



40th Annual Student Design Competition

2022-2023 Request for Proposals (RFP)

***High-Speed Vertical Takeoff
and Landing (HSVTOL)
Aircraft***

Sponsored by



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1. Basic Proposal Information

Sikorsky, A Lockheed Martin Company, invites university students to participate in the 40th Annual Student Design Competition (SDC) by the Vertical Flight Society (VFS).

This Request for Proposal (RFP) is divided into two sections. Section 1 (this section) provides:

- General description of the competition
- Process for entering
- Rules (both general and proposal specific)
- Schedules
- Award description
- Contact information

Section 2 describes the specific challenge by Sikorsky and VFS.

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, ***with the exception of countries or persons prohibited by the United States Government.*** A student may be full-time or part-time; their education level will be considered in the classification of their team (see Section 1.1.3).

1.1.2 Team Information: Roles, Size and Number of Teams

The formation of project teams is encouraged and must follow these rules:

- ALL teams, regardless of size, MUST name at least one (1) faculty advisor in order to compete
- Maximum number of students on a single-university team is ten (10)
- 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 (10) students
- A student may be a member of one team only
- Teams are allowed to include up to two external (2) advisors e.g., from industry and/or government organizations to mentor/advise on the design. The advisors' roles should be limited to providing feedback on existing ideas/designs. *External advisors from the current sponsor of the RFP are NOT allowed.*

We look favorably upon the development of collaborative, 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 (LOI). The LOI is drafted by the team captain and emailed to the Vertical Flight Society contact by the date specified in Section 1.3. Information in the Letter of Intent must include:

- Name of the university or universities forming the team
- Name of the team
- Printed name of each student member of the team including
 - Email
 - Education Level (Undergraduate or Graduate)



- Affiliation of each student in the case of multi-university team
- Printed name(s) and email address of the team captain and faculty advisor(s): ***the team captain and faculty advisor will be the point of contact for all SDC communication.***
- Printed name, affiliation and email address of any industry or government advisors.

1.1.3 Categories and Classifications

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

- Undergraduate Student Category: (1st, 2nd, 3rd)
- Graduate Student Category: (1st, 2nd, 3rd). NOTE: The classification of a team is determined by the *highest* educational level currently pursued by *any* member of the team.
- New Entrant Category: A new entrant is defined as any school (undergraduate or graduate) that has not participated in the last three prior competitions.

1.1.4 Language of Proposal

Regardless of the nationality of the teams, all submittals, and communications to and from VFS must be in English.

1.1.5 Units Used in Proposal

All teams must submit using both **English and SI units**. The primary units are to be English units, followed by the secondary units in parentheses. The use of units shall be consistent throughout the proposal. All engineering units should be expressed in the units of:

- Force: pounds (Newtons)
- Mass: pound-mass or slugs as appropriate (kilograms)
- Time: seconds, minutes, or hours as appropriate
- Length: feet (meters)
- Power: horsepower (kilowatts). Note, for electric power, only kW is necessary.

1.1.6 Proposal Format, Length and Medium

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

The Final Proposal is the complete, self-contained proposal of the team and must be submitted in Adobe PDF format and follow these guidelines:

- Undergraduate: no more than 50 pages
- Graduate: no more than 100 pages
- All pages numbered
- Page count includes all figures, diagrams, drawings, photographs, and appendices
- Pages should measure 8½ x 11 inches
- Use of font size of at least 10 points and spacing that is legible
- 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

In short, anything that can be read or viewed is considered a page and subject to the page count, with the following exceptions:

- Cover page
- Acknowledgement page



- Signature page (see Section 1.1.7)
- Posting permission page (see Section 1.1.10)
- Table of contents
- List of figures
- List of tables
- Nomenclature
- Reference pages
- Executive Summary

The Executive Summary. This is a self-contained “executive” briefing of the proposal and must be submitted in Adobe PDF format and follow these guidelines:

- Limited to twenty (20) pages for both undergraduate and graduate category and can use a presentation format
- No additional technical content should be introduced in the Executive Summary
- All pages numbered
- Pages should measure 8 ½ x 11 inches
- Use of font size of at least 10 points and spacing that is legible
- If a submission exceeds the page limit, judges will apply the same page count penalty to the Executive Summary score as the Final Proposal
- The Executive Summary is not scored separately but contributes up to 10% of the total score of the complete submission

All submissions shall be made via e-mail to the VFS contact or by upload to VFS.

