30th Annual American Helicopter Society
Student Design Competition

2013 Request for Proposal (RFP)
For

The HealCopter

Sponsored by

EUROCOPTER
AN EADS COMPANY

And

AHS INTERNATIONAL

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1.0 Basic Proposal Information

EUROCOPTER extends greetings and invites you to participate in the 30th Student Design Competition (SDC) of the American Helicopter Society, International (AHS). This Request For Proposal (RFP) is divided into two sections. Section 1 (this section) provides a general description of the competition and the process for entering. This section covers the rules (both general and proposal specific) and schedules that the sponsor requires of the participants. It also describes the awards and provides contact information. Section 2 describes the specific challenge by EUROCOPTER.

1.1 Rules

1.1.1 Who May Participate

All undergraduate and graduate students from any school (university or college) may participate in this competition, regardless of nationality. A student may be full-time or part-time; their education level will be considered in the classification of their team (see 1.1.3).

1.1.2 Team Size and Number of Teams

We encourage the formation of project teams. The maximum number of students on a team is ten (10); the minimum team size is one (1), an individual. Schools may form more than one team, and each team may submit a proposal, but each team is limited to a maximum of ten students. A student may be a member of one team only.

We look favorably upon the development of multi-university teams for the added experience gained in education and project management. The maximum number of students for a multi-university team is twelve (12), distributed in any manner over the multi-university team.

The members of a team must be named in the Letter of Intent. The Letter of Intent is drafted by the captain of a team and sent to the American Helicopter Society by the date specified in section 1.3. Information in the Letter of Intent must include the name of the university or universities forming the team, the name of the team, the printed names of the members of the team from all the universities in the team, the e-mail addresses and education level (undergraduate or graduate) of each team member, the affiliation of each student in the case of a multi-university team, and the printed names and affiliations of the faculty advisors.

1.1.3 Categories and Classifications

The competition has two categories that are eligible for prizes. They are:

- Undergraduate Student Category
- Graduate Student Category

The classification of a team is determined by the highest education level currently pursued by any member of the team.

A "new entrant" is defined as any school (undergraduate or graduate) that has not participated in at least two of the prior three competitions. An additional prize will be awarded for the best proposal by a new entrant.

1.1.4 Language of Proposal

Regardless of the nationality of the teams, all submittals and communications to and from the American Helicopter Society will be in English.

1.1.5 Units Used in Proposal

All proposals shall provide answers in English and SI units. The primary units are to be SI units, followed by the secondary units in parentheses. The use of units shall be consistent throughout the proposal.

1.1.6 Proposal Format, Length and Medium

Two separate files comprise the Final Submittal and both must be present for a submission to be considered complete. The judges shall apply a significant penalty if either file is missing. The two files are the Executive Summary and the Final Proposal. Each are described herein.

The first file is called the Final Proposal. It is the complete, self-contained proposal of the team. It shall be submitted in PDF form readable with Adobe Acrobat. Exceptions will be considered with advance request.

Undergraduate category Final Proposals shall be no more than 50 pages and graduate category Final Proposals shall be no more than 100 pages. All pages are to be numbered. This page count includes all figures, diagrams, drawings, photographs and appendices. In short, anything that can be read or viewed is considered a page and subject to the page count, with the following exceptions. The cover page, acknowledgement page, signature page, posting permission page (see section 1.1.9), table of contents, list of figures, list of tables, nomenclature, reference pages and the Executive Summary are excluded from the page count for the Final Proposal. See section 1.1.6 for specific information about the signature page.

Pages measure 8 ½ x 11 inches. Undergraduate submissions may have four (4) larger fold-out pages with a maximum size of 11 x 17 inches, and graduate submissions may have eight (8) larger fold-out pages with a maximum size of 11 x 17 inches. If a submission exceeds the page limit for its category, the judges will apply a penalty equal to ¼ point per page over the limit.

All proposals and summaries shall use a font size of at least 10 point and spacing that is legible and enhances document presentation.

The second file is a PDF file called the Executive Summary. This is a self-contained "executive" briefing of the proposal. Both undergraduate and graduate category Executive Summaries are limited to twenty (20) pages measuring 8 ½ x 11 inches, with no more than four (4) larger fold-out pages of a maximum size of 11 x 17 inches. The Executive Summary can take the form of a viewgraph-style presentation, but it must be a PDF file readable with Adobe Acrobat. No additional technical content may be introduced in the Executive Summary. The judges shall apply the same page count penalty to the Executive Summary score as with the Final Proposal. The Executive Summary shall account for no more than 20% of the total score of the complete submission.

