MEPNN Supplier Scouting Opportunity Synopsis

Section 1: General Information

Scouting Number	2024-360
Item to be Scouted	Wire Arc Additive Manufacturing (WAAM) System
Days to be scouted	30
Response Due By	12/20/2024
Description	WAAM system with Cold Metal Transfer (CMT) welding capability. Do not want a Plasma Arc-based process.
Notify Requester Immediately	Yes
State item to be used in	Virginia

Section 2: Technical Information

Type of supplier being sought	Manufacturer
Reason	BABA
Describe the manufacturing processes (elaborate to provide as much detail as possible)	Standard manufacturing process for wire arc welding machines (Mechanical / Electrical Assembly) by a company meeting BABAA requirements.
Provide dimensions / size / tolerances / performance specifications for the item	Approximately 2.5x2.5x2.5 m machine size Print volume at least 0.4 x 0.4 x 0.4 m At least 4 Motion Axes (i.e. X-Y-Z gantry with a rotary table) Accuracy ~ 0.25 mm
List required materials needed to make the product, including materials of product components	Stainless steel, Copper-Nickel, Titanium
Are there applicable certification requirements?	No
Are there applicable regulations?	Yes
Details	Client is looking for companies that meet BABAA requirements listed here: https://www.commerce.gov/oam/build-america-buy-america
Are there any other stndards, requirements, etc.?	No
NAICS 1	
NAICS 2	
Additional Technical Comments	

Section 4: Business Information

Estimated potential business volume	One machine to start with possibility of purchasing more.
Estimated target price / unit cost information (if unavailable explain)	$400k
When is it needed by?	March 2025
Describe packaging requirements	Machine scale - do not have a crane or lift to move machine on location. Forklift or similar equipment may be required.
Where will this item be shipped?	Virginia

Additional Comments

Is there other information you would like to include?	For all BABA related questions please contact: GENEDGE Elisabeth Mazza emazza@genedge.org please copy scouting@nist.gov on questions.

Wire Arc Additive Manufacturing (WAAM) - Key Evaluation Features

The following is a list of features to be used to evaluate potential sources for a Wire Arc Additive Manufacturing System, including a brief description of the features, key considerations about each feature when evaluating a system and CCAM's requirements

System Budget: CCAM has budgeted no more than $500,000 for this system

System Feature	Description	Key Considerations	Requirement or Preference
Machine Axes	Machine axes refer to the degrees of freedom the WAAM system possesses, typically categorized as 3-axis, 4-axis, 5-axis or robot platform. More axes allow for greater flexibility but increases machine complexity and required operator knowledge and experience. Gantry-based systems (3, 4, 5-axis) are typically more accurate and repeatable than robot-based platforms.	**Number of Axes:** More axes provide the ability to create more complex geometries but require complex operation **Movement Precision:** Expected accuracy and repeatability of the machine's movements across all axes. **Software Compatibility:** Ensure the machine's axis control is compatible with CAD/CAM software	No hard requirement for number of axes or gantry vs robot. System of interest (WAAM3D MiniWAAM) has 4-axis motion platform (X, Y, Z, gantry motion + rotary/positioner table). Prefer less axes for simple operation. Other features will be more critical than machine axes.
Positioner	A positioner is a component that holds and tilts and/or rotates the workpiece during the deposition.	**Degrees of Freedom:** Consider tilt and rotation compared to rotation-only **Load Capacity:** Consider the max weight capacity and challenges with maintaining accuracy while tilting large/tall parts	A rotary-only table is required Tilt + rotary is nice-to-have Parts are expected to be < 75 kg
Build Volume	Build volume defines the maximum size of the part that the WAAM system can produce. It encompasses the dimensions (length, width, height) within which the process can operate.	**Maximum Dimensions:** Ensure the build volume meets largest part size requirements. **Scalability:** Consider if the system allows for expansion or modification	Parts are expected to be ≤ 0.5 x 0.5 x 0.5 m

