Request for Proposal (RFP)

High-Volume Low-Cost Cruise Missile

Need

The military services of the United States and its allies have a need for high-volume, low-cost cruise missile designs where production can be readily surged in a wartime environment. While current cruise missile designs exist, inventories are limited and could be rapidly depleted in the early days of a potential conflict. The current lead time for replacing any expended weapons is so long that replacement weapons would not be available to meet the continued need presented by an extended conflict. Additionally, rebuilding inventories of the current weapons systems would be extremely costly. There is therefore a need for a cruise missile system that can be produced quickly and affordably so that a sufficient weapon inventory can be maintained even during a protracted conflict.

Objective

The objective of this project is to design a low-cost cruise missile that can be produced in high volumes. It must also be possible to readily surge production of the missile as needed in a wartime environment. Participants shall provide engineering analysis and total system design associated with this system. 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 low-cost cruise missile that can be produced in high volumes with surge production capability. Emphasis should be on maximizing system performance while meeting system cost, production, and launcher requirements. The goal is to maximize system performance while not exceeding cost requirements. Accurate cost estimation is crucial.

Top-level requirements for the system are described below:

- Missile production cost shall not exceed $500k (2025 basis) per missile.
- Missile should be capable of meeting the following performance metrics:
    - Maximum range: Threshold: 500 nautical miles (nm) launch to impact
    - Cruise speed: Objective: Mach 3+

  - Cruise altitude: Objective: low-level ingress (≤500 ft AGL) for last 10% of range.

- The cruise missile must be capable of being launched from existing launcher systems:
  - Threshold: ship- or land-based Mark 41 vertical launch system
    - Maximum size: 24 inches by 24 inches by 240 inches, 5000 lbm
  - Objective: mobile land-based launchers (e.g., HIMARS, MLRS)
    - Maximum size: 18 inches by 18 inches by 154 inches, 2000 lbm
  - Objective: air-launch from fighter aircraft external carriage(e.g., F-18, F-15)
    - Maximum size: 22 inches by 22 inches by 168 inches, 2000 lbm
  - Objective: air-launch from fighter aircraft internal carriage(e.g., F-35)
    - Maximum size: 15 inches by 15 inches by 144 inches, 2000 lbm
  - Objective: tube-launch from submarines
    - Maximum size: 20 inches diameter by 240 inches, 3500 lbm
  - Assume air-launch is at Mach 0.85 at 30,000 feet, standard day.
  - Size constraints need not apply post-launch.
- Detailed warhead design is not required, but warheads shall be sized such that only a single flight vehicle is needed to neutralize a single target. Targets include:
  - Threshold: unhardened, fixed surface targets, such as airfields, buildings, radar sites, missile launchers, and parked vehicles and aircraft.
  - Objective: moving maritime targets, including support vessels, frigates, and destroyers.
  - Objective: hardened, fixed surface and subsurface targets, such as bunkers.
- The cruise missile design should include command data links for in-flight updates.
- The high-volume, low-cost cruise missile, including energetics and/or propellants, shall be compatible with safe storage, transportation, and handling requirements for at least 10 years without maintenance.
- Assume a production run of 1200 missiles per year for 10 years, plus 100 missiles for developmental testing.

- Production rate must be capable of being surged from 24 missiles per week (1200 per year) to 72 missiles per week (3600 missiles per year) within one week and be maintainable at the elevated rate indefinitely.

For the purpose of determining technology availability and program planning, design and development starts October 2026, and the system initial operational capability (IOC) shall occur no later than December 2031.

Teams are encouraged to describe alternate designs and cost sensitivities for enhanced capability beyond the minimum requirements as well as suitability for the missile system to be adapted to other missions and/or launch platforms.

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.

In case of conflicting or unachievable requirements, teams shall identify which constraints or requirements proved infeasible, clearly explain the trade-offs involved, and provide a solution that attempts to satisfy as many requirements as closely as is feasible.

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 high-volume, low-cost cruise missile system clearly and concisely. The proposal shall include pertinent analyses and trade studies supporting the design decisions. A full description of the high-volume, low-cost cruise missile solution 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 mission timeline. Additionally, the concept for all support equipment required for operation of the high-volume, low-cost cruise missile system 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 missile 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 missile system, including dimensions and center of gravity location as well as an inboard profile drawing illustrating sufficient volume for all necessary components and systems.
- Aerodynamic characteristics, stability, propulsion characteristics, and weight statement of the recommended design.
- Details on the design of the guidance, navigation, and control systems.
- Structural design and analysis, materials selection, and manufacturing techniques.
- Analysis results quantifying the aerothermal environment and showing that the design can survive relevant environments.
- The physical and performance characteristics of the preferred concept shall be compared to all requirements.
- Documentation of key trade studies and decisions including the methods and rationale for how the final 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, shall be estimated and documented. The estimate should include the cost of the missile 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. Identify manufacturing and technology options to lower the cost of various sub-systems and to enable a surge production capability. The cost estimation methods

should be described with an appropriate level of detail, and evidence should be provided supporting the accuracy of the cost estimation methodology.

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 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. The use of generative Artificial Intelligence (AI) is prohibited.

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. The use of generative AI is prohibited.

Competition Timeline

The timeline for the competition will be that posted on the AIAA Design Competitions web site: https://www.aiaa.org/get-involved/students-educators/Design-Competitions. Based on past competitions this timeline will likely be as follows, with specific dates TBD:

- August 2025: Teams may begin working on their design.
- February 2026: Teams submit roster and proposal information via online submission site.
- May 2026: Teams submit proposal via online submission site.
- August 2026: AIAA announces winners.

Additionally, teams are requested to contact the AIAA MSTC point of contact Peter Cross via email to peter.g.cross@gmail.com giving notice of planned participation in the competition at their earliest convenience.

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 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

Teams have the option of requesting mid-term and/or final design reviews with MSTC. Design reviews are completely optional and have no bearing on competition scoring.