All submissions shall be made on a compact disc (CD). A back-up submission via e-mail to the AHS may also be provided by a team, but the submission will not be considered executed without receipt of a compact disc by the submittal deadline.

This *submission format made of two separate files is mandatory.*

1.1.7 Signature Page

All submittals must include a signature page as the second page, following immediately after the cover page. The signature page must include the printed name, e-mail addresses, education level, (undergraduate or graduate), and signature of each student that participated. In the case of a multi-university team, the page must also indicate the affiliation of each student.

The submittals must be wholly the effort of the students, but Faculty advisors may provide guidance. The signature page must also include the printed names, e-mail addresses and signatures of the Faculty Advisors.

Design projects for which a student receives academic credit must be identified by course name(s) and number(s) on the signature page.

1.1.8 Withdrawal

If a student withdraws from a team, or if a team withdraws their project from the competition, that team must notify the AHS National Headquarters Office in writing immediately.

1.1.9 Special Sponsor Rules

No special sponsor rule is requested.

1.1.10 Proposal Posting

The AHS will post the winning entries in the undergraduate and graduate categories on their web site. Other entries will be posted if the teams provide written permission by their team captain or designated point of contact and a faculty advisor at the time of submission. The written permission shall appear on a separate page immediately following the signature page. This permission page will not count against the page count.

1.2 Awards

EUROCOPTER is very pleased to sponsor the AHS Student Design Competition this year. EUROCOPTER will provide the funds for the awards and travel stipends.

Submittals are judged in two (2) categories.

Undergraduate category:

- 1st place - $800
- 2nd place - $400

Graduate category:

- 1st place - $1300
- 2nd place - $700

In addition, the best "New Entrant" (defined in section 1.1.3) will be awarded $300.

Certificates of achievement will be presented to each member of the winning team and to their faculty advisors for display at their school. The first place winner or team representative for the graduate and undergraduate categories will be expected to present a technical summary of their design at the 2014 AHS International Annual Forum. Presenters receive complimentary registration and will be provided up to $1000 in expenses to help defray the cost of attendance.

1.3 Schedule

Schedule milestones and deadline dates for submission are as follows:

Milestone	Date
AHS Issues a Request For Proposal	August 24, 2012
Submit Letter of Intent to Participate	No Later Than (NLT) February 1st, 2013
Submit Requests for Information/Clarification	Continuously, but NLT February 28th, 2013
AHS Issues Responses to Questions	NLT March 15th, 2013
Teams submit Final Submittal (Final Proposal and Executive Summary)	NLT June 28th, 2013
Sponsor notifies AHS of results	August 2nd, 2013
AHS announces winners	August 16th, 2013
Winning team presents at AHS Forum	May 20-22, 2014

We reiterate; if you intend to participate, your Letter of Intent must arrive at the American Helicopter Society, International no later than February 1st, 2013. The signature page must include all of the information requested in section 1.1.6.

All questions and requests for information/clarification that are submitted by teams to the AHS will be distributed with answers to all participating teams and judges. Entrants' requests for information/clarification (questions) will be answered as soon as possible. All of the questions and answers will also be distributed collectively to all entrants no later than March 15th, 2013.

The Final Submittal must be postmarked by June 28th, 2013.

1.4 Contacts

All correspondence should be directed to:

Ms. Kay Brackins, Deputy Director
AHS International
217 N. Washington Street
Alexandria, Va. 22314
Phone: (703) 684-6777
Fax: (703) 739-9279
E-mail: kbrackins@vtol.org

1.5 Evaluation Criteria

The proposals shall be judged on four (4) primary categories with weighting factors specified below.