System Feature	Description	Key Considerations	Requirement or Preference
		to accommodate larger parts in the future. **Limitations**: Consider build volume limitations – e.g. tall parts cannot be tilted on Positioner	
Welding System	The welding system in WAAM includes the arc welding equipment, power supply, and control mechanisms that facilitate the metal deposition process. Most systems utilize the GMAW process (similar to MIG), and the dominant production and research welding system is from Fronius and includes their cold-metal-transfer (CMT) process. Some systems offer a plasma-transferred-arc (PTA) welding system (comparable to TIG welding).	**Metal Transfer:** Consider the welding approach (MIG vs TIG) and metal transfer method (e.g. cold-metal transfer – CMT). **Power Control:** Evaluate the precision of current and voltage control for consistent energy input.	GMAW/MIG process capable of CMT is required. Plasma-transferred-arc process does not achieve the same deposition as GMAW/MIG and is not desirable for CCAM's needs.
Current – Energy Input Parameter	Current settings in the WAAM process directly influence the energy input into the weld pool, affecting deposition rate, bead geometry, and part properties.	**Stability and Control:** Look for systems that maintain consistent current levels and allow precise control over the current to maintain uniform deposition. **Monitoring Capabilities:** Verify if the system provides real-time monitoring and feedback on current settings.	High-quality, high-performance welding system is required to allow modifications to be made to the current input. Monitoring the current input is required – most weld system manufacturers provide current and most WAAM OEM's include current monitoring in their processing software.
Voltage – Energy Input Parameter	Voltage settings work in tandem with current to determine the overall energy input, influencing the welding arc characteristics and deposition quality.	**Stability and Control:** Look for systems that maintain consistent voltage levels and allow precise control over the voltage to maintain uniform deposition.	High-quality, high-performance welding system is required to allow modifications to be made to the voltage input. Monitoring the voltage input is required – most

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		Monitoring Capabilities: Verify if the system provides real-time monitoring and feedback on voltage settings.	weld system manufacturers provide voltage and most WAAM OEM's include voltage monitoring in their processing software.
Wire Feed Rate	Wire feed rate controls the amount of wire material fed into the weld pool, directly affecting the deposition rate and the energy input per unit length.	**Adjustability:** The ability to precisely adjust wire feed rates for different materials and deposition requirements. **Stability Monitoring:** Look for systems that monitor and maintain a consistent wire feed rate to prevent defects such as, porosity or lack of fusion. **Multi-Wire Feed**: Systems can feed multiple wires simultaneously to increase deposition rate or allow in-situ alloying.	The ability to track, modify, and control the wire feed rate during deposition is required. Multi-wire feed capability is nice-to-have.
Long-wave Infrared (LW-IR) Sensor	LW-IR sensors are used to monitor part-scale thermal signatures. This sensor can be used to measure interlayer temperatures (ILT) which is used as a feedback control metric in AM.	**Specifications:** LW-IR camera specifications (resolution, capture rate, etc.) and filtering meet the requirements. **Integration:** Consider systems with a LW-IR sensor integrated to the machine and software. **Feedback Control**: Consider systems that use LW-IR to measure ILT and feedback to adjust dwell times or other process settings.	LW-IR camera (or equivalent thermal sensor) is required. Measuring Range: 20 - 600°C Temp. resolution: 0.1°C Working distance: 500 mm Update rate: 30 Hz Image resolution: 0.5 mm/pixel USB or GigE connection to computer
3D Scanner or Profile Measurement	Incorporating 3D scanning or profile measurement allows for real-time monitoring and feedback of the part	**Accuracy and Resolution**: High-precision scanning systems can	Sensor to measure layer thickness and deposition geometry is required.

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	geometry during the build process, ensuring dimensional accuracy and part integrity. Sensor can be used to maintain constant working distance throughout buildup ensuring uniform deposition quality.	detect minute deviations and ensure the build conforms to specifications. **Integration with Software**: Ensure compatibility with the WAAM system's software for seamless data integration and process adjustments. **Feedback control**: Systems that provide immediate feedback for adjustments during the build process can enhance quality control.	Measuring range: 100 mm Working distance: 300 mm Resolution in Z-dir.: 2 um Resolution in XY-dir.: 0.5 mm Update rate: 100 Hz (line scanner); or 5 Hz (3D scanner) USB or Ethernet connection to computer
Other Sensors	Sensors beyond a LW-IR camera and 3D scanners, such as alternative IR or temperature sensors, melt pool monitors, or gas flow sensors, provide critical data for process control and quality assurance.	**Comprehensive Monitoring**: A variety of sensors can offer a more complete picture of the manufacturing process, helping to detect and correct issues in real-time. **Data Integration**: Ensure sensor data can be integrated into the system's control software for automated adjustments. **Reliability**: Choose sensors known for durability and accuracy in manufacturing environments. **Feedback Control:** Sensors used for feedback control during the process can enhance build quality.	Pyrometer (nice-to-have): Measuring Range: 200 – 2,600°C Temp. resolution: 2°C Working distance: 500 mm Update rate: 1 kHz USB or GigE connection to computer High-dynamic range camera (nice-to-have) can resolve the high light intensity melt pool and low light intensity surrounding material.
Interlayer Temperature Control (ILT)	ILT involves maintaining optimal temperatures between layers to prevent defects like warping, residual stresses, and poor layer adhesion. Typically measured/calculated using LW-IR and then used to set a dwell time between layers.	**Temperature Uniformity:** Systems should ensure even temperature distribution across the build. **Control Mechanisms:** Look for advanced control systems that can actively manage interlayer	Edge computer/controller for LW-IR camera: Real time processing of LW-IR camera; Update range: 10 Hz

