

Request for Proposal

Shoulder-Launched Anti-UAV Missile System

Need

The military services of the United States and its allies maintain a variety of air defense systems to protect against threats such as aircraft and cruise or ballistic missiles. These air defenses may include shoulder- and ground-launched intercept missiles. There is however a gap in defensive capabilities targeting uninhabited aerial vehicles (UAVs), commonly called drones, in groups 1 and 2. These UAVs are significantly smaller in size and detectability than conventional aircraft, and can be operated easily by non-state actors proliferating their use.

Objective

The objective of this project is to design a shoulder-launched anti-UAV missile. The missile can have either lethal or non-lethal means to destroy or disable the UAV. As UAVs are highly maneuverable, the missile should be capable of endgame maneuvers. Participants shall provide engineering analysis and total system design associated with this missile system, including personnel effects. 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 an anti-UAV missile system launched from human shoulder to destroy or disable group 2 UAVs (threshold) and group 1 UAVs (objective). Emphasis should be on maximizing the effectiveness against UAVs while minimizing the system's cost, complexity, and weight.

Top-level requirements for the system are described below:

- The system shall be capable of achieving a threshold range (parallel to ground) of 3.0 nautical miles and an objective range of 3.5 nmi. It shall be capable of achieving a threshold service ceiling of 3,000 ft above ground level (AGL) and an objective ceiling of 5,000 ft AGL. A minimum range is not specified, but collateral ground damage should be considered when analyzing minimum range.
- The entire launch system (launcher + one missile) when fired shall weigh less than 40 pounds. A single launcher and 10 missiles must weigh no more than 125 pounds and

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may be distributed across 3 personnel such that no single individual carries more than 50 pounds.

- The system must be capable operating in a raid scenario. This requires the system to detect, acquire, target, and engage up to 10 UAVs in an hour. For this requirement, you can consider the UAVs evenly spaced in time (1 UAV every 6 minutes for an hour).
- The target system, including fuel and/or propellants, shall be compatible with safe storage, transportation, and handling requirements for at least 10 years without maintenance.
- A warhead (if used) shall not be armed within 200 ft of the launch location.
- The decibel noise level shall not exceed 120dBA within 100ft of the launch location.
- The missile shall not accelerate more than 2g's at launch to reduce personnel injury.
- If desired, a modular system may be designed with a common propulsion system and different types of anti-UAV payloads. Payloads shall be capable of being changed within 5 minutes.
- Assume a production run of 200 missiles and 20 launchers a year for 10 years plus 15 missiles 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 2027.

Teams are encouraged to describe alternate designs and cost sensitivities for enhanced capability beyond the minimum requirements as well as suitability for the system to be adapted to other applications / target sets. For example, the primary target is small group 1 and 2 UAVs, but teams may propose variants of their design capable of engaging other types of aircraft.

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 missile concept clearly and concisely. The proposal shall include pertinent analyses and trade studies supporting the design decisions. A full description of the missile 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. The concept of operation shall include descriptions of how off-board sensors, communication, and other assets (if any) are implemented as well as human-in-the-loop versus automated functions. Additionally, the concept for all support equipment required for transportation, integration, checkout, and operation of the missile system, and the number and function of personnel to set-up and 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.
- The physical and performance characteristics of the preferred vehicle concept shall be compared to all requirements.

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- 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, set-up, and operating cost (per month), 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. Costs for any proposed modifications to existing launch equipment or development of new such equipment must be included. 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.

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.

Deliverables

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

Additional Information

All technical questions pertaining to this RFP should be directed to the AIAA MSTC point of contact Dr. Peter Cross via email at peter.cross@navy.mil 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/>