Request for Proposal
Thin Haul Transport and Air Taxi

Opportunity Description
It is not economically feasible (even with the Essential Air Service program) for established airlines operating large aircraft to serve the majority of the thousands of airports (and potential routes) in the United States. Many of the routes that can support service by airlines can only do so at very low frequency, diminishing the value to passengers. Many carriers have found a solution in using smaller airports either with higher-frequency scheduled flights with smaller aircraft or by offering an on-demand air taxi service. Despite the higher per-seat-mile cost of operating smaller aircraft, demand has been shown to increase on routes once a reasonable frequency and availability can be achieved.

Project Objective
The objective of the project is to design a domestic transport aircraft for these ‘thin haul’ scheduled or on-demand operations servicing small airports and short routes. Special consideration should be given to vehicle aspects, such as boarding and egress, that improve the passenger experience and ease the adoption barriers to travel in small aircraft. You may also consider additional markets such as personal ownership, EMS, and/or logistics/cargo, but your primary objective should be to develop a platform with low direct operating costs and that maximizes profits for operators when compared against alternatives such as the Piper PA-46, Cirrus SR22, and similar.

Requirements and Constraints
● Planned certification to 14 CFR Part 23; certification level: 2, performance level: low speed
● If reciprocating engine powered, must either be multi-engined or have a full-aircraft parachute
● Since operations take place in smaller communities, must meet single-engine noise limits per Part 36 Sec. G36.301(c), even if multi-engined
● Certification / entry into service: 2025; all technologies employed must have achieved demonstration of an actual system prototype in an operational environment, i.e., on an aircraft (TRL 7+)
● Payload: Four passengers / 800 lbs (175 lbs + 25 lbs baggage per passenger)
● Crew: Single pilot / 180 lbs

It is not required to explore deviations from these requirements. However, the following deviations may be explored and utilized if justified by cost (development and/or operating), operational, and/or other considerations:
● As few as two or as many as six passengers; in the case of two or three passengers, payload is 180 lbs + 30 lbs baggage per passenger
● Increasing automation to the extent of elimination of the on-board pilot
● Electric or hybrid propulsion, as long as the following realistic limits are used:
○ At the pack level (including packaging and management), no battery specific energy greater than \(285 \, \text{W} \cdot \text{hr/kg} = P \times 85 \, \text{s} \), where \(P\) is pack peak specific power
○ Minimum 250 USD per kW-hr battery pack overhaul cost (includes salvage value of cells) every 1000 cycles (or equivalent sum of partial cycles)
○ Minimum 0.10 USD/kW-hr cost of electricity

**Mission profiles**

Missions are flown at ISA+0, zero wind conditions, with sea level field elevation for takeoffs and landings.

**Reference mission**

This is the expected typical mission flown in operations an average of twenty times per week. The reference mission is flown at 50% passenger capacity (½ payload weight).

Mission profile:
1. Warm up and taxi for 10 min.
2. Take off over 50’ obstacle in ≤ 2500 ft
3. Climb to cruise altitude, with range credit
4. Cruise
5. Descend to sea level, with range credit
6. Land over 50’ obstacle in ≤ 2500 ft, with fuel/energy on board remaining sufficient for:
   a. Climb to 3000 ft
   b. Loiter a best endurance speed for 45 minutes
   c. Descend to sea level (no loiter time credit)
   d. Landing
7. 10 min. taxi and shutdown

Total range of flight (segments 3-5) ≥135 nmi
Average ground speed (segments 3-5) ≥180 ktas (total flight time ≤45 minutes)

**Sizing mission**

The aircraft must also be able to complete a long-range sizing mission, which is the same as the reference mission with the following modifications:

- Full payload
- Total range of flight (segments 3-5) ≥250 nmi
- No speed/flight time requirement

**Design Data Requirements**

The technical proposal must clearly and concisely present the design of the aircraft covering all relevant aspects, features, and disciplines. Pertinent analyses and studies supporting design choices must be presented with sufficient detail. A full description of the aircraft is expected along with performance capabilities and operational limits. These include, at a minimum:
1. Aircraft weight statement; aircraft center-of-gravity envelope reflecting relevant payload and fuel allocations and limits for safe flight.
2. Materials selection for main structural groups and general structural design, including layout of primary airframe structure.
3. Complete geometric description, including clearances, control surfaces, and internal arrangement of passengers, payload, and crew. 3-views, internal arrangements, and 3-D model imagery of appropriate quality are expected.
4. Important characteristics and performance descriptions for key mission segments during the design mission (including but is not limited to: segment altitude, L/D, velocity, rate-of-climb, duration, fuel consumption, etc.), including takeoff and landing performance.
5. Performance flight envelope, payload-range, and V-n diagrams.
7. Summary of basic stability and control characteristics; this should include, but is not limited to static margin, pitch, roll and yaw derivatives.
8. Cost estimates and business case analysis, including variable cost for reference mission, direct operating costs for the reference mission, and production cost per unit at 500, 1000, and 2000 units.

The students are to develop and present the alternative concepts considered leading to the down-select of their preferred concept. The methods and rationale used for the down select shall be presented. At a minimum, a qualitative assessment of strengths and weaknesses of the alternatives shall be given, discussing merits leading to a justification as to why the preferred concept was the best proposal response. Quantitative justification of why the selected proposal is the best at meeting the proposal measures of merit(s) will strengthen the proposal. In addition, the submittal shall include the major trade studies conducted justifying the optimization, sizing, architectural arrangement and integration of the specifically selected proposal concept. Quantitative data shall be presented showing why the concept "works" and is the preferred design compromise that best achieves the RFP.

References

Essential Air Service
14 CFR Part 23
14 CFR Part 23, Amdt. 64 (useful reference tool for Amdt. 65+ means of compliance)
Cape Air testimony and data supporting increased demand with higher frequency service
Centaur
Alpha Electro
Operators:
- ImagineAir
- Skyway Air Taxi
- Linear Air
- Surf Air
- Cape Air
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 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 2019 (11:59 pm Eastern Time)
- Proposal delivered to AIAA Headquarters — 10 May 2019 (11:59 pm Eastern Time)
- Announcement of Winners — 31 August 2019 (11:59 pm Eastern Time)
  - Engine Design Competition dates
    - Letter of Intent – 14 February 2019 (11:59 pm Eastern Time)
    - Proposal submitted, via online submission site to AIAA Headquarters – 16 May 2019 (11:59 pm Eastern Time)
    - Round 1 evaluations completed – 30 June 2019 (11:59 pm Eastern Time)

Round 2 presentations at AIAA Propulsion and Energy Forum 2019

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.
- 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.
  - Letters 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 25 MB.

Electronic report files must be named: “2019_[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.

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.

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 $1,000 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 – Electric Vertical Takeoff and Landing (E-VTOL) Aircraft
  - 1st Place: $500; 2nd Place: $300; 3rd Place: $250
- Undergraduate Team Aircraft – Thin Haul Transport and Air Taxi
  - 1st Place: $500; 2nd Place: $300; 3rd Place: $250
- Undergraduate Individual Aircraft – Power Line Survey Unmanned Aircraft Systems
  - 1st Place: $1,000; 2nd Place: $500; 3rd Place: $300

Engine Design Competition
- Undergraduate Team Engine – Candidate Engines for Hybrid Electric Medium Altitude Long Endurance Search and Rescue UAV
  - 1st Place: $500; 2nd Place: $300; 3rd Place: $250

Space Design Competition
• Undergraduate Team Space Design – Reusable Lunar Surface Access Vehicle
  o 1st Place: $500; 2nd Place: $300; 3rd Place: $250

**Structures Design Competition**

- Graduate Team Structures – Design of the Structure for a VTOL Taxi
- Undergraduate Team Structures – Design of Deployable Solar Array Structure
  o 1st Place: $500; 2nd Place: $300; 3rd Place: $250

**Missile Systems Design Competition**

- Undergraduate Team Missile Systems - Design of a Long Range Strategic Missile
  o 1st Place: $500; 2nd Place: $300; 3rd Place: $250

**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.