty the bidder must provide the necessary after sales support for smooth operation of the system for 5 years or more.	
11.0	**Acceptance criteria**	The system must able to perform a proper butt joint of thick plate as per AWS B3.0-77 specification after installation.	