A. Technical Content (40 points)

The Technical Content of the proposal requires that …

- The design meets the RFP technical requirements
- The assumptions are clearly stated and logical
- A thorough understanding of tools is evident
- All major technical issues are considered
- Appropriate trade studies are performed to direct/support the design process
- Well balanced and appropriate substantiation of complete aircraft and subsystems is present
- Technical drawings are clear, descriptive, and accurately represent a realistic design

B. Application & Feasibility (25 points)

The proposals will be judged on how well current and anticipated technologies are applied to the problem, and on the feasibility of the solution. The proposals must …

- Justify and substantiate the technology levels that are used or anticipated
- Direct appropriate emphasis and discussion to critical technological issues
- Discuss how affordability considerations influenced the design process
- Discuss how reliability and maintainability features influenced the design process
- Discuss how manufacturing methods and materials were considered in the design process
- Show an appreciation for the operation of the aircraft

C. Originality (20 points)

The originality of the proposal shall be judged on …

- How innovative is the solution
- How much does the solution demonstrate originality and show imagination
- Vehicle/system aesthetics

D. Organization & Presentation (15 points)

The organization and presentation of the proposal requires …

- A self-contained Executive Summary that contains all pertinent information and a compelling case as to why the proposal should win. It must be a separate file.

- An introduction that clearly describes the major features of the proposed system
- A well-organized proposal with all information presented in a readily accessible and logical sequence
- Clear and uncluttered graphs, tables, drawings and other visual elements
- Complete citations of all previous relevant work (the State-of-the-Art)
- Professional quality and presentation
- The proposal meets all format and content requirements

The RFP describes the contest and the requirements. Schedule, page count and other limits, and the basic rules are part of the RFP and will be judged under section 1.5, D.

1.6 Proposal Requirements

The Final Submittal 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. Use the following as guidance while developing a response to this Request for Proposal (RFP):

A. Demonstrate a thorough understanding of the RFP requirements.

B. 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.

C. Identify and discuss critical technical problem areas in detail. Present descriptions, method of attack, system analysis, sketches, drawings, and discussions of new approaches in sufficient detail in order to assist in the engineering evaluation of the submitted proposal. Identify and justify all exceptions to RFP technical requirements. Design decisions are important, but so are process and substantiation.

D. 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.

E. Section 1.1.5, titled “Proposal Format, Length and Medium” describes the data package that a team must provide in the Final Submittal. Specifically, the Final Submittal must contain two files transmitted on a Compact Disc. The first file is the Final Proposal, which is the full length, complete and self-contained proposed solution to the RFP. By self-contained, we mean that the proposal does not refer to and does not require files other than itself. The second file is an Executive Summary, which presents a compelling story why the sponsor should select your design concept. The Executive Summary should highlight critical requirements and the trade studies you conducted, and summarize the aircraft concept design and capabilities.

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

G. Unless otherwise specified, all engineering units should be expressed in SI units as a primary unit and the English units as secondary units.

2.0 System Objectives

2.1 Operating Concept

2.1.1 Difficulties faced by the ultimate customer with the current helicopter technologies

Recently, the images of the consequences of the earthquake that hit China in the province of Sichuan on May 12th, 2008 showed the vulnerability of the population located in these difficult to access regions.

That day, the rupture lasted close to 2 minutes and propagated at an average speed of 3 kilometers per second. The characteristics of this earthquake, which was of magnitude 8.0 on the Richter scale, were so severe that the quake destroyed almost 80% of the buildings.

In the past, disasters of such magnitude occurred for example in Alaska in 1964 and on the average, it is common belief that one earthquake of such size occurs somewhere in the world each year.

The consequences of the quake in China were dramatic as it hit areas with high population density and which were difficult to access both because they are located in mountainous areas and because the earthquake destroyed the existing infrastructures.

The rescue efforts were deployed internationally but they encountered major difficulties because of multiple reasons. First, the roads were completely damaged; some places were blocked off by landslides, so that emergency aid could not be distributed via the roads. Second, the extreme terrain conditions precluded the use of helicopter evacuation in most cases. As a consequence, there were numerous examples of population being stranded in their demolished village for several days without food and water before the rescue could finally arrive.

The authorities ordered the deployment of more than 150 helicopters, but they appeared to be sometimes not adapted to the specific atmospheric conditions (fog), which led to some accidents.

Satellite images provided some help, but it appeared that the means used to rescue the population were not satisfactory.

2.1.2 A brief history of previous attempts

We have other examples of natural disasters. Hurricane Katrina, which occurred in 2005 in the New Orleans area is remembered as the worst natural disaster in the history of the United States. It generated about 2000 casualties and caused considerable damage.

The Unites States Coast Guard provided a remarkable assistance to the 60,000 people stranded in New Orleans, rescuing over 33,500. Their pilots held their HH-65 Dolphins or HH-60 Jayhawk helicopters in steady hovers while the crewmembers provided emergency aid and raised up survivors.

It appeared that the pilots tend to go beyond their duty in a generous attempt to save as many as possible lives.

Several days into the disaster, other aircraft such as the Skycrane, the Chinooks, or the H-53 stepped in to help the rescuers.

Despite the huge efforts deployed, it appeared that the rescue operations did not provide the expected benefits, with many casualties and suffering among the population.

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2.1.3 State of the Art

The <u>first requirement</u> for a helicopter aimed at rescuing victims of natural disaster is the capability to reach rapidly the scene of the disaster with a large payload. It can be food, water, medical aid, tents. It should also be capable of reaching high altitude sites, and provide enough power even in high external temperature conditions.

Today, some helicopters provide large loading and carrying capabilities. Some have a reasonable speed but are quite slow compared to tilt-rotors or some high-speed compound helicopters, which are currently being tested.

Conversely, these faster aircraft configuration have generally a much lower productivity index in terms of weight.

The <u>second requirement</u> is related to the equipment the helicopter needs to operate safely. In addition to hoists, which can help extract the people trapped in dangerous areas, helicopters can be equipped with mission equipment, TAWS (Terrain Awareness and Warning), TCAS, (Traffic Collision Avoidance System), on-board medical equipment, and satellite communication systems.

2.1.4 Possible Approaches and Technologies

The rotorcraft aimed at rescuing the victims of natural disaster would embody several characteristics. It should be fast in order to reach rapidly the area where the rescue should take place, even at high altitude (3000 m). It should also have large autonomy at low speed to distribute first medical aid, and be equipped with special equipment aimed at providing first medical treatment to the most seriously wounded victims and operate safely in the midst of a large rescue fleet of aircraft.

Ideally, it would carry large amount of material and food, but this last requirement could be relieved considering that some material could be dropped by some airplanes and the rotorcraft would just transport weight from the area where the aid is dropped to the location of the victims.

The maximum speed the aircraft should achieve is about 240 knots. To achieve large autonomy at this speed, a classical helicopter would probably not be suited and one should consider alternate technologies.

To achieve large autonomy, 2 different requirements have to be followed. First, the aircraft must be capable of flying over a long distance. To achieve this, it could benefit from new engine technologies (diesel for example) or be optimized in terms of fuel consumption at the rotor level with efficient airfoils, adaptive twist, or configurable rotors. It could also benefit from a clean aircraft design with low drag, eventually with active devices to reduce it. The second requirement, to which the aircraft should comply, is related to the pilot workload and fatigue. The aircraft should benefit from pilot aids to reduce the workload, and be comfortable, both in terms of vibrations and noise level.

2.2 Specific Objectives

The following tasks are required.

Task 1 is required of all teams, Task 2 is required only of the graduate teams, and Task 3 is optional.

2.2.1 Task 1

The teams which take part in this competition, whatever the category, must choose an aircraft configuration (helicopter, tilt-rotor, compound aircraft) and the engine technology aimed at reaching high speed (240 knots minimum), a large autonomy in order to be able to perform the rescue mission as it is described hereafter.

The task should include:

- Global architecture tradeoff studies for competing designs.
- Rotor / wing / propeller / optimization studies (depending on the architecture chosen)
- Engine optimization studies
- Performance analysis for several atmospheric conditions (ISA;0m, ISA+20;3000m)
- Weight breakdown
- Transmission architecture
- Technological studies for the key components
- Costs estimates (DMC, DOC)

The aircraft is intended to operate within a fleet of several machines performing rescue operations in a coordinated manner. One aircraft is responsible for the coordination; several others are responsible for the evacuation of wounded people, while the others are responsible for the aid distribution. To increase its performance for each of the mission profiles, It should be easily reconfigurable. The three mission profiles are described in more detail in the following paragraphs:

a) Fast deployment and rescue coordination

This mission consists of a fast deployment to the disaster area and reconnaissance in order to assess damage victims and the nature of the help required, and areas where aid can be dropped by parachute for example, or landing areas for large aircrafts (Lockheed C130 Hercules,..).
Data and images are transmitted to the relief operation commander.

