2011-2012 Undergraduate Team Aircraft Design Competition

I. Rules – General

1. All undergraduate AIAA branch or at-large Student Members are eligible and encouraged to participate. In team competitions, teams are limited to ten (10) members.

2. An electronic copy of the report in MS Word or Adobe PDF format must be submitted on a CD or DVD to AIAA Student Programs. Total size of the file(s) cannot exceed 20 MB. *A "signature" page must be included in the report and indicate all participants, including faculty and project advisors, along with their AIAA member numbers and signatures.* Designs that are submitted must be the work of the students, but guidance may come from the Faculty/Project Advisor and should be accurately acknowledged.

Each proposal should be no more than 100 double-spaced pages (including graphs, drawings, photographs, and appendices) if it were to be printed on 8.5" x 11.0" paper, and the font should be no smaller than 10 pt. Times New Roman. Up to five of the 100 pages may be foldouts (11" x 17" max).

3. *Design projects that are used as part of an organized classroom requirement are eligible and encouraged for competition.*

4. The prizes shall be: First place-$2,500; Second place-$1,500; Third place-$1,000 (US dollars). Certificates will be presented to the winning design teams for display at their university and a certificate will also be presented to each team member and the faculty/project advisor. One representative from the first place design team may be expected to present a summary design paper at an AIAA Conference in 2012.

Reasonable airfare and lodging will be defrayed by the AIAA for the team representative

5. More than one design may be submitted from students at any one school.

6. If a design group withdraws their project from the competition, the team leader must notify AIAA Headquarters immediately!

7. Team competitions will be groups of not more than ten AIAA branch or at-large Student Members per entry. Individual competitions will consist of only 1 AIAA branch or at-large Student Member per entry.

II. Copyright

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

Any submission that does not contain a copyright notice shall become the property of AIAA. A team desiring to maintain copyright ownership may so indicate on the signature page but nevertheless, by submitting a proposal, grants an irrevocable license to AIAA to copy, display, publish, and distribute the work and to use it for all of AIAA's current and future print and electronic uses (e.g. "Copyright © 20__ by _____. Published by the American Institute of Aeronautics and Astronautics, Inc., with permission.).

Any submission purporting to limit or deny AIAA licensure (or copyright) will not be eligible for prizes.

III. 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.

IV. Schedule and Activity Sequences

Significant activities, dates, and addresses for submission of proposal and related materials are as follows:

A. Letter of Intent — 19 March 2012
B. Proposal delivered to AIAA Headquarters — 10 June 2012
C. Announcement of Winners — August 2012

Groups intending to submit a proposal must submit a Letter of Intent (Item A), with a maximum length of one page to be received with the attached form on or before the date specified above, at the following address:

AIAA Student Programs
1801 Alexander Bell Drive, Suite 500
Reston, VA 20191-4344

The Letter of Intent should contain the names of participants, project title, name(s) of faculty/project advisor(s), and contact information for the team leader and project/faculty advisor(s). Letters of Intent may be emailed to Rachel Andino at rachela@aiaa.org.

V. 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 and keyed accordingly:

1. Demonstrate a thorough understanding of the Request for Proposal (RFP) requirements.

2. 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.

3. 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.

4. Include tradeoff studies performed to arrive at the final design.

5. Provide a description of automated design tools used to develop the design.

VI. Basis For Judging

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.

VII. REQUEST FOR PROPOSAL

Humanitarian Response Unmanned Aircraft System (HR-UAS)

1. OPPORTUNITIES DESCRIPTION

Ever since unmanned aircraft have entered service, providing intelligence, surveillance, reconnaissance and now strike capability, the question that continues to be raised is "What other capabilities can unmanned aircraft provide?" One area that has continued to gain interest, especially in the wake of recent natural disasters such as the earthquakes that struck Haiti and Japan, is cargo resupply for humanitarian assistance missions.

There is a need for an affordable, humanitarian response aircraft system that can provide aid to the populations of both developed and under-developed nations worldwide when natural disasters occur.

Assisting those affected by earthquakes, tsunamis, hurricanes, etc. requires immediacy but these calamities can also cause logistical challenges that can hamper the response effort. Precision, unmanned resupply could help alleviate some of these challenges. 'Precision' would permit the delivery of critical supplies to remote, discontinuous areas where terrain and environment have limited the access of current assets. Use of an 'Unmanned' vehicle could reduce the potential for casualties and also allow for humanitarian assistance in areas that may be politically sensitive.

