Open Call for White Paper: General and Specific Topics (v. 06-21.1)

Steel Performance Initiative: Steel Technology Advanced Research (STAR)

1. Scope and Purpose

SFSA is accepting Steel Performance Initiative (SPI) research project white papers for potential funding.

The principal objective of this work is to enable the United States to develop innovative steel technology and retain domestic world-class capability through the implementation of advanced steels for both commercial and defense needs.

Proposed projects may be one to five years. Individual PI proposals should not exceed $300k per year. Multi-institution proposals may also be submitted and have no specified cost objective, but should keep in mind the $300k per year per PI threshold. Proposals that exceed the $300k per year threshold may be considered on a case-by-case basis.

Projects are funded in one-year increments and are not guaranteed full funding for out-years. Annual substantive progress must be demonstrated on all multi-year proposals, and annual deliverables should be detailed in any submitted proposal. Future funding is also contingent on program strategic needs and available resources.

2. Eligibility

Submitting entities must be a US entity and meet at least one of the following criteria:

1. Be a current (active contract or completed delivery within the last 12 months) supplier to a DoD Original Equipment Manufacturer (OEM)
2. Be a DoD OEM
3. Have received prior awards totaling at least $1M for research and development work from a DOD contract within the last 3 years

Entities who do not meet one of the above eligibility criteria must do one of the following:

1. Collaborate with an entity that does meet one of the requirements above while not receiving either the plurality or more than 49% on an awarded proposal
2. Submit an additional 1-page supplemental document detailing their qualifications and capability to perform this type of work, including reference to prior examples

The funding for SPI is not for fundamental science but is DoD Manufacturing Technology Program (MANTECH) funding. Accordingly, all project work will require funding government agency review and approval prior to publishing. DFAR 252.204-7000 requires prior approval to safeguard against unauthorized release of funded results.

SPI research is categorized as advanced technology development, which may require the entity to receive or generate Controlled Unclassified Information (CUI). Entities must be compliant with the cybersecurity requirements as outlined in DFARS 252.204-7008 and 252.204-7012 and submit a cyber self-assessment into the Supplier Performance Risk System (SPRS) against NIST 800-171. Eventually, Cybersecurity Maturity Model Certification (CMMC) will be required when funding government agency incorporates it into future contracts.

SPI subcontracts will be issued as a cost reimbursement, cost share contract. Entities will be required to provide a minimum cost share of 5% of the contract value. White papers must include a cost share estimate and source(s).

3. Requirements

Submitted white papers shall be in accordance with the provided template and include the following information:

- Project title
- Proposer and Partner Identification
    - Name, title, years of related experience, company, phone and email
- Key Personnel with contact information
    - PIs, collaborating entities, subcontractors
    - Government partner/collaborator
- Technical proposal
- SPI Objective(s) or Topic project is aligned with
- Duration of project in years
- Cost estimate to perform the scope of work
    - Multi-year proposals must include a cost-estimate total for each year
    - The first year of the proposal must also be itemized for:
        - Labor
        - Materials
        - Travel
        - Equipment
    - Cost share estimate
- Benefit/ROI such as:
    - Estimate of cost savings for implementation
    - Details of capability improvements for DoD
    - Details of capability improvements for industry
- Technology transition plan
- Acceptance acknowledgment of CUI and publication requirements

Multiple discrete proposals from a single entity are acceptable, but should be submitted separately. Submissions shall not be proprietary and only include information approved for public release.

Proposals that fail to address all requirements will not be considered. Total proposal packages containing more than 5 pages will not be considered. Proposals without acceptance of the cybersecurity and publication review requirements will not be considered.

4. Selection Criteria

This is a competitive open call for white paper proposals. All, some, or none may be selected. Evaluation criteria may include:

- Solution to current DoD issues or future capability need
- Solution to current industry issues or future capability need

- Amount of benefit and time to delivery of benefit to the DLA and DOD
- Technical merit
- Relevance to and degree of advancement of the SPI Objectives
- Innovative approach compared with previous work
- Degree of risk
- Overall proposal cost
- Schedule to complete work: significant and attainable deliverables should be projected for each year of multi-year proposals
- Ability to address multi-service objectives in a single proposal
- Cost savings of implementing developed technology
- Capability improvements possible through developed technology
- Fidelity of transition plan for new technology
- Cost share

5. Statement of Work

Proposers are encouraged to base their proposals on one of the Specific Topics or on the SPI Objectives, particularly relating to the needs of the DLA for supporting individual and joint services.

