2010 – 2011 AIAA Foundation Undergraduate Team Aircraft Design Competition

I. Rules – General

1. All undergraduate AIAA branch or at-large Student Members are eligible and encouraged to participate.

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. Schedule and Activity Sequences

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

A. **Letter of Intent** — 11 March 2011
B. **Proposal delivered to AIAA Headquarters** — 10 June 2011
C. **Announcement of Winners** — August 2011

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 or email (rachela@aiaa.org):

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).

IV. 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.

V. 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.

VI. REQUEST FOR PROPOSAL

Ultra Heavy Lift Hybrid Air Vehicle (HAV)

Background:
There is a need to offer commercial and military cargo transportation systems with another option for moving large volumes and/or weights of cargo long distances. Today, two options exist; fast but expensive aircraft and slow but inexpensive ships. The new option, hybrid air vehicle, would fit between aircraft and ships both in speed and cost. A hybrid air vehicle combines the advantages of aerodynamic lift from the lifting body hull shape (like an airplane) and the efficiencies of lighter-than-air derived from the buoyancy of the helium-filled envelope (like an airship or blimp). Approximately forty percent of the hybrid air vehicle's lift is generated from the aerodynamics and sixty percent from helium buoyancy. When fully loaded, the air vehicle is heavier than air and operates much like an airplane. The air vehicle integrates an air cushion landing system (ACLS) (like a hovercraft) instead of conventional aircraft landing gear. This enables the air vehicle to land and takeoff from virtually any reasonable flat surface. Reversing the ACLS engines on landing creates suction to a solid surface facilitating loading and unloading and eliminates the need for ground handling crews or elaborate tie downs in the lighter-than-air mode when the air vehicle is empty of payload and fuel. The hybrid air vehicle is capable of landing and taking off with large heavy payloads from anywhere, whether it is from remote fields, deserts, marshes, harbors, waterways, even covered with snow or ice. Thus it does not require the support of an airport. Commercial cargo carriers, like FEDEX and UPS, would be able to transport goods across the Pacific Ocean in less than two days or could remain on station with reduced payload for up to eight days using conventional fuel. The military would be able to transport massive amounts of equipment to worldwide battle zones in two to four days. In flight refueling from tanker versions of the hybrid air vehicle would permit non-stop delivery of cargo to almost any spot around the globe. The very large volume of the helium-filled envelope produces enormous surface areas for integration of solar cells. Since size is greatly increased over aircraft, the options for alternate fuels that require greater volumes are practically limitless.

Project Objectives:

This RFP is for a future (2020) hybrid air vehicle design that incorporates new aircraft, airship and hovercraft technologies. Two

concepts of operation will be used to evaluate the resulting design. (1) A commercial delivery of 96 twenty-foot equivalent units (TEU's) intermodal containers from Tokyo, Japan to Los Angeles, California. (2) A military delivery of 9 M1A1 Abrams tanks, from Ft. Lewis, WA to Pusan, S. Korea. The evaluation figure of merit in both scenarios is dollars per pound delivered between the stated destinations.

General Requirements:

The general requirements for this hybrid air vehicle are as follows:

Maximum Payload Weight: 1,200,000 Pounds
Cargo Bay Volume: >165,000 ft3
Cargo Load Outs:
- -96 TEU's
- -9 M1A2 Abrams Main Battle Tanks
- -6 AH-64D Apache Longbow Helicopters
- -60 463L Pallets
- -1000 Passengers/Paratroops
- -300 Medical Litters

Maximum Unrefueled Range (no winds): 6000 nm
Maximum Refueled Range (no winds): 10,000 nm
Initial Cruise Altitude: 4000 ft
Maximum Cruise Altitude: 9000 ft
Nominal Cruise Speed: 90 KEAS
Maximum Cruise Speed: 110 KEAS
Temperature: ISA
Takeoff Distance (35 ft obstacle)(no winds): 6700 ft
Maximum design vertical descent rate: 5 ft/sec
Cargo Bay Floor: < 5 ft above ground
Crew: 3 pilots, 3 co-pilots, 1 loadmaster

The landing system shall provide a parking mode suitable for safe vehicle parking in variable winds up to 30 kts, and head-on winds up to 50 kts.

For emergencies, the ballonets shall be sized to permit short-duration flight up to 12,000 ft without venting helium.

Maximum allowable useful load= Maximum payload+ Maximum fuel load

The vehicle shall be capable of landing, taxing, and taking off at a maximum allowable useful load on any sufficiently large body of fresh or salt water for sea state 3 or less.

The vehicle shall be capable of amphibious operations on beach grades up to 5 degrees slope.

The cargo floor shall be designed to support a loading of at least 500 psf.

In addition to the seats on the flight deck, the vehicle shall provide living accommodations for two flight crews for up to 8 days. Provisions shall include, as a minimum, bunks, galley, restroom, and storage space for personal belongings.

It is expected that large antennas for radar and/or communications may be mounted inside the helium envelope of some vehicles.

Supporting Data:

The technical proposal must convincingly demonstrate that the design can satisfy both the commercial and military missions stated in the project objectives. The proposal should satisfy the following tasks to show how the design would be developed.

1. Justify the final design and describe the technologies, engine selection and technical approach used to meet the mission requirements
2. Include a dimensioned 3-view general arrangement drawing
3. Include an inboard profile showing the internal helium envelope, crew quarters and cargo bay arrangements
4. Show criteria used to select distribution of total lift between aerodynamics, thrust vectoring, and helium buoyancy
5. Include an illustrated description of the primary load bearing structures and state rationale for material selection

6. Show an estimated drag build-up and drag polar for the cruise configuration, the take-off configuration and the landing configuration
7. Show a weight breakdown of the major components and systems and center of gravity travel
8. Provide estimates of performance, emissions and community noise
9. Demonstrate vehicle stability for all flight and loading conditions
10. Provide flyaway cost and life cycle cost estimates for production runs of 250 and 500 units

Letter of Intent Form

Use this file, , to indicate the names and AIAA Member numbers of all team members. Page two allows for the Letter of Intent to be written.

This form may also be downloaded from the AIAA Web site in the Students and Educators area under Design Competitions (http://www.aiaa.org/content.cfm?pageid=210).