2. PROJECT OBJECTIVE

This specific Request For Proposal (RFP) provides the requirements for an unmanned aircraft that is practical, easy to acquire, and operate. The aircraft will be supported by a ground station that can be easily reconfigured to be transported anywhere.

3. REQUIRED SYSTEM CAPABILITES

Able to operate on short landing areas	• Takeoff and Land in ≤ 500 ft ground roll (at sea level standard day conditions)
Autonomous Flight during day or night	• Capable of autonomous flight using GPS (including waypoint navigation and in flight waypoint, speed and altitude changes) • Terminal area operations (taxi, warm-up, takeoff, landing, climb & descent) can be autonomous but the option for pilot-in-the-loop control via a ground station must be available • Ground station equipment necessary for autonomous control, handoff and manual control must weigh ≤ 50 lbs and be backpack transportable by a person • You are not required to design a mission control system (air vehicle avionics, ground station, antennas, computer equipment) for the vehicle. All equipment would be acquired "off the shelf." The air vehicle must allocate weight and volume for the selected air vehicle avionics.
Payload Carriage & Useful Load of Military Utility	• Useful Load (total payload + useable fuel) ≥ 3,000 lb • The air vehicle must have an available cargo volume to allow the carriage of two 36 in. x 36 in. pallets loaded 42 in. high (including pallet height) • Payload should be able to be easily loaded and unloaded by personnel at a remote resupply area • Cargo handling system should facilitate cargo unloading/loading times of 30 minutes
Speed and Altitude of Military Utility	• Cruise Speed ≥ 140 knots, true airspeed • Service Ceiling ≥ 15,000 ft MSL
Payload / Range Mission Performance	• Transport 1,800 lb to 300 nm and return 300 nm (unrefueled) with 1,800 lb payload retained
Affordable & Supportable	• Off the shelf components, especially engines and mission control system, can be utilized in the design to reduce overall development and acquisition cost • The air vehicle must allow for ease of operation, repair, maintenance, and support in the field
Transportable	• In a shipping configuration, the entire unmanned cargo vehicle must fit completely within the cargo bay of a C-130J-30 (10 ft W x 9 ft H x 55 L) and be easy to assemble to a flying configuration

3.1 Required Mission Performance (zero wind, standard day atmosphere - see Figure 1)

1. Warm-up and taxi (if needed) at idle for 5 minutes
2. Takeoff from a forward operating base (FOB) at sea level with 1,800 lbs payload
3. Climb to 8,000 feet MSL with 1,800 lbs payload
4. Cruise at 8,000 ft MSL for 300 nm with 1,800 lbs payload (not including distance to climb)
5. Descend to sea level and Land in less than or equal 500 ft ground roll at a remote resupply area (RRA) with 1,800 lb payload

6. Cargo unloading/loading time of 30 minutes (engines off) followed by warm-up and taxi (if needed) at idle for 5 minutes
7. Takeoff at sea level in less than 500 ft ground roll from an RRA without refueling and with 1,800 lb payload retained
8. Climb to 8,000 feet MSL with 1,800 lbs payload
9. Cruise at 8,000 ft MSL for 300 nm with 1,800 lbs payload (not including distance to climb)
10. Descend to sea level and Land at a FOB with 1,800 lbs payload, taxi (if needed) and shutdown

* Fuel reserves for 20 minutes of flight at 2,000 ft MSL
* No range credit should be allotted for descents
* It can be assumed that the RRA has an improvised gravel or grass landing strip

