

**25th Annual AHS Student Design Competition
2008 Request for Proposal (RFP)**

For

**Advanced VTOL Concept
“SMART – COPTER”**

Minimizing Energy Consumption

Sponsored by



and



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Section 1 – Basic Proposal Information

1. Rules

a. Competition categories include:

- Graduate Student Category
- Undergraduate Student Category
- New Entrant Category

The “New Entrant” category is open to all schools (graduate and undergraduate) that have not participated in at least 2 of the prior 3 competitions.

b. All undergraduate and graduate students may participate in this competition. Schools are encouraged to form project teams. The maximum number of students on each team is 10.

The development of multi-university cooperative teams is strongly endorsed, for the added educational and project management experience. For multi-university teams, the maximum number of participants is equal to 12. This is in order to allow one equivalent project coordinator for each university. To prevent fragmentation of tasks, the maximum number of universities on a cooperative team is 2. Regardless of the nationality of the participant teams, all submittals and communications to AHS shall be in English

c. The classification of a team is determined by the highest education level of any member of the team. Part-time students may participate at the appropriate graduate or undergraduate level.

d. “New Entrant” team proposals will be judged at the appropriate graduate or undergraduate level, and evaluated for the best “New Entrant” category from the group of all New Entry teams.

e. Only one design proposal may be submitted by each student or team; however a university or college may enter multiple teams, each with its own individual proposal.

f. Final proposals must be submitted to AHS International in digital format readable using Adobe Acrobat (requests for exceptions will be considered in advance). All documents submitted shall use a font size of at least 10 point and a spacing that is legible and enhances document presentation.

g. Graduate category submissions shall be no more than 100 pages and undergraduate submissions shall be no more than 50 pages (including all figures, drawings, photographs, and appendices). The cover page, table of contents, lists of figures/tables, nomenclature, and references are not to be considered part of the page limit. Pages shall be 8½ x 11 inches, with the exception that 8 pages may be larger fold-out pages up to a maximum size of 11 x 17 inches.

h. The Final Proposal must include a self-contained Executive Summary briefing, limited to no more than 20 pages. This summary is not to be considered part of the page limit. No additional technical content can be included in the executive summary. This is to prevent improper use of this medium to exceed the previously stated submission size. The executive summary can take the form of a viewgraph-style presentation, but will be part of the .pdf file.

i. For all submittals, an inside cover page must include the printed name, educational level and signature of each student who participated. Submittals *must* be the work of the students, but guidance may come from Faculty Advisor(s), and must be acknowledged on this signature page. Design projects for which any student receives academic credit must be identified as such on this signature page.

j. If any student or design team withdraws their project from the competition, the student or team leader must notify the AHS National Headquarters Office immediately in writing.

2. Awards

The submittals will be judged in 2 primary categories:

Graduate Category:

- 1st place - \$1300
- 2nd place - \$650

Undergraduate Category:

- 1st place - \$700
- 2nd place - \$350

In addition, the best new entrant will be awarded \$500. Certificates will be presented to each member of the winning team and to their faculty advisors for display at the school. The 1st place winner, or a team representative, in each category will be expected to present a technical summary of their design at the 2009 AHS International Annual Forum. Presenters will receive complimentary registration and Eurocopter will reimburse up to \$1000 in expenses to help defray the cost of attendance.

3. Schedule

Scheduled milestones and deadline dates for submission of the proposal and related material are as follows:

- | | |
|---|-------------------|
| a. AHS Issue of Request for Proposal (RFP). | July 01, 2007 |
| b. Submit Letter of Intent to Participate. | February 16, 2008 |
| c. Teams Submit Requests for Information/Clarification. | February 28, 2008 |
| d. AHS Issue Responses to Questions | March 31, 2008 |
| e. Teams Submit Final Proposals. | June 01, 2008 |
| f. Eurocopter Notifies AHS of Results. | August 10, 2008 |
| g. AHS Announces Winners. | August 20, 2008 |
| h. Winning Teams Present Executive Summary at AHS Forum 65. | May, 2009 |

All questions and requests for information/clarification that are submitted by teams to AHS will be distributed with answers to all participating teams. The proposal must be postmarked by June 01, 2008.

