**New Efficient Water and Terrestrial (NEWT) Aircraft**
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**Background**
Island nations and developing countries often have limited resources and land to create airports. Air passenger and cargo commerce can be useful in the economic development of outlying communities. Many of these communities do have access to bodies of water or short runways that could be used to transport passengers or cargo. There are also niche markets that could benefit from this type of aircraft (shuttle services for commuters in cities like Seattle, New York etc. where existing airports are a considerable distance from the city center).The current aircraft designs that serve these markets include the Twin Otter, Beaver, Otter and Cessna Caravan that can be put on amphibious floats. They are limited in size to less than 20 passengers and, as conversions of land planes, are not optimized for amphibious operations. Purpose-built amphibians include the Seastar, US-2, Be-200 and Bombardier 415.

This Request for Proposal (RFP) is for the design of an amphibious aircraft capable of both passenger and cargo missions. The entry into service (EIS) is 2031 for the passenger model.

Most aircraft manufacturers create a product that can cover the largest number of missions and markets with a minimum of non-recurring development costs and changes to a design. The requirements for this RFP specify both a passenger mission and a cargo mission that must be met with the same basic airframe.

**Requirements** (M) = Mandatory Requirement (T) = Tradable requirement

- **General Requirements**
  - (M) Capable of taking off and landing from runways (dirt, grass, metal mat, gravel, asphalt & concrete)
  - (M) Capable of taking off and landing from fresh and salt water
  - (M) Minimum cruise speed of 200 knots
    - (T) Target cruise speed: 250 knots or greater
  - (M) Capable of VFR and IFR flight
  - (M) Capable of flight in known icing conditions
  - (M) Meets applicable certification rules in FAA 14 CFR Part 23
    - All missions below assume reserves and equipment required to meet applicable FARs
  - (M) Mission energy cost per passenger at least 20% better than an existing aircraft on a similar mission length
    - Economic mission of 150 nmi in a single-class configuration
  - (M) Engine/propulsion system assumptions documented and the use of an engine that will be in service by 2031.
    - Document assumptions on, at a minimum, specific energy consumption/efficiency, thrust/power and weight should be specified
- **Design Passenger Missions**
  - (M) Crew: 1 flight crew
  - (M) Passenger capacity: 19 at a 28” or greater seat pitch
  - Passenger and baggage weight assumptions
    - Passenger weight of 193.6 lb (88 kg)
    - Baggage weight per passenger 37.4 lb (17 kg) and volume of at least 4 cubic feet (0.113 cubic meters) per passenger
  - (M) 250 nmi Short TakeOff and Landing (STOL) runway mission with 19 passengers
    - Maximum takeoff and landing field lengths of 1,500’ over a 50’ obstacle to a runway with dry pavement (sea level ISA + 18$^{o}$ F day).
    - Takeoff, and landing performance should also be shown at 5,000’ above mean sea level (ISA + 18$^{o}$ F) as well as for dirt, grass, metal mat, gravel, asphalt & concrete fields at sea level (ISA+18$^{o}$ F).
  - (M) 250 nmi Short TakeOff and Landing (STOL) water mission with 19 passengers

        - Maximum takeoff distance of 1,900 (sea level ISA + 18º F day) over a 50' obstacle.
        - Takeoff, and landing performance should also be shown at ISA + 18º F at 5,000' MSL (ISA+18º F).
            - This is to show performance into and out of a mountain lake
        - (M) Ability to takeoff and land in Sea State 3 conditions
- **Design Cargo Mission**
    - (M) 5,000 lb (2,268 kg) payload
    - (M) 200 nmi range
        - Show takeoff and landing field lengths over a 50' obstacle to a runway with dry pavement (sea level ISA + 18º F day).
        - Show takeoff and landing field lengths from water (sea level ISA + 18º F day).
    - (M) Ability to unload, refuel (or re-energize) and load cargo in no more than 60 minutes
- **Economic Mission**
    - (M) 19 passenger payload
        - Passenger weight of 193.6 lb (88 kg)
        - Baggage weight per passenger 37.4 lb (17 kg)
    - (M) 150 nmi range
    - Mission characteristics (altitude, etc.) optimized for minimum energy cost
        - Minimum cruise speed of 200 knots

**Other features and considerations**
- Flying qualities should meet CFR Part 23
- Identify all systems functionality and components that are required for the aircraft to operate in both controlled and uncontrolled airspace.
- Identify, at a high level, flight deck system components and functionality that enable single pilot operations
- List the equipment required to conduct passenger missions

**Design Objectives**
- Minimize production cost by choosing materials and manufacturing methods appropriate for the annual production rate that is supported by the team's assessment of the potential market size.
- Make the aircraft visually appealing so it will be marketable and identify what features are important to the operators for different missions

**Notes and assumptions:**
- Assume an EIS of 2031 when making technology decisions

**Proposal and Design Data Requirements**

The technical proposal shall present the design of this aircraft clearly and concisely; it shall cover all relevant aspects, features, and disciplines. Pertinent analyses and studies supporting design choices shall be documented.

