

Request for Proposal

Close Air Support Aircraft (A-10 Replacement)

Background

The A-10 Close Air Support (CAS) aircraft is now over 45 years old. While still a very effective CAS aircraft, the A-10 airframes and engines are old. They suffer from fatigue, corrosion, and lack of compatible spare parts. The F-35 may replace some of the A-10's capabilities, but at excessive cost. The Air Force needs an affordable, survivable replacement for the A-10 that can be fielded very quickly. Any required technical development must be completed by the end of 2020. The cost should be kept very low.

Project Objective

This RFP solicits proposals for a new Close Air Support aircraft as a replacement for the A-10. There are two primary roles for this vehicle:

1. To provide continuous airborne armed overwatch (AAO) presence over and close air support (CAS) to regular and special operations ground troops in contact with an enemy force
2. To provide observation, detection, and targeting imagery and of enemy forces and facilities for strikes by other supporting aircraft.

The aircraft must be able to:

1. Operate from unimproved airstrips as short as 6,000 ft long
2. Carry up to 14,000 lb of weapons or other stores on at least 10 stores stations
3. Carry a gun with the ability to kill armored vehicles
4. Carry an electro-optical targeting system capable of providing Category 2 target coordinates
5. Carry an advanced communications array, allowing it to more effectively integrate with ground forces and communicate with command and control elements
6. When fully loaded, be able to provide at least 4 hours of AAO at a 500 nautical mile radius from its operating airfield

General Design Requirements

Crew Station

Crew: 1-2 (if a single pilot is utilized, then the pilot workload must be justified)

Performance: Required Thresholds

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Airborne Armed Overwatch (AAO): 4 hours at 500 nm radius

Mission radius: When carrying a full weapons load, 500 nm when providing 4 hours of AAO

Weapons payload: 1x 35mm cannon with 750 rounds, and 14,000 lb of stores

Max speed: 300 knots true airspeed (KTAS)

Cruise Speed: At least 200 KTAS

Ceiling: 45,000 ft

Minimum Runway Length: 6,000 ft (the sum of takeoff and abort distance with 3-second delay between acceleration to takeoff speed and braking to stop without arresting gear)

Assume ICAO hot day, 5,000-ft field elevation

Maximum design load factor: 8 g

Objective Function

Grade vehicle design trades against the following objective function:

$$OF = [(Actual\ Range\ with\ 4\ hrs\ AAO)/(500\ nm)]^2 + [Actual\ Dash\ Speed/(300\ KTAS)]^2 + [Actual\ Cruise\ Speed/(200\ KTAS)]^2 + [\$40M / (Actual\ Fly-Away\ Cost)]^2 + [\$3000/hour / (Actual\ Direct\ Operating\ Cost)]^2 + [6,000\ ft / (Fully\ Loaded\ Minimum\ Runway\ Length)]^2 + [(Max\ Positive\ Load\ Factor\ with\ 50\%\ Internal\ Fuel,\ Gun,\ and\ Gun\ Ammo)/8]^2 + Observable$$

(= 0 if missiles/sensor pod/ gun/fuel tanks are externally carried, 1 otherwise)

Choose the vehicle design that maximizes the objective function.

Each term in the objective function should be preceded by a weighting factor. Part of the design task is to determine values for these weighting functions that represent the Air Force's (and Army's) needs and desires. The A-10 could be used to determine a minimum objective function value. The goal is to improve as much as possible on that value while minimizing cost.

Miscellaneous

Compliance with military specifications and requirements (MIL-SPECs) is required.

Entry into service date: 2025

Specific emphasis should be placed on the following analyses:

- Fly-away and direct operating cost estimation
- Alternate mission considerations
- Systems selection (adapt existing systems wherever possible)
- Technology development plans (including projected budgets and schedules)
- Risk reduction plans (in case technology development fails)

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- Layout (primary and secondary controls - powered and/or unpowered, pressurization, anti-icing, hydraulics, avionics)

Other items expected to be covered include:

- Weight and balance estimation
- Aircraft sizing and configuration selection
- Aerodynamic design
- Mission analysis
- Structural layout and sizing
- Stability and handling qualities
- Propulsion integration

The technical proposal must convincingly demonstrate that the design can satisfy the design performance requirements, while coming in at empty weights that will meet the cost requirements. The proposal should satisfy the following tasks to show how the design would be developed.

