1986 AIAA/UNITED TECHNOLOGIES/ PRATT & WHITNEY Individual Student Aircraft Design Competition

I. PURPOSE

The purpose of this competition is to stimulate interest in the conceptual phase of aircraft design and provide the individual student an opportunity for design competition.

II. ELIGIBILITY

All student members of the American Institute of Aeronautics and Astronautics who are full-time undergraduate students are eligible to participate in this competition.

III. PRIZES

The prizes shall be:

lst place—\$1,000 + certificate 2nd place—\$500 + certificate 3rd place—\$250 + certificate

In addition to the monetary awards, copies of the top five design proposals will be forwarded to major U.S. aerospace corporations.

IV. SCHEDULES

Milestones for the submission of a proposal are:

- Request for Proposal (RFP) release date— 15 August 1985
- 2. Letter of Intent due date-14 March 1986
- 3. Receipt of Proposal-13 June 1986
- 4. Announcement of Award Winners-1 September 1986

The letter of intent and the proposal must be postmarked and submitted on or before the specified dates to:

Alina Z. MacNichol Director of Student Programs AIAA Headquarters 1633 Broadway New York, NY 10019

V. DATA TO BE SUBMITTED

1. <u>Five</u> copies of the design proposal will be submitted. Each copy of the proposal must be accompanied by a letter of transmittal signed by the individual and endorsed by a faculty advisor. The endorsement must attest to the competition eligibility of the student.

2. Proposals shall be limited to one hundred pages including figures. Up to five of the 100 pages may be foldouts (11" x 22" max.). The remainder shall be $8\frac{1}{2}$ " x

11". Submit five (5) copies of proposal.

3. A student may only submit one design proposal each year and that proposal must be an individual effort. Faculty guidance, through classroom or individual instruction, is encouraged and must be carefully referenced or documented within the design proposal.

4. A conceptual design proposal, for the purpose of this competition, will be defined by the following requirements. These requirements are the *minimum* necessary and are not meant to restrict innovative analyses and presentations. Emphasis should be placed upon a narrative justification of all methods and results.

a. A final aircraft configuration must be presented. This configuration will include:

- (1) Three-view drawings of the aircraft.
- (2) Location of major equipment items (fuel cells, engines, landing gear, avionics bays, etc.).

(3) Airfoil section nomenclature for lifting surfaces.

b. A weight statement which includes the weight and c.g. location of each major component must be included.

c. An aircraft lift and drag analysis will be required. The results will be presented graphically as total drag coefficient versus the airplane lift coefficient.

d. The propulsion system's fuel consumption and thrust data for important mission conditions in the flight regime must be presented. Propulsion installation losses should be discussed.

e. A structural analysis of the wing spar/spars is required.

f. The results of a three axes static stability and control analysis and a performance analysis are required.

g. Parametric trade studies which analyze the significant design parameters, excluding cost, are necessary requirements to support the final selection of the design configuration.

VI. BASIS FOR JUDGING

1. Technical Content (35 points)

Technical evaluation will cover completion of all RFP requirements, correctness of theory, validity of reasoning used and consideration of major and related factors.

2. Organization and Presentation (20 points)

Effectiveness of the design as an instrument of communication through organization, clarity and inclusion of pertinent information is a major factor.

3. Originality (20 points)

Proposal should avoid standard textbook information and show independence of thinking through originality, imagination, and unique solutions.

4. Application and Feasibility (25 points)

Proposal should present conclusions and/or recommendations that are technologically feasible, practical and realistic.

Design Objectives and Requirements

Request for Proposal for an Unmanned Vehicle System

I. OPPORTUNITY DESCRIPTION

Oil and gas pipelines carry these products over a several state area within the United States. These pipelines must be inspected daily to ensure that no breaks have occurred. At the present time, light aircraft are used to fly the pipelines for inspection purposes. Any signs of oil/gas leaks are radioed to a monitor station for ground inspection. Technology shall be available by 1990 for sensors to be able to detect oil or gas leakage and forward this information to a monitor station.

II. PROJECT OBJECTIVES

The project objectives are as follows:

1) Design a low-cost, unmanned, recoverable vehicle system with an endurance of eight (8) hours.

2) The design shall make use of the latest technology in structural materials. It shall also use the latest aerodynamics, flight control, artificial intelligence, sensor technologies, and avionics to be available by 1990. Latest advanced propulsion systems shall be applied.

III. REQUIREMENTS AND CONSTRAINTS

The design shall incorporate the following requirements:

1) Design Mission: The aircraft shall be sized to carry the required sensor suite and data link. It must be capable of cruising for a period of eight (8) hours at the best endurance speed with a minimum 10% fuel reserve. It shall be recovered at the end of its mission. The cruise speed need not exceed 120 knots at an altitude of 5000 feet. It shall operate at altitudes from 500 to 1000 feet above ground level (AGL). It shall have a service ceiling of at least 20,000 feet.

2) *Mission Applications:* The system must be capable of oil or gas pipeline surveillance. Other surveillance duties may be assigned.

3) Design Criteria: The aircraft design criteria are as



follows:

a) A benign environment must exist for the avionics and sensors.

b) The vehicle must be recovered with no or minimum damage. Turn around time shall be two (2) hours.

c) Means must be provided to disperse dye material over suspected oil/gas leaks.

d) It shall be capable of day or night surveillance.

e) Navigation system shall be capable of following an established pipeline.

f) Sensors shall be capable of detecting oil or gas leaks.

g) It must have high reliability and maintainability.

h) Data link and remote control shall be included.

i) Ground handling crew requirements for launch and recovery shall be minimal.

j) It shall be storable for a minimum of five (5) years.

k) Operational probability after storage shall be 0.8.

4) Configuration Selection Criteria: The point design configuration will be selected on the basis of low unit cost, low cost per flight hour, low direct maintenance man hours (DMMH) per flight hour, the ability of the system to successfully complete its mission and to be recovered with no or minimum damage.

IV. DATA REQUIREMENTS

The following data are required for the selected design configuration:

1) Discussion of the design approach, including tradeoffs and criteria used, plus any unique features of the design.

2) Discussion of and criteria used for the selection of the sensor suite.

3) A three-view general arrangement drawing showing external geometry and dimensions.

4) A drawing showing internal arrangement.

5) Performance analysis, including aerodynamic performance, and stability and control considerations. Aircraft component drag build-up data and range endurance data are required.

6) Mass properties including permissible center-ofgravity travel.

7) An electrical power requirements profile is required.8) A section of the final report called "Detail Design" shall describe the basic vehicle structure and the design of the engine installation. This should include installation layouts and a discussion of noise considerations.

9) A cost estimate, showing all assumptions, shall be made for a projected buy of 200 vehicles.