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:

- Student name
- E-mail address
- Education level (undergraduate or graduate)
- Signature of each student
- 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, the team captain must notify the VFS SDC point of contact by email immediately.



1.1.9 Special Sponsor Rules

The Vertical Flight Society and the Student Design Competition Committee reserves the right to decline to make all the awards in the listed categories if there are not a sufficient number of submissions that meet the expectations of the judges.

Proposals that do not, in the assessment of the judges, demonstrate an adequate understanding of the problem may be deemed ineligible for an award. In addition, any proposal that includes plagiarism or that copies substantial portions of prior proposals or publications will be disqualified.

1.1.10 Permission/Proposal Posting

VFS will post at least the Executive Summaries of each of the winning entries in the undergraduate and graduate categories on their website. *Therefore, written permission MUST appear on a separate page immediately following the signature page – the permission page will not count against the page count.*

1.2 Awards

Sikorsky is very pleased to sponsor the VFS Student Design Competition this year. Sikorsky will provide the funds for the awards and travel stipends through VFS. Submittals are judged in four (4) categories. Awards are granted per team. All amounts are specified in US Dollars.

Undergraduate category

- 1st place: \$2,000
- 2nd place: \$1,200
- 3rd place: \$750

Graduate category

- 1st place: \$2,500
- 2nd place: \$1,800
- 3rd place: \$1,000

Best New Entrant (as defined in section 1.1.3)

- \$500 (undergraduate)
- \$750 (graduate)

Additional award information:

- Certificates of achievement will be presented to each member of the winning team and to their faculty advisors for display at their school.
- Student representatives from the first place graduate (up to two students) and undergraduate (up to two students) teams are expected to present a technical summary of their design at the Vertical Flight Society's 80th Annual Forum, May 7-9, 2024, in Montreal, Quebec, Canada, during an Aircraft Design Technical Session.
- The students(s) presenting the winning design will receive complimentary registration to the Forum.
- In addition, the first place graduate and undergraduate team's school will be provided a \$1,000 stipend to help defray the cost of the team's Forum attendance – the additional travel stipend amount will be included in the first place award disbursement to the school.



1.3 Schedule

Schedule milestones and deadline dates for submission are as follows:

<u>Milestone</u>	<u>Date</u>
VFS issues a Request for Proposal	August 2022
Teams submit Letter of Intent (LOI) to participate	NLT February 1, 2023
Teams submit questions for clarification Note: questions/answers will <u>not</u> be communicated on a case-by-case basis. VFS will distribute ALL questions/answers collectively to all participating team captains by March 28, 2023.	Continuously, but NLT February 24, 2023
Sponsor reviews team questions	Feb. 24 to March 27, 2023
VFS issues question responses to teams	March 27, 2023
Teams submit executive summary and final proposal	May 31, 2023
SDC Committee reviews/scores final proposals	June 1 to July 31, 2023
Sponsor notifies VFS of results	August 2023
VFS announces winners	August 2023
Winning Graduate and Undergraduate Teams present at VFS Forum 80 (2024)	Forum 80: May 7-9, 2024 Montreal, Canada

1.4 Point of Contact

All correspondence should be directed to:

Julie M. Gibbs, Technical Programs Director
Vertical Flight Society
2700 Prosperity Ave., Suite 275
Fairfax, VA 22031 USA
Phone: +1-703-684-6777 x103
E-mail: jmgibbs@vtol.org

1.5 Evaluation Criteria

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

1.5.1 Technical Content (40 points)

The Technical Content of the proposal requires that:

- The design meets the RFP technical requirements
- 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

1.5.2 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

1.5.3 Originality (20 points)

The originality of the proposal shall be judged on:

- Innovation, simplicity, and elegance of the solution
- Imagination and ingenuity of the ideas investigated within the trade studies
- Vehicle/system aesthetics

1.5.4 Organization & Presentation (15 points)

The organization and presