Arctic STOL Aircraft

Request for Proposal

2025-2026 Graduate Team Aircraft Design Competition
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1. OPPORTUNITY DESCRIPTION

Harsh climate and living conditions make it very difficult for people to live north of the Arctic Circle. Nevertheless, approximately 4 million people currently live there. These people typically live in small remote communities and have a need for aircraft for transportation, goods, and emergency medical services. Aircraft that operate in this difficult environment encounter gravel fields and unprepared landing surfaces, quick weather changes, extremely cold temperatures, and cold, wet conditions.

2. PROJECT OBJECTIVE

The objective of this project is to design a new, affordable, aircraft that will operate north of the Arctic Circle with Short Take-Off and Landing (STOL) field capability to serve small communities by providing transportation of people and goods and emergency medical services. Special consideration should be given to the aircraft features, such as boarding, egress, and cargo loading that improves the passenger and operator experience. The aircraft must reliably operate in the extreme environmental conditions that exist north of the Arctic Circle including icing conditions, cold weather, and with minimal supporting infrastructure. The primary objective should be to develop a robust platform with low direct operating costs to maximize profits for operators.

3. DESIGN REQUIREMENTS AND CONSTRAINTS

3.1 General Design Requirements and Constraints

- Certification:
    - Planned certification to 14 CFR Part 23
    - Certification and entry into service (EIS) shall be no later than 2033.
        - All subsystem technologies should have achieved Technology Readiness Level (TRL) 6+, i.e., demonstration of an actual system prototype in an operational environment.
        - If technologies have not yet achieved TRL 6+, risk statements with mitigations should be included.
    - Must be certified for flight into known icing (FIKI) conditions

- Configurations and Payload Capacity
    - The aircraft shall be reconfigurable and capable of carrying the following payloads:
    - Configuration 1 - Passenger transport
        - 9 passengers / 2,250 lb (200 lb + 50 lb baggage per passenger)
        - Minimum 31” seat pitch
    - Configuration 2 - Cargo transport:
        - Cargo weight equivalent to the 9-passenger configuration (2,250 lb + weight of the removable seats)
        - Must be capable of transporting a 8,000 watt generator and 55 gallons of diesel fuel (in no more than 3 containers, preferably one)
    - Configuration 3 - Aerial Ambulance
        - 1 litter (50 lb stretcher), 4 passengers (2 medical technicians, 1 patient, 1 patient escort, all 200 lb each), 300 lb of additional medical supplies & equipment: 1,150 lb total

- Crew
    - 2 pilots / 400 lb (180 lb each + 20 lb baggage per pilot)

- Propulsion
    - The aircraft may be of single or multi-engine design
    - The engine(s) for the proposed aircraft shall be an existing production design or able to be certified by 2030

- Operations and Performance
    - Must be capable of cold weather operations down to -30° F
    - Pressurization is not required, but is allowed if justified
    - Must be capable of operating on gravel runways
    - Capability to take off and land on other types of unprepared surfaces is desirable
    - Service Ceiling ≥ 18,000 ft
    - Rate of Climb ≥ 800 ft/min at MTOW, ISA+5
    - Maximum velocity (VNE) ≥ 180 KTAS

Any deviations from the requirements listed in this document must be justified by considerations relating to cost (development and/or operating) or operations.

3.2 Mission Requirements

Missions are flown at ISA+5, zero wind conditions, with sea level field elevation for takeoffs and landings.

Reference mission

The reference mission is the expected typical mission flown an average of ten times per week and should be used to optimize and assess operating costs The reference mission is flown at 90% payload weight in Configuration 1. Aircraft will operate on both asphalt and gravel (unpaved) runways at all times of the year. Account for summer and winter runway conditions in the TOFL predictions.

Mission profile:

1. Warm up and taxi for 10 min.
2. Take off over 50’ obstacle in ≤ 500 ft
3. Climb to cruise altitude
4. Cruise
5. Descend to sea level
6. Land over 50’ obstacle in ≤ 500 ft, with fuel/energy on board remaining sufficient for:
    a. Climb to best loiter altitude
    b. Loiter at best endurance speed for 45 minutes
    c. Descend to sea level
7. 10 min. taxi and shutdown

- Total range of flight segments 3-5 ≥ 450 nmi
- Average ground speed segments 3-5 ≥ 130 ktas
- No altitude requirements for cruise

Medevac mission

The Medevac mission is flown in Configuration 3. The total mission time for the round-trip flights must be minimized to improve likelihood of positive health outcomes for the patient. Refueling at the patient pick-up location is not available, therefore the aircraft must carry enough fuel to complete outbound and inbound flights, including the ability to loiter on both. Assume the use of gravel runways in both locations.

Outbound Flight

1. Warm up and taxi for 10 min.
2. Take off over 50’ obstacle in ≤ 500 ft
3. Climb to cruise altitude
4. Cruise
5. Descend to sea level
6. Land over 50’ obstacle in ≤ 500 ft, with fuel/energy on board remaining sufficient for:
    a. Climb to best loiter altitude
    b. Loiter at best endurance speed for 45 minutes
    c. Descend to sea level
    d. Inbound flight including loiter segments (13a-13c)
7. 10 min. taxi and shutdown

- Total range of flight segments 3-5 ≥ 350 nmi
- No speed or altitude requirements for cruise
- Outbound flight is flown with a full suite of medical equipment and stretcher on board, as well as two medical technicians
- Assume a 45-minute turnaround time for assessing and loading the patient and patient escort on board when calculating the total mission time

Inbound Flight

8. Warm up and taxi for 10 min.
9. Take off over 50’ obstacle in ≤ 500 ft
10. Climb to cruise altitude
11. Cruise

12. Descend to sea level
13. Land over 50’ obstacle in ≤ 500 ft, with fuel/energy on board remaining sufficient for:
    a. Climb to best loiter altitude
    b. Loiter at best endurance speed for 45 minutes
    c. Descend to sea level
    d. Loiter segments (6a-6c) on outbound flight
14. 10 min. taxi and shutdown

- Total range of inbound flight segments 10-12 must equal the range of outbound flight segments 3-5, and be ≥ 350 nmi
- No speed or altitude requirements for cruise
- Inbound flight is flown with a full suite of medical equipment and stretcher on board, as well as two medical technicians, a patient, and a patient escort
- Total mission time should be calculated as the time required for the outbound flight (without loiter segments 6a-6c), the 45-minute turnaround time, plus the inbound flight (without loiter segments 13a-13c)

4. Report 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, cargo, 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 not limited to: segment altitude, L/D, velocity, rate-of-climb, duration, fuel consumption, etc.), including takeoff and landing performance as well as flight into icing.
5. Performance flight envelope, payload-range, and V-n diagrams.
6. Propulsion system description and characterization of propulsion performance (including impacts of system operation).
7. Summary of basic stability and control characteristics including, but not limited to static margin, pitch, roll and yaw derivatives.
8. A discussion of the cruise speed and altitude trades and justification of the values chosen for development of the concept.
9. Discussion of equipment, technologies and/or concepts to improve passenger experience and technology acceptance (this may include, but is not limited to approaches to: reduce cabin noise, improve aircraft ride quality, safety, survivability, decrease manufacturing and operating costs)
10. Discussion of equipment, technologies and/or concepts included in the design to enable reliable operation in icing and cold weather conditions.
11. 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 200, 500, and 1000 units.

The proposal response must include trade documentation on the two major aspects of the design development: the concept selection trades and the concept development trade studies.

A) The team shall 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 must be included. 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 is 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.
B) In addition, the report 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 their concept 'works' and is the preferred design compromise that best achieves the requirements of the RFP.

Specific analysis and trade studies of interest sought in proposals include:

1. Mission performance and sizing for the mission profiles.
2. Overall aircraft concept selection (airframe and propulsion system) vs. design requirements objectives

All concept and technology assumptions must be reasonable and justified for the EIS year.

5. Reference Material

- ASTM F3120: https://store.astm.org/f3120_f3120m-20.html