4. Contacts

All correspondence will be directed to:

Kim Smith, Deputy Director
AHS International
217 N. Washington Street
Alexandria, VA 22314
Phone: (703) 684-6777
Fax: (703) 739-9279
Email: kim@vtol.org

5. Evaluation Criteria

The proposals will be judged based on 4 primary categories, with weighting factors specified in brackets:

a. Technical Content (40 points)

The Technical Content of the proposal requires that ...

- The design meets RFP technical requirements
- The assumptions are clearly stated and logical
- A clear understanding of design tools is evident
- Major technical issues are considered
- Appropriate trade studies are performed to direct/support the design process
- Well balanced and appropriate substantiation of the complete system is presented
- Technical drawings are clear, descriptive and accurately describe the complete aircraft (including relevant subsystems)

b. Organization & Presentation (15 points)

The organization and presentation of the proposal requires ...

- A self-contained Executive Summary that contains all pertinent information and makes a compelling case why the proposal should win
- An introduction that clearly describes the major features of the proposed aircraft
- A well organized proposal that makes all pertinent and required information readily accessible and presents this information in a logical order (continuity of topics)
- Figures, graphs and tables that are uncluttered and easy to read and understand
- All previous relevant work be cited
- Professional quality and presentation of the proposal

c. Originality (15 points)

The originality of the proposal will be judged on ...

- Vehicle aesthetics

- How much the solution demonstrates originality and shows imagination

d. Application & Feasibility (30 points)

The proposals will be judged on how well current and anticipated technology levels are applied to the problem, and how feasible the solution appears to be. Specifically, the proposals must ...

- Justify and substantiate the technology levels that are used or anticipated
- Identify and discuss the high risk technological areas
- Discuss the influence of affordability considerations on the design process
- Discuss the influence of reliability and maintainability on the design process, including life cycle support
- Discuss how the manufacturing methods and materials were considered in the design process, including modularity and lean implementation
- Demonstrate an appreciation of how the vehicle will be used by the operator
- Identify a path to production-ready technology

In addition, the proposal should consider additional applications other than those specified in the RFP.

6. Proposal Requirements

The proposal response needs to communicate a description of the design concepts and the associated performance criteria (or metrics) to substantiate the assumptions and data used and the resulting predicted performance, weight, and cost. The following should be used as guidance while developing a response to this Request for Proposal (RFP):

1. Demonstrate a thorough understanding of the RFP requirements.
2. Describe how the proposed technical approach complies with the requirements specified in the RFP. Technical justification for the selection of materials and technologies is expected. Clarity and completeness of the technical approach will be a primary factor in evaluation of the proposals.
3. Identify and discuss critical technical problem areas in detail. Descriptions, method of attack, system analysis, sketches, drawings, and discussions of new approaches should be presented in sufficient detail in order to assist in the engineering evaluation of the submitted proposal. Exceptions to RFP technical requirements must be identified and justified.

4. Describe the results of trade-off studies performed to arrive at the final design. Include a description of each trade and a thorough list of assumptions. Provide a brief description of the tools and methods used to develop the design.

5. The data package that must be provided in the proposal is described in Section 2.

The proposal package must also contain an Executive Summary Briefing that presents a compelling story why your design concept should be selected. The Executive Summary Briefing should highlight critical requirements and the trade studies you conducted, and summarize the aircraft concept design and capabilities.

Judging will focus on innovative solutions, system performance, and system value.

Section 2 – Design Objectives and Requirements

1. Overview of Operations

This rotorcraft concept would be proposed for all conceivable Military / Para-military / Public multi-purpose transport missions. Passenger and material transportation should be considered. The target mission is short range and medium speed. The design shall lead to innovative solutions that minimize energy consumption.

This rotorcraft would be operated in high population density areas. One important aspect of the potential mission is operation in neighbourhoods surrounding cities. Missions like these imply the need for a high level of technology specifically aimed at enhanced safety and reduced noise.

The proposed aircraft will be utilized

- in congested areas, where infrastructure on ground for air transportation is limited,
- for deployment of people or materials in areas that have been devastated following an earthquake, tsunami or other catastrophic event,
- in areas where ground transportation is no longer feasible and VTOL aircraft remains the only means of adequate transport for people and/or material.

