Request for Proposal

Reusable Penetrating Hypersonic ISR Platform

Need

The military services of the United States and its allies maintain a variety of intelligence, surveillance, and reconnaissance (ISR) systems to gather imagery and other information supporting time-sensitive battlefield decisions. However, there is increasing pressure to reduce the time required to collect such information, and to do so in the face of increased adversary capabilities. Thus, there is the need for the development of a reusable penetrating hypersonic ISR platform that can arrive on station and collect information more rapidly than existing subsonic platforms.

Objective

The objective of this project is to design a remotely-piloted, unmanned, reusable hypersonic ISR platform. Participants shall provide engineering analysis and total system design associated with this platform. The teams shall determine a system concept that best satisfies mission requirements and goals. The teams shall describe their design process, the physical and performance characteristics of the final system design and its components, an operational concept, cost estimate, development plan, and necessary support equipment and other resources necessary to comply with the Technical Requirements.

Technical Requirements

The overall requirement of this Design Competition is to develop a reusable hypersonic ISR platform. Emphasis should be on maximizing system performance and effectiveness while minimizing the system's cost and complexity.

Top-level requirements for the system are described below:

- Cruise speed: Threshold: Mach 5.0; Objective: Mach 8+.
- Cruise altitude: Threshold: 80 kft; Objective: 100 kft.
- Maximum range: Threshold: 2500 nautical miles; Objective: 3000 nautical miles.
- Capable of takeoff and landing on conventional paved runways; required runway length should not exceed 8000 ft.
- Capable of performing both round-trip missions (returning to the launch point) and one-way missions (landing at a friendly runway beyond the target area).

- Remotely piloted, unmanned system. Autonomy is permitted, but not required, for cruise portion of flight.
- Reusable, with turn-around time between sorties not to exceed 24 hours.
- Other than for the following items, the ISR payload can be considered as a "black box" piece of customer-provided equipment. Design and analysis of the ISR payload is not required.
    - Provide space for an integrated ISR payload, represented by a brick measuring 3 feet by 3 feet by 12 feet.
    - Accommodate an ISR payload weighing 1000 lbm.
    - Provide 2000 Watts of electrical power to the ISR payload
    - Locate two downward-looking windows, each with a diameter of 12 inches, transparent for EO/IR imagery, and contiguous to the payload space allocation.
    - Provide options for RF antenna aperture (size 1×2 ft) locations on both sides of the fuselage, with little or no occlusion from vehicle. Heat flux at aperture location should be minimized.
- The system may reuse components of existing aircraft or other flight vehicles to reduce cost. Teams may propose existing propulsion systems, flight control systems, electronics, or other components capable of meeting performance requirements.
- Assume a production run of 10 aircraft and 2 ground control stations per year for 10 years, plus 5 aircraft and 2 ground stations for developmental testing.

For the purpose of determining technology availability and program planning, design and development starts October 2022, and the system initial operational capability (IOC) shall occur no later than December 2030.

Teams are encouraged to describe alternate designs and cost sensitivities for enhanced capability beyond the minimum requirements as well as suitability for the platform to be adapted to other applications (e.g. as a weapons delivery platform).

Designs shall adhere to standard engineering practices for health, safety, and environmental impact. Where appropriate, teams shall evaluate performance improvements offered by design choices versus cost, hazards to personnel, manufacturability, and maintenance considerations.

Where not specified, requirements shall be derived by the project team based on reasonable, justified assumptions that should be documented in the submitted proposal. The AIAA Missile Systems Technical Committee (MSTC) may be contacted with critical

questions the team needs resolved to proceed with the project (see the Additional Information section below).

Data Requirements

The team shall provide a final technical proposal documenting the design of the hypersonic ISR platform concept clearly and concisely. The proposal shall include pertinent analyses and trade studies supporting the design decisions. A full description of the vehicle is expected, including its performance capabilities and operational limits. Further details of proposal contents are described below.

Concept of Operation

The team shall formulate and describe a complete concept of operation, including a notional timeline. Additionally, the concept for all support equipment required for operation of the hypersonic ISR platform, and the number and function of personnel to operate the system shall be described.

Performance Assessments

Description of the design's capability for the performance requirements shall be provided. Data products shall include, at a minimum:

- A time history of the design mission trajectory (flight performance parameters), including as a minimum, altitude, range, fuel/propellant flow rate, weight, net thrust, lift, drag, velocity, angle of attack and Mach number.

Systems Analysis

The teams shall describe design and analysis techniques, the system design process, data sources (references), assumptions, and derived requirements. Data products shall include, at a minimum:

- Scaled drawing of the vehicle including its dimensions and center of gravity location as well as an inboard profile drawing illustrating sufficient volume for all necessary components and systems.

- Aerodynamic characteristics, propulsion characteristics and weight statement of the recommended design.

- Analysis results to show that the recommended design has sufficient aerodynamic stability and is controllable.

- Analysis results quantifying the aerothermal environment and showing that the design can survive this environment.

- The physical and performance characteristics of the preferred vehicle concept shall be compared to all requirements.

- Documentation of key trade studies and decisions including the methods and rationale for how the final vehicle concept was selected and why it best satisfies the requirements described in this RFP.

Cost Estimate

The total cost of the complete system, to include acquisition, maintenance, and operating cost (per mission), shall be estimated and documented. The estimate should include the cost of the vehicle (tooling, materials, labor, overhead, other expenses and reasonable profit), support equipment unique to the design, supplies to maintain the system, and any other costs. Unique equipment that cannot readily be used for other purposes must be included in the system cost, but the cost of equipment commonly used for other purposes need not be included. Cost of the ISR payload need not be included.

Development Plan

A sequenced development plan shall be described to highlight activities (such as design, test and evaluation) needed to be ready to produce the new components needed for the system. This plan should include details of required ground testing, and a list of the facilities that would be utilized.

Deliverables

A written final design report conforming to the submission guidelines is due for judging as specified below in the AIAA design competition rules. The Imperial system of units shall be used in documentation (feet, lbs., etc.). Metric units (in parenthesis) alongside Imperial unit values are acceptable.

Analysis Tools

All analytical modeling tools, data sources, computer codes, and technical resources used to generate, analyze, model and produce the design and associated report must be:

i.) Available for inspection, download, and/or sale to all individuals and entities regardless of nationality as allowed by US export laws; or

ii.) Generated personally by the students on the team without the use of codes falling under restriction i or substantial material assistance by individuals or entities outside of the team.

Teams are required to list all computer codes used along with the URL where they may be obtained under the conditions above.

Additional Information

All technical questions pertaining to this RFP should be directed to the AIAA MSTC point of contact Peter Cross via email at peter.g.cross@gmail.com or the MSTC design competition subcommittee at aiaaMSTC@gmail.com.

Any updates to this RFP will be posted on the AIAA Design Competitions web site: http://www.aiaa.org/DesignCompetitions/

Updates to the RFP, as well as questions and answers related to the competition and RFP will be posted on the AIAA Engage "Missile Systems: Public Forum" website: https://engage.aiaa.org/space-and-missiles/communities/community-home?CommunityKey=e7efeb09-17d2-4a1f-80f4-7451de96b516