Specific Topics

1. NDT Tracker Software
   Traditionally, foundries would track quality issues by marking up a drawing or even just a hand written note. In this format, the information is logged but is not useful for process improvement. Besides tracking indications, there may be other requirements such as weld maps. Having digital NDT records that can be analyzed unlocks Smart Data. Beyond tagging indications to a solid model of a part, image capture technology could transpose an inspector's markings on the castings, thus improving efficiency and accuracy. Being able to track both location and magnitude would enable cost analytics and process engineering improvements to focus on the big problems.
2. Mold-metal Interface
   There are multiple reactions that can occur between molten steel and a sand mold. The sand mold and coatings have binders and other additives that can form gasses when they are heated by the molten steel during filling. Molten steel can react with these gasses and get entrained in the casting. The breakdown of the binder at high temperatures can also provide a carbon-rich atmosphere at the interface which can cause carbon pick-up on the surface of the casting. The sand and binder system provides either a reducing or oxidizing mold environment, which influences the decomposition of the binder and other additives and the oxidation of molten steel. Iron oxide is typically added to the sand to minimize reaction between sand and molten steel or to control the mold atmosphere, but it can also react with the sand. The interaction between the molten steel and the sand can lead to sand penetration that can be categorized into 3 mechanisms: liquid penetration, chemical penetration, and vapor penetration. A better understanding of the mold-metal interaction backed with technical data will enable improvements in the quality and surface finish of steel castings.
3. Steel Metal Mold Casting
   Manufacturing steel castings in a metal mold can enable faster cooling rates, thus providing a

smaller grain structure and higher properties. With simple geometry parts, it can also leverage production efficiency for higher volume parts that offset the amortization of the metal mold. Reducing the chilled metal surface from being pulled into the casting will be important. Graphite molds may also be considered. The predominant challenge with graphite molds is cracking.

4. Steel Property Dataset
   Data mining of published datasets to develop big data for structural steel mechanical properties for all product forms (mill, forged, cast). Additional testing of steels and actual parts to represent actual processing and conditions can be completed to build out or refine datasets. Data will be used to develop design allowables and predictive properties based on processing.
5. QNDT Processes
   Develop NDT practices for steel castings and other specialty steel products that improve the ability for quantitative results with improved Gage R&R. These can be with current methods or by leveraging new methods – such as Computed Tomography (CT), Thermography Imaging (TI), Total Focusing Method (TFM), Electromagnetic Testing (ET), or Radio Tomographic Imaging (RTI). The methods need to work on complex shapes that may not have a smooth surface. A method to analyze for macro inclusions in steel castings could be of specific interest. Innovative research to improve/develop Quantitative NDT with high reproducibility and repeatability is key so that results can drive reliable part performance.
6. CNC Spray Quench
   The ability to heat treat a part is often limited by the size of one's quench tank. A CNC spray quench machine would enable tank-less quenching of complex steel parts. Spray quench will reduce the formation of vapor blankets and improve the efficiency of the quench. Through CNC of the spray, nozzle flow, location, and movement can be programmed to evenly control the cooling of a complex part to reduce cracking or enhance property specific regions in the part.
7. ARtisan Technology
   The use of Augmented Reality in job shop manufacturing can afford several opportunities for artisans who are critical to manufacturing specialty steel product. Smart Glasses can provide on-the-spot and current work instructions to eliminate paper and outdated copies or the need to review details at a terminal away from the job. Smart Glasses can also provide while-on-the-job training for tasks whether it is the first time or as a refresher, including the opportunity for video or live training. Finally, the camera technology in Smart Glasses can be used for validation if required processing was completed or for process optimization.
8. Automated Lip Pour Ladle or Direct Pour Furnace
   Pouring of steel castings is a critical step in making clean steel. Air entrainment can result in inclusions and quality issues. Automating this process so the right amount of metal is delivered at the appropriate temperature, time, and rate is key. Some automation has already taken place in mills and foundries who use bottom pour ladles. Thus, this project focuses on lip (teapot or simple lip) pour ladles. In addition, an opportunity to directly pour castings from the furnace would afford reducing the heat, time, and oxidation penalty of transferring to a ladle; however, this needs to offset the missed time the furnace is not melting the next heat.

SPI Objectives

1. Robust Advanced High Strength Steels (RAHSS)
2. Quantitative Non-destructive Testing (QNDT) and Non-destructive Evaluation (NDE)
3. Integrated Computational Materials Engineering (ICME) and Model-based Process & Product Design (MP^2D)
4. Hybrid Manufacturing Technology (Hybrid ManTech)
5. Next Gen Job Shop Manufacturing (Smart JSM)

6. SPI Contracting Point of Contact:

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8. Proposal Submission

PDF versions of the completed proposals should be submitted via e-mail to Ryan Moore and Hayley Brown.