Request for Proposal

Responsive Aerial Fire Fighting Aircraft

Background

With continued changes to the planet's climate, the number and intensity of wildfires continues to increase, posing ever larger threats to life and property both within the United States and around the world. Researchers anticipate this trend to continue for the next 50-100 years as temperatures rise, weather events become more extreme, and regional drying continues. In addition to increasing need, technology available today enables more effective fire responses. There has never been a better time to design and produce specialized aircraft for wildfire response, keeping in mind the proposed solution must be affordable by the various Government agencies and their contractors that are potential customers.

The majority of the aircraft currently in service for firefighting purposes are modified commercial or military airframes. Internal or external equipment is integrated onto the airframes, but compromises and inefficiencies are created due to the differences in aerial firefighting payload delivery compared to the aircrafts' original design missions. The density of fire retardant creates substantial structural loads on key parts of the airframe. These high loads are exacerbated by the extreme maneuvers required when delivering the fire retardant. The purpose-built designs could trade robust structural designs with easily repairable/replaceable structures at a potential weight savings.

Requirements: [R] = Mandatory Requirement [O] = Objective or Goal, Tradeable

General Requirements

- Entry Into Service (EIS)
  - [R] 2030
  - [R] Use existing engine(s) or one that is in development will be in service by 2028, or at least two years prior to the airplane EIS.
  - [R] Assumptions on at least specific fuel consumption/efficiency, thrust/power and weight must be documented.
- Fire Retardant Capacity
  - [R] 4,000 gal
  - [O] 8,000 gal
  - [R] Multi-drop capable; minimum 2,000 gal per drop
  - [R] Fire retardant reload >= 500 gal / min
  - [R] Retardant density of at least 9 lbs / gal
- Payload Drop
  - [R] Drop speed <= 150 kts
  - [O] Drop speed <= 125 kts
  - [R] Drop altitude <= 300 ft AGL

- Design Radius with Full Payload
  - [R] 200 n mi
  - [O] 400 n mi
- Design Ferry Range (No Payload)
  - [R] 2,000 n mi
  - [O] 3,000 n mi
- Dash Speed (After Payload Drop)
  - [R] 300 kts
  - [O] 400 kts
- Field Requirements
  - [R] Balanced field length <= 8,000 ft @ 5,000 ft MSL elevation on a +35°F hot day
  - [O] Balanced field length <= 5,000 ft @ 5,000 ft MSL elevation on a +35°F hot day
- Certifications
  - [R] Capable of VFR and IFR flight with an autopilot
  - [R] Capable of flight in known icing conditions
  - [R] Meets applicable certification rules in FAA 14 CFR Part 25
    - All missions below assume reserves and equipment required to meet applicable FARs
  - [O] Provide systems and avionics architecture that will enable autonomous operations
    - Provide a market justification for choosing to either provide or omit this capability
    - Determine how the design would change with this capability

Design Objectives

- Minimize operations and support cost by designing modularity into the structure and key components facilitating rapid repairs and replacements based on a chosen support strategy.
- 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 reliability and operational availability equal or better than that of comparable aircraft.
- Make the aircraft maintenance (failure rate, time-to-repair, etc.) equal or better than that of comparable aircraft.

Other Features and Considerations

- Flying qualities should meet CFR Part 25.
- Identify all systems functionality and components that are required for the aircraft to operate in both controlled and uncontrolled airspace.
- List the equipment required.
- Consider what features will be basic and which will be optional to a customer.

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 or graphical representation of the sized aircraft based on the requirements and design objectives given. This should describe or represent the quantitative justification for the sized wing area and selected power or thrust of the aircraft design.
2. An analysis of the performance of the aircraft against the design and long-range ferry missions.
3. Aircraft performance summaries shall be documented and the aircraft flight envelopes shall be shown graphically.
4. A V-n diagram for the aircraft with identification of necessary aircraft velocities and design load factors.

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 and pull-up speeds 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.

    – Scaled three-views (dimensioned) and 3-D model imagery of appropriate quality are expected. The three-view must include at least:

        1. Fully dimensioned front, left, and top views
        2. Location of aircraft aerodynamic center (from nose)
        3. Location of no-payload, full-payload and intermediate-payload CG locations (relative to nose)
        4. Tail moment arms

    – Diagrams showing the location and functions for all aircraft systems.

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 fuel allocation. Establish a forward and aft center of gravity (CG) limit for safe flight.

    – Weight assessment summary shall be shown at least at the following level of detail:

        1. Propulsion (engine, propeller, gearbox, nacelle, strut, fan, etc. as applicable)
        2. Airframe Structure
            1. Wing
            2. Empennage
            3. Landing Gear (including wheels tires and brakes)
            4. Fuselage
        3. Control System (flight controls linkages, hydraulics, wires, actuators bellcranks, engine controls etc.)
        4. Crew
        5. Payloads and Payload Equipment
        6. Systems

1. Instruments and Avionics
2. Fuel/oil
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, pitch, roll and yaw derivatives.
11. Summary of cost estimates and a business case analysis. This assessment should identify the cost groups and drivers, assumptions, and design choices aimed at the minimization of operation costs.
    - Estimate the non-recurring development costs of the airplane including engineering, FAA/EASA certification, production tooling, facilities and labor
    - Estimate the acquisition (or "fly away") cost
    - Estimate the price that would have to be sold for to generate at least a 15% profit
    - Show how the airplane could be produced profitably at production rates ranging from 4 to 10 airplanes per year or a rate that is supported by a brief market analysis
    - Estimate of operating cost for the aircraft assuming 1,200 flight hours per year in a mixture of training, ferry, and operational flights.
        - Fuel, oil, tires, brakes, and other consumable quantities
        - Estimate of maintenance cost per flight
        - Flight crew costs
        - Including other costs will strengthen the proposal

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.

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 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:

- Mission performance and sizing for the definition of a mission profiles.
- 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.

Additional Contacts

All technical questions pertaining to this RFP should be directed to Jeffrey Corbets at aiaadesigncompetitions@gmail.com

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

Reference Material

FAA 14 CFR Part 25

https://www.ecfr.gov/cgi-bin/text-idx?SID=ffa15036a5063e0af45f080a365945dc&mc=true&tpl=/ecfrbrowse/Title14/14cfr25_main_02.tpl