The following details describe the mission:

I) range: 600 km (approach, cruise speed 240 knots) + 600 km (flyover at 120 knots) + 600 km (return at 180 knots)
II) max density altitude: approach and return at 6000 m ISA+15°C, flyover at 2000 m ISA+15°C)
III) max TOGW: 15 tons
IV) useful load: 6 tons minimum
V) # of PAX:3
VI) Min acceptable climb rate: 2000 ft/min
VII) Load/unload max time allowed: not applicable for this mission

The mission will consist of:

- Engines start and warm-up for a quarter of an hour
- Take-off at ISA+15 and 1500m of altitude and climb from Z=1500m to Z=6000 m
- Acceleration to achieve cruise speed of 240 knots.
- Cruise at 240 knots (range including acceleration and climb phase: 600 km)

- Descent to Z=2000m
- Low speed flyover at Z=2000m: 120 knots during 2 and a half hour
- Climb to 6000 m
- Return to base at 180 knots, range 600 km

b) Aid distribution

This mission consists of providing medical aid to the most serious victims. One could consider the distribution of water, water purification devices, tents, food, clothes, medical aid, depending on the type of event for a total of 2 tons per aircraft and mission. The aircraft should perform level flight and drop food, medical aid, relief material with small parachutes. There will be no requirement for the aircraft to land and take-off repeatedly.

The following details describe the mission:

I) range: 600 km (approach, cruise speed 180 knots) + 200 km (flyover at 80 knots) + 600 km (return at 140 knots)
II) max density altitude: approach and return at 6000 m ISA+15°C, flyover at 2000 m ISA+15°C)
III) max TOGW: 15 tons
IV) useful load: 6 tons minimum
V) # of PAX:3
VI) Min acceptable climb rate: 2000 ft/min
VII) Load/unload max time allowed: 1 hour for 2 tons of material

The mission will consist of:

- Engines start and warm-up for a quarter of an hour
- Take-off at ISA+15 and 1500m of altitude and climb from Z=1500m to Z=6000m with 2 tons of relief material.
- Acceleration to achieve cruise speed (180 knots)
- Cruise at 180 knots (range including acceleration and climb phase: 600 km)
- Deceleration and descent at Z=2000m
- Low speed level flight to deliver medical aid (assumed 80 knots for a total range of 200 km)
- Climb to 6000 m
- Return to base at 140 knots

c) SAR: Evacuation of casualties

This mission consists of evacuating the most seriously injured people to the base where other helicopters are waiting for the transfer to the nearby hospitals.

The following details describe the mission:

I) range: 600 km (approach, cruise speed 240 knots) + 10 km (descent, landing, take-off, climb) + 600 km (return at 240 knots)
II) max density altitude: approach and return at 6000 m ISA+15°C, take-off and landing at 2000 m ISA+15°C)
III) max TOGW: 15 tons
IV) useful load: 6 tons minimum
V) # of PAX:3 + 6 wounded
VI) Min acceptable climb rate: 2000 ft/min
VII) Load/unload max time allowed: 30 min for 6 victims

The mission will consist of:

- Engines start and warm-up for a quarter of an hour
- Take-off at ISA+15 and 1500m of altitude and climb from Z=1500m to Z=6000m.
- Acceleration to achieve cruise speed (240 knots)
- Cruise at 240 knots (range including acceleration and climb phase: 600 km)
- Deceleration and descent at Z=2000m
- Landing
- Installation of victims
- Take-off and climb to 6000 m
- Return to base at 240 knots

The hard requirements are the following:

- Cruise speed minimum 240 knots
- High range for the 3 missions (if higher ranges than requested can be achieved, they should be provided and will be used for the evaluation of the project)
- Mission equipment for SAR and medical aid

The soft requirements are the following:

- Maximum take-off weight 15 tons

The Performance Index which will be used to compare the different proposals will be:

PI= PI weight + PI range + PI speed + PI DOC + PI DMC

- PI weight=15000/(Maximum take-off weight)

- PI range: (range for mission (a)/1800) + (range for mission (b)/1400)+ (range for mission (c)/1210

- PI speed: (maximum speed in knots)/240
- PI DOC (Direct Operating Costs): DOC/ (Black Hawk DOC+25%)
- PI DMC (Direct Maintenance Costs): DMC/ (Black Hawk DMC+25%)

2.2.2 Task 2

For the graduate category, a deeper technological investigation of the aircraft key elements is required. This will entail some stress level assessment and static and/or fatigue substantiation of the critical elements. The objective is to demonstrate, on a few selected cases, that the students master the stress substantiation tasks, including FAR requirements. The students should select at least one dynamics component (blade, hub, or transmissions) and one airframe component (frame, tail boom,…)

2.2.3 Task 3

All candidates may improve the report with innovative mission and system solutions aimed at making the flight as safe as possible.