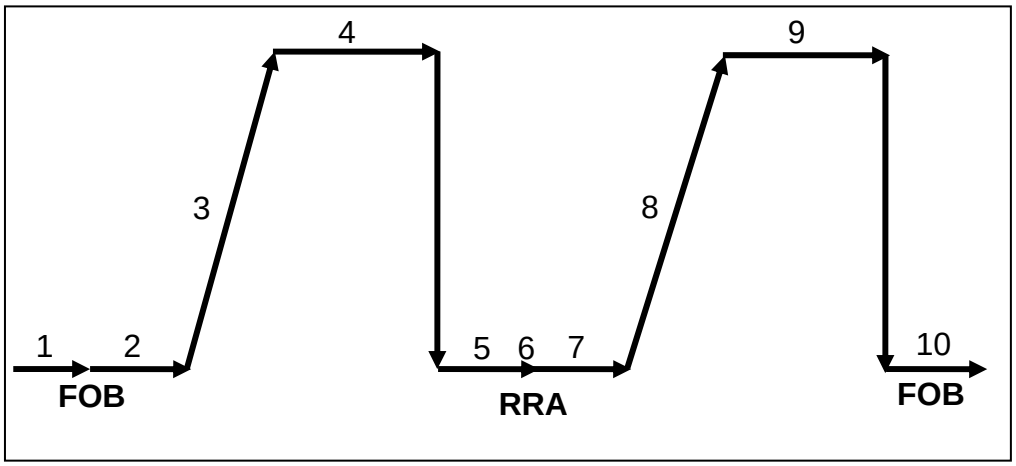

Figure 1: Mission Profile

FOB: Forward Operating Base
RRA: Remote Resupply Area

4. DATA REQUIREMENTS

The technical proposal must convincingly demonstrate that the design team can provide a superior and cost effective solution to the need identified by this RFP. The proposal should satisfy the following tasks to show how the team would develop the design of a new aircraft.

1. Describe the initial set of vehicle configurations your team evaluated
2. Describe the method and explain the process used for evaluating each configuration's effectiveness in meeting the stated required capabilities and justify your team's selected configuration.
3. Perform trade studies and provide carpet plots used to optimize the final selected design (including but not limited to cruise speed, propulsion selection, wing parameters and mid mission takeoff & landing distance). Use these trade studies to justify the team's design choices.
4. Include a dimensioned 3-view drawing.
5. Include an inboard profile showing the general internal arrangement.
6. Include an illustrated description of the primary load bearing airframe structure and state rationale for material selection.
7. Include a V-n diagram.
8. Show an estimated drag build up and drag polar for the cruise configuration, the takeoff configuration and the landing configuration.
9. Show a weight breakdown of major components and systems, and center of gravity travel.
10. Provide performance estimates and demonstrate air vehicle stability for all flight and loading conditions.
11. Describe any advanced technologies and their relative benefits to the design. Address risk mitigation if these technologies fail to materialize including potential cost increases or decrement to performance.
12. Describe how the air vehicle is transported, configured to a flying configuration, launched and recovered.
13. Describe the undercarriage of the air vehicle, explaining design features that allow for operations on improvised gravel or grass landing strips. Show how the undercarriage meets appropriate tip over criteria with respect to the aircraft's center of gravity.
14. Describe how the vehicle carries the required cargo volume. Also describe the cargo handling system including the loading and unloading scheme.
15. Describe the range and endurance capability of the air vehicle with zero payload and with 1,800 lbs payload.
16. Describe the capabilities, weight and cost of the selected mission control system.
17. Describe the concept of employment (CONEMP) envisioned for the unmanned cargo delivery system you designed (air vehicle, ground station and pilot-in-the-loop). Explain how the system will be controlled and/or flown during the different phases of the mission profile (e.g. autonomous cruise phases with pilot in the loop terminal area operations, completely autonomous, etc.).
18. Provide flyaway cost and life cycle cost estimates for production runs of 50, 100, and 500 air vehicles.

Intent Form

2011 – 2012
AIAA
Undergraduate Team Aircraft Design Competition
Request for Proposal: **Humanitarian Response Unmanned Aircraft System (HR-UAS)**

Title of Design Proposal: _____

Name of School: _____

Designer's Name	**AIAA Member #**	**Graduation Date**	**Degree**
_____	_____	_____	_____
Team Leader			
_____			
Team Leader E-mail			
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

In order to be eligible for the 2011 AIAA Undergraduate Team Aircraft Design Competition, you must complete this form and return it to the AIAA Rachel Andino (rachela@aiaa.org) of Student Programs ***before 19 March 2012***, at AIAA Headquarters, along with a one-page "Letter of Intent" as noted in Section II, "Schedule and Activity Sequences." For any nonmember listed above, a student member application and member dues payment should also be included with this form.

Signature of Faculty Advisor	Signature of Project Advisor	Date
Faculty Advisor – Printed	Project Advisor – Printed	Date