<u>Request for Information</u>

Conformal Ablative TPS Manufacturing Scale-Up

Deployable Aeroshell Concepts and Conformal TPS (DACC) Project

National Aeronautics and
Space Administration

Ames Research Center
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1.0 INTRODUCTION AND BACKGROUND

NASA has identified the need for research and technology development in the area of Deployable Entry Systems capable of supporting Exploration Class Missions. NASA has established the Deployable Aeroshell Concepts and Conformal (DACC) Thermal Protection Systems (TPS) project based at NASA Ames Research Center (ARC). One element of DACC is the development of a conformal ablative TPS technology targeting missions requiring peak heat-flux around 250 W/cm^2 (CA250). NASA's plan to develop CA250 is the focus of this Request for Information (RFI).

2.0 TECHNICAL APPROACH – CONFORMABLE ABLATIVE (CA250) TPS

A conformal TPS over a rigid aeroshell has the potential to solve a number of challenges faced by traditional rigid (low strain-to-failure) TPS materials. NASA believes the compliant (high strain to failure) nature of the conformal ablative materials will allow easier integration of the TPS with the underlying aeroshell structure and enable monolithic-like configuration and larger segments (or parts) to be used. By reducing the overall part count, the cost of installation (based on cost comparisons between blanket and tile materials on the Space Shuttle) should be significantly reduced. The conformal ablator design will include a simplified design of seams between gore panels, which should eliminate the need for gap filler design, and should accommodate a wider range of allowable carrier structure imperfections when compared to attachment challenges associated with a rigid ablator material.

NASA ARC is currently conducting an in-house research and development effort to determine the best conformal ablative (CA250) materials. The capabilities goal for the conformal TPS is similar to an MSL design reference mission (~250 W/cm2) with matching pressures and shear environments. Both conformal and flexible carbon-felt based materials have been successfully tested in aerothermal environments above 500 W/cm^2 under the Aeronautics Research Mission Directorate (ARMD) Fundamental Aeronautics Program (FAP) Hypersonics Project and Exploration Systems Mission Directorate (ESMD) Entry Decent and Landing Technology Development Project (EDL TDP), respectively. *The current materials under development are considered Government sensitive information.* For the purpose of this RFI, it is only necessary to know that materials under consideration are low density (0.18-0.28 g/cm^3) similar to Phenolic Impregnated Carbon Ablator (PICA) – US Patent #5,536,562 Tran, et al. July 16, 1996, and are comprised of:

- A flexible carbon substrate (carbon felt)
- Infiltrated with an ablative resin system (silicone and/or phenolic)

In addition, materials will most likely need to be processed in molds in conically shaped (45°, 1-m base diameter) sections.

3.0 TECHNICAL OBJECTIVE

The goal for the DACC project is to develop and deliver a TRL 5 conformal TPS capable of ~250 W/cm^2 (CA250). This involves down selecting, manufacturing and testing candidate materials from the ARMD and EDL TDP efforts, demonstrating uniform infiltration of resins into baseline ~1" thick carbon felt, selecting primary conformal material formulation based on arc jet and material property testing, developing and demonstrating advanced instrumentation for felt-based materials and, based on the material property and arc jet data, developing a low fidelity material response model so that the conformal TPS thickness for missions can be established.

Later, based on the above effort, development and refining metrics for mission utilization of conformal ablator technology will be carried out. The project will develop and deliver CA250 to TRL 5 by continuing material characterization testing that includes thermal, arc jet and structural properties and a mid-fidelity thermal response model. In addition, developing and demonstrating joining technique/seams in relevant aerothermal environments will lead to system level technology maturation and demonstration.

4.0 ANTICIPATED PROCUREMENT ACTIVITY

NASA anticipates that it will require the services of a contractor who has the in-house experience and capabilities to manufacture its selected CA250 material. Although an acquisition plan has not been formalized, this effort may include some or all of the following activities and deliverables:

- Manufacturing Plan for felt-based conformal ablator materials of at least 1-m diameter: which includes the necessary processes, procedures, equipment, and any services required
- Non-destructive methodologies necessary to examine variations in the felt structure and the resulting conformal ablator and for bond verification
- Proposed specifications for certified TPS processing and NDE evaluation of the ablative materials
- Design support and manufacture of a 1-meter class manufacturing demonstration unit (MDU).