The proposed aircraft must be “low maintenance”.

2. Design Objectives

The objective of this RFP is the design of an advanced VTOL concept capable of operating from unprepared area and which minimizes energy consumption throughout the operational envelope.

This “SMART-COPTER” must be capable of vertical takeoff and landing (VTOL) and will have an initial operational capability (IOC) in 2020.

The proposal must provide a comparison with an equivalent payload rotorcraft (R44 / ... / R66 / EC120).

The vehicle shall be capable of Take-Off within 10 minutes after being positioned on the heli-surface.

A semi-automatic take-off and landing system shall allow the normal use of the helicopter by private pilots (non professional pilots).

3. Mission Profiles

The primary design mission for the SMART-COPTER is cruise flight, minimizing fuel consumption for a one (1) hour flight at a 120 knots target speed, without any loss of hover versatility and performance. Specific capability requirements are:

- Crew: 1 pilot.
- Payload: 4 passengers with luggage, or 500 kg freight
- Minimum Internal volume:
Height 1.1 m, Length 1.4 m, Width 1.0 m
- Hover-out-of-ground-effect (15 min) with Maximum Take-off Weight at 1500m - ISA+20
- Minimum recommended cruise speed 100 knots
- Range 300 nautical miles

Additional weight data that may be helpful in sizing the helicopter is listed below:

- Crew = 100 kg (1 crew)
- Avionics = 120 kg
- Payload = $4 * (90 + 20) \text{ kg} = 440\text{kg}$ = (4 passengers plus luggage)
- Contingency = 5% of empty weight

The main objective remains energy consumption in operation. Any architectural innovation is welcome:

- Rotor morphing should be considered (diameter, chord, twist airfoil camber, sweep, etc.),
- New anti-torque system (if needed),
- Drag reduction,
- Additional aerodynamic devices
- Engines (turbines, diesel, fuel cells, etc.)
- Hybrid energy
- Alternative fuel (synthetic fuel produced from bio-mass, coal, natural gas, etc.)

- Moreover, a rough estimate of the overall energy consumption of the helicopter during its whole cycle (manufacturing, operation, maintenance and recycling at end of life) shall be given.
- Criteria for comparison with similar size helicopters (see section 2.0) will be proposed, addressing recurring costs, non-recurring costs and operating costs
- Local pollution: when operating rotorcraft, in flight and on ground (power & energy consumption, hydraulic fluids (if any), lubrication, etc.) will be estimated, or, when possible, computed (CO₂, CO, NO_x, particles, etc.)
- Complete Pollution chain: (taking into account the effluents and health hazardous material (carcinogenic...) including manufacturing from basic materials up to final assembly (machining, transportation, chemical treatments, etc.) and recycling.

Comfort of passengers must equal that of an equivalent helicopter. Particular attention should be given to:

- ECS
- Seats
- Internal noise
- Sun protection
- Vibration

The vehicles shall utilize advanced techniques to enhance mission survivability, autorotation capability or equivalent capability (glider mode, wing fixed or with movable parts, etc.), airbag (internal / external).

Particular attention should be given to minimizing acoustic signatures

Engine perspectives to 2020 must be proposed with specific fuel consumption reduction and power to weight ratio improvement.

4. System Design Optimization and Affordability

The primary metric that will be used to judge system value for this design competition will be:

The fuel or energy consumption (Joule, weight, volume, price)

The corresponding waste (NO_x emission, general pollution, etc.)

However, the proposed aircraft will also be judged on qualitative measures of system affordability, which should include (but not be limited to):

- Engine size and number of engines,
- Empty weight,
- System complexity ((drive system, engines, blades, wing, number of parts, etc.).

Cost minimization should focus more on the rationale than upon the figures. That is, a qualitative evaluation of cost minimization is desired more than a quantitative evaluation.

- All student categories will address “direct effects”: energy consumption and local pollution in operation, recurring costs, non-recurring costs and operating costs.
- Graduate category will also address “indirect effects”: the overall energy consumption and the complete pollution chain.