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		temperatures based on real-time data. **Integration:** Ensure ILT is seamlessly integrated with other process controls for cohesive feedback control.	
Layer Height or Geometry Control	This feature measures the thickness and shape of each deposited layer, crucial for achieving the desired part geometry and surface finish.	**Precision Control**: The ability to precisely set and maintain layer heights for high dimensional accuracy. **Control Mechanism**: Systems that can adjust layer height dynamically based on part geometry or real-time feedback. **Surface Quality**: Advanced control mechanisms that minimize layer inconsistencies and improve surface finish.	Software to process 3D scanner or profile measurement sensor is required
Tool Path (CAM)	CAM (Computer-Aided Manufacturing) software generates the tool paths that guide the WAAM system during the build process, defining the geometry and deposition sequence.	**Software Capabilities**: Robust CAM software that can handle complex geometries and optimize tool paths for efficiency and quality. **Ease of Use**: User-friendly interfaces that allow for easy programming and modification of tool paths. **Integration with WAAM System**: Ensure seamless communication between the CAM software and the WAAM hardware for accurate execution and ability to facilitate feedback control algorithms.	Software to generate toolpaths is required Compatibility with Siemens NX (CAD and CAM) is nice-to-have but not preferred and would replace the requirement for CAM software from the machine purchase. CCAM currently utilizes NX for CAD/CAM of other AM processes.
Data Acquisition	Process monitoring involves the continuous tracking of various parameters (e.g., temperature,	**Comprehensive Monitoring**: Systems that monitor all critical parameters affecting part quality.	Process monitor update rate: time-series plots: 10 Hz; Imaging: 10 Hz;

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and Processing	deposition rate, layer thickness) during the WAAM process to ensure deposition consistency and part quality.	**Data Logging**: The ability to record and store process data for quality assurance and process optimization. **Alert Systems**: Real-time alerts for any deviations or anomalies detected during the build process.	Logging update rate: 10 Hz
Feedback Control	Feedback control systems use data from process monitoring to automatically adjust manufacturing parameters, ensuring that the WAAM process remains within desired specifications. ILT and layer height accuracy are the most common metrics used for feedback control.	**Automation Level**: Degree to which the system can automatically adjust parameters without manual intervention. **Responsiveness**: How quickly the system can respond to feedback data to correct deviations. **Configurability**: The ability to set thresholds and control strategies based on specific application requirements. **Advanced Algorithms**: Look for systems with sophisticated control algorithms that can interpret sensor data effectively. **Real-Time Adjustment**: The ability to make instantaneous adjustments based on feedback to correct process deviations. **User Interface**: An intuitive interface for monitoring feedback data and making manual overrides if necessary.	Automatic control based on previous calibration; Responsiveness: 10 ms
Other Capabilities	This encompasses additional features and accessories that enhance the WAAM system's functionality, such as material handling systems, heating or	**Added Functionality**: Identify any extra components that can improve efficiency or part quality, such as	No requirement for Other Capabilities

System Feature	Description	Key Considerations	Requirement or Preference
	cooling systems, or integrated CNC machining tools.	base-plate heating, additional shielding gas, or software features. **Customization Options**: Determine if the vendor offers customizable components to tailor the system. **Support and Upgrades**: Consider the availability of ongoing support and the ability to upgrade components as technology advances.	