Full descriptions of the aircraft are expected along with performance capabilities and operational limits. These include, at a minimum:

1. A description of the design missions defined for the proposed concepts for use in calculations of mission performance as per design objectives. This includes the selection of cruise altitude(s) and cruise speeds supported by pertinent trade analyses and discussion.
2. Aircraft performance summaries shall be documented and the aircraft flight envelope shall be shown graphically.
3. Payload range chart(s)
4. A V-n diagram for the aircraft with identification of necessary aircraft velocities and design load factors.
    a. Required gust loads are specified in Federal Aviation Regulations (FAR) Part 25.
5. Materials selection for main structural groups and general structural design, including layout of primary airframe structure as well as the strength capability of the structure and how that compares to what is required at the ultimate load limits of the aircraft. The maximum dive speed of the aircraft shall be specified.
6. Complete geometric description, including dimensioned drawings, control surfaces sizes and hinge locations, and internal arrangement of the aircraft illustrating sufficient volume for all necessary components and systems.
    a. Scaled three-views (dimensioned) and 3-D model imagery of appropriate quality are expected. The three-view must include at least:
        i. Fully dimensioned front, left, and top views
        ii. Location of aircraft aerodynamic center (from nose)
        iii. Location of average CG location (relative to nose)
        iv. Tail moment arms
    b. Diagrams and/or estimates showing that internal volume requirements are met, including as a minimum the internal arrangements of the passenger, cargo and maritime surveillance variants.
        i. Cross-section showing passenger and cargo configuration
        ii. Layout Of Passenger Accommodations (LOPA) for 28” pitch single class
        iii. Layout of cargo and size and location of any unique cargo doors
        iv. Fuselage centerline diagram
    c. Diagrams showing the location and functions for all aircraft systems.
    d. Figure showing the waterline and center of buoyancy at maximum taxi weight for both forward and aft CG conditions.
7. Important aerodynamic characteristics and aerodynamic performance for key mission segments and requirements
8. Aircraft weight statement, aircraft center-of-gravity envelope reflecting payloads and energy weight allocation. Establish a forward and aft center of gravity (CG) limits for safe flight in the normal categories.
    a. Weight assessment summary shall be shown at least at the following level of detail:
        i. Propulsion
        ii. Airframe Structure
            1. Wing
            2. Empennage
            3. Landing Gear
            4. Fuselage
        iii. Control systems
        iv. Payloads
        v. Systems
            1. Instruments and Avionics
            2. Fuel/oil (battery if electric)
            3. Hydraulic/pneumatic/electrical systems (if chosen)
9. Propulsion system description and characterization including performance, dimensions, and weights. The selection of the propulsion system(s), sizing, and airframe integration must be supported by analysis, trade studies, and discussion
10. Summary of basic stability and control characteristics; this should include, but is not limited to, static margin.
11. Summary of cost estimate and a business case analysis. This assessment should identify the cost groups and

drivers, assumptions, and design choices aimed at the minimization of production costs.

   a. Estimate the non-recurring development costs of the airplane including engineering, FAA/EASA certification, production tooling, facilities, and labor
   b. Estimate the fly away cost of each member of the family
   c. Estimate of direct operating cost per airplane flight hour

12. Lifecycle emissions analysis, which includes:
    a. Emissions associated with aircraft production
    b. In-service emissions
       i. Analysis should include key greenhouse gases such as Carbon Dioxide and Nitrous Oxide

The proposal response will include trade documentation on the two major aspects of the design development, a) the concept selection trades, and b), the concept development trade studies.

A) The student is 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 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 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 their concept 'works' and is the preferred design compromise that best achieves the RFP

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

1. Mission performance and sizing for the definition of a 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.

**Procured Data**

No data is procured as part of this RFP.

**Reference Material**

- Passenger and baggage weight assumptions
  - https://www.easa.europa.eu/sites/default/files/dfu/Weight%20Survey%20R20090095%20Final.pdf

- 14 CFR Part 23
  - https://www.ecfr.gov/cgi-bin/text-idx?SID=77b75e4594e5c1b7992d66b816d9f3c6&mc=true&tpl=/ecfrbrowse/Title14/14cfr23_main_02.tpl

**Representative Amphibian Aircraft Designs**
http://www.shinmaywa.co.jp/aircraft/english/us2/ (ShinMaywa US-2)
https://en.wikipedia.org/wiki/Beriev_Be-200 (Beriev Be-200)
http://www.bombardier.com/en/aerospace/amphibious-aircraft/bombardier-415.html (Bombardier 415)
http://www.dornierseawings.com/ (Seastar)
http://www.vikingair.com/viking-aircraft/dhc-6-twin-otter (Twin Otter)
http://cessna.txtav.com/caravan/caravan-amphibian (Caravan Amphibian)