At the conclusion of the procurement activity to select a contractor to support NASA's effort, and upon award of a contract, it is expected the selected contractor will be required to sign an agreement such as a Non-Disclosure Agreement (NDA), and then the technology under development at NASA would be disclosed. It is expected that the vendor will be required to supply small-scale samples for testing followed by large-scale materials for application to the 1-m diameter MDU, as shown in Figure 1. At the end of about two years, the CA250 project anticipates having matured a conformal ablator TPS to TRL-5 by testing in a relevant environment, developing the model to predict behavior, and demonstrating manufacturability on large-scale systems.

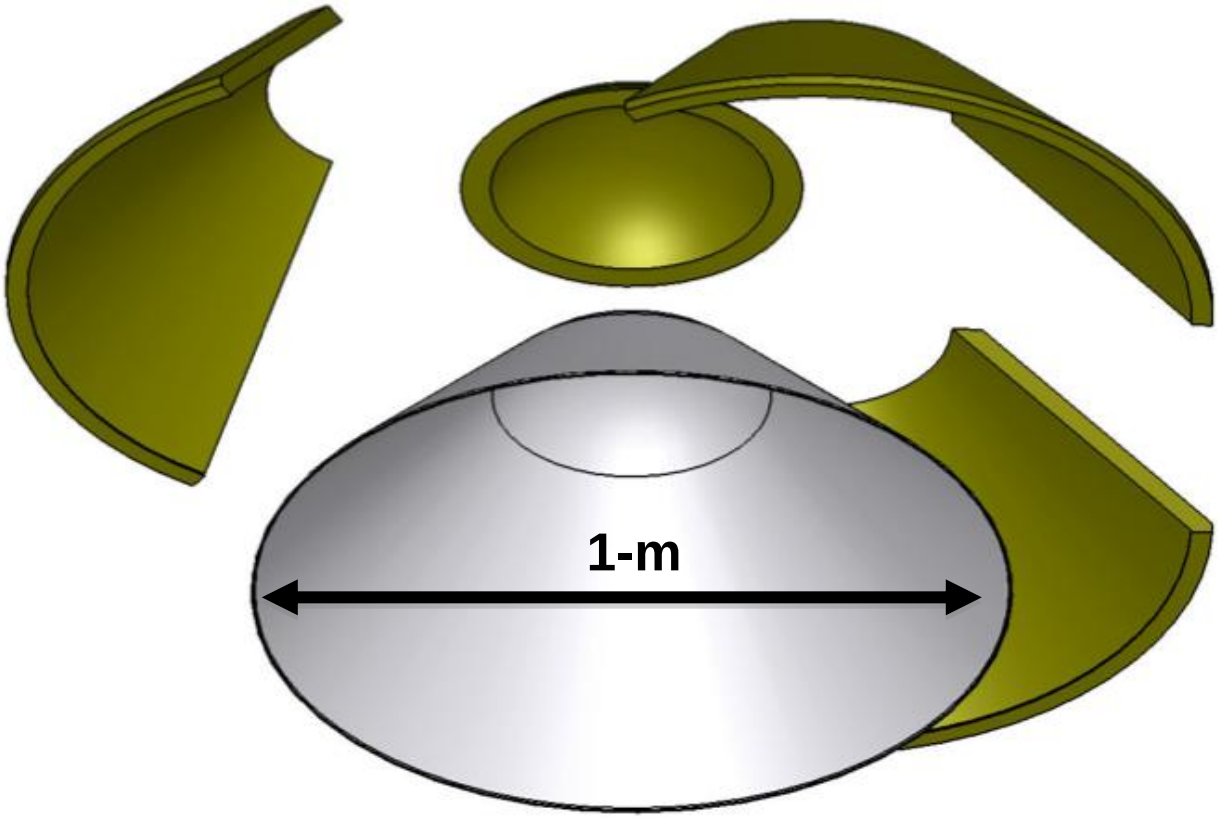

Figure 1 – Schematic of Manufacturing Demonstration Unit (MDU) with notional application of meter-scale conformal TPS segments over aluminum shell substructure.

5.0 INFORMATION REQUESTED FROM INDUSTRY

In order for NASA to understand the current capabilities of industry, interested organizations are invited to submit responses to the following questions:

1. What is your current capability in heat shield relevant (aerospace grade) TPS manufacturing?
    a. Personnel experienced in making aerospace grade materials.
    b. Associated product assurance certifications and processing equipment necessary to do so.
    c. Certifiable process procedures and specifications.
2. What types of polymer composites have you produced? Please describe substrate and resin systems, part sizes, and curing techniques, final material density targeted.
3. Do you have experience in working with felts? Have you produced composites from them? Using what types of resins and what dimensions (including thickness) for the final parts? Have you joined felt-based parts either side-by-side or in layers?
4. What types of resin infiltration techniques do you have experience with?
5. Do you have the ability to work with large volumes of solvents?
6. What manufacturing methods would be used to manufacture the proposed TPS to the 1-m scale (materials will most likely need to be processed in molds in conically shaped (45°, 1-m base diameter) sections).
    a. What in house equipment is available to enable the manufacturing method described above?
    b. Where is your manufacturing facility located?
    c. What are your current limitations in composite part manufacture with respect to size? Does existing equipment need to be scaled up? If so, what would be involved in terms of cost and schedule?
    d. What are the likely process limitations for scale-up beyond 1-m? (Length, Width, Thickness?)
7. Describe your experience making flight hardware. If you have only provided elements of flight components, please specify.
8. Describe any Non-Destructive Evaluation (NDE) techniques that you have available or that would be necessary to certify the proposed TPS for flight.
9. Describe your process for specifying a process such that all materials fabricated are consistent within predetermined process values.

6.0 FORMAT

Electronic format (Microsoft® Word or Adobe PDF). There are no page limits or font size restrictions, although figures, diagrams, etc. should be readable.

7.0 ADDITIONAL INFORMATION

All notices pertaining to this RFI will be posted at the NASA Ames Research Center (ARC) Procurement website at:

http://server-mpo.arc.nasa.gov/Services/Proc/home.tml

Interested firms are requested to submit their capability statements and responses to the questions in Section 5.0 above, as well as any comments on the acquisition approach via email to the Contracting Officer, Marianne.Shelley@nasa.gov no later than the date and time indicated in the synopsis at the ARC procurement website. Please indicate your company's business size (large business, small business, veteran-owned small business, service-disabled veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns).
This preliminary information is being made available for planning purposes only, subject to FAR Clause 52.215-3, entitled "Request for Information or Solicitation for Planning Purposes." This is a request for information only and does not constitute a commitment, implied or otherwise, that NASA Ames Research Center (ARC) will take procurement action in this matter. Further, neither NASA ARC nor the Government will be responsible for any cost incurred in furnishing this information. NASA ARC is issuing this RFI to gain a better understanding of industry capabilities and to assess the current state of the technology.

Detailed requirements for a future acquisition have not been finalized, nor have the specifics for the acquisition strategy been determined. NASA intends to use the results of this market research to aid in the making of these final decisions. Any future procurement resulting from this RFI is contingent upon the availability of appropriated funds.

The current materials under development are considered Government sensitive information and any information learned about them as a result of participation in a future procurement shall not be disclosed or used for private purpose without prior arrangement with the Government.

Although all comments received in this RFI will be carefully reviewed and considered for inclusion in a later action, the initiators of this request make no commitment to include any particular recommendations.

Following this initial feedback, NASA may conduct one-on-one meetings with potential contractors. These meetings will allow for exchange of information and will provide an opportunity for potential offerors to provide feedback on the Government's requirements and its acquisition approach.

All information received in response to this RFI that is marked "Proprietary" will be handled and protected accordingly. As applicable, NASA may provide Proprietary information to its support service contractors who are under an obligation to keep third-party Proprietary information in confidence. By submitting a response to this RFI, the responder is deemed to have consented to release of Proprietary information to such NASA support service contractors.