1. Justify the final design, and describe the technologies, engine selection and technical approach used to meet the mission requirements
2. Provide carpet plots used to finalize the final selected design
3. Include a dimensioned three-view general arrangement drawing
4. Include an inboard profile showing the general internal arrangement
5. Include an illustrated description of the primary load bearing airframe structure, and state rationale for material selection
6. Show an estimated drag build-up and drag polar for the cruise configuration, the take-off configuration, and the landing configuration
7. Show a weight breakdown of the major components and systems and center-of-gravity travel.
8. Provide performance estimates
9. Demonstrate aircraft stability for all flight and loading conditions.
10. Describe any advanced technologies or design approaches and their relative benefits as used to obtain performance improvements. Address risk mitigation if these technologies fail to materialize, including cost increase and performance decrements.
11. Provide flyaway cost and life cycle cost estimates for production runs of 500 and 1500 units.

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12. Discuss how the objective function drove various design decisions, how weighting factors for each objective function term were chosen and what constraints, if any needed to be added.

Additional Contacts

All technical questions pertaining to this RFP should be directed to Steve Brandt via e-mail at: steve.brandt@usafa.edu.

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

Design Competition Rules

Eligibility Requirements

- All AIAA Student members are eligible and encouraged to participate. Membership with AIAA must be current to submit a report and to receive any prizes.
- Students must submit their letter of intent and final report via the online submission to be eligible to participate. **No extensions will be granted.**
- More than one design may be submitted from students at any one school.
- If a design group withdraws their final report from the competition, the team leader must notify AIAA Headquarters immediately.
- Design projects that are used as part of an organized classroom requirement are eligible and encouraged for competition.

Schedule

- Letter of Intent — 10 February 2018 (11:59 pm Eastern Time)
- Proposal delivered to AIAA Headquarters — 10 May 2018 (11:59 pm Eastern Time)
- Announcement of Winners — 31 August 2018 (11:59 pm Eastern Time)
 - Engine Design Competition dates
 - Letter of Intent – 14 February 2018 (11:59 pm Eastern Time)
 - Proposal submitted, via online submission site to AIAA Headquarters – 16 May 2018 (11:59 pm Eastern Time)
 - Round 1 evaluations completed – 30 June 2018 (11:59 pm Eastern Time)

Round 2 presentations at AIAA Propulsion and Energy Forum 2018

Categories/Submissions

- Team_Submissions
 - Team competitions will be groups of not more than ten AIAA Student Members per entry.
- Individual_Submissions
 - Individual competitions will consist of only one AIAA Student member per entry.

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- Graduate
 - Graduate students may participate in the graduate categories only.
- Undergraduate
 - Undergraduate students may participate in the undergraduate categories only.
- Letter of Intent (LOI)
 - A Letter of Intent indicating interest in participating in the design competitions is required before submitting a final report.
 - All Letters of Intent must be submitted through the online submission system.
 - Letter of Intent must include student's names, emails, AIAA membership numbers, faculty advisor(s) names, emails, and project advisor(s) names and emails.
Incomplete LOI's will result in the Team or Individual being ineligible to compete in the competition.
- Submission of Final Design Report

Each team or individual must provide an electronic copy their design report as outlined below to the online Submission site

 - An electronic copy of the report in Adobe PDF format must be submitted to AIAA using the online submission site. Total size of the file cannot exceed 20 MB.
 - Electronic report files must be named: "2018_[university]_DESIGN_REPORT.pdf"
 - A "Signature" page must be included in the report and indicate all participants, including faculty and project advisors, along with students' AIAA member numbers and signatures.

 - Electronic report should be no more than 100 pages, double-spaced (including graphs, drawings, photographs, and appendices) if it were to be printed on 8.5"x11.0" paper, and the font should be no smaller than 10 pt. Times New Roman.
 - Engine Design Competition is limited to 50 pages.

Copyright

All submissions to the competition shall be the original work of the team members.

Authors retain copyright ownership of all written works submitted to the competition. By virtue of participating in the competition, team members and report authors grant AIAA non-exclusive license to reproduce submissions, in whole or in part, for all of AIAA's current and future print and electronic uses. Appropriate acknowledgment will accompany any reuse of materials.

Conflict of Interest

It should be noted that it shall be considered a conflict of interest for a design professor to write or assist in writing RFPs and/or judging proposals submitted if (s)he will have students participating in, or that can be expected to participate in those competitions. A design professor with such a conflict must refrain from participating in the development of such competition RFPs and/or judging any proposals submitted in such competitions.

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Awards

The prize money provided for the competitions is funded through the AIAA Foundation. The monetary awards may differ for each competition, with a maximum award of \$1,000. The award amounts are listed below.

The top three design teams will be awarded certificates. One representative from the first place team *may be* invited by the Technical Committee responsible for the RFP to make a presentation of their design at an AIAA forum. A travel stipend *may be* available for some competitions, with a maximum travel stipend of \$750 which may be used to help with costs for flight, hotel, or conference registration to attend an AIAA forum.

Aircraft Design Competitions

- Graduate Team Aircraft - Advanced Pilot Training Aircraft
- Undergraduate Team Aircraft – Hybrid-Electric General Aviation Aircraft (HEGAA)
 - 1st Place: \$500; 2nd Place: \$250; 3rd Place: \$125
- Undergraduate Individual Aircraft – Close Air Support Aircraft (A-10 Replacement)
 - 1st Place: \$1,000; 2nd Place: \$500; 3rd Place: \$300

Engine Design Competition

- Undergraduate Team Engine –Candidate Engines for a Next Generation Supersonic Transport
 - 1st Place: \$500; 2nd Place: \$250; 3rd Place \$125

Space Transportation Competition

- Undergraduate Team Space Transportation – Pluto Orbiter
 - 1st Place: \$500; 2nd Place: \$250; 3rd Place: \$125

Space Design Competition

- Undergraduate Team Space Design – Lunar Prospecting
 - 1st Place: \$500; 2nd Place: \$250; 3rd Place: \$125

Structures Design Competition

- Graduate Team Structures – Fuselage Design
- Undergraduate Team Structures – Supersonic Wing
 - 1st Place: \$500; 2nd Place: \$250; 3rd Place: \$125

Proposal Requirements

The technical proposal is the most important factor in the award of a contract. It should be specific and complete. While it is realized that all of the technical factors cannot be included in advance, the following should be included:

- Demonstrate a thorough understanding of the Request for Proposal (RFP) requirements.
- Describe the proposed technical approaches to comply with each of the requirements specified in the RFP, including phasing of tasks. Legibility, clarity, and completeness of the technical approach are primary factors in evaluation of the proposals.
- Particular emphasis should be directed at identification of critical, technical problem areas. Descriptions, sketches, drawings, systems analysis, method of attack, and discussions of new techniques should be presented in sufficient detail to permit engineering evaluation of the proposal. Exceptions to proposed technical requirements should be identified and explained.
- Include tradeoff studies performed to arrive at the final design.
- Provide a description of automated design tools used to develop the design.

Basis for Judging

The AIAA Technical Committee that developed the RFP will serve as the judges of the final reports. They will evaluate the reports using the categories and scoring listed below. The judges reserve the right to not award all three places. Judges' decisions are final.

1. Technical Content (35 points)

This concerns the correctness of theory, validity of reasoning used, apparent understanding and grasp of the subject, etc. Are all major factors considered and a reasonably accurate evaluation of these factors presented?

2. Organization and Presentation (20 points)

The description of the design as an instrument of communication is a strong factor on judging. Organization of written design, clarity, and inclusion of pertinent information are major factors.

3. Originality (20 points)

The design proposal should avoid standard textbook information, and should show the independence of thinking or a fresh approach to the project. Does the method and treatment of the problem show imagination? Does the method show an adaptation or creation of automated design tools?

4. Practical Application and Feasibility (25 points)

The proposal should present conclusions or recommendations that are feasible and practical, and not merely lead the evaluators into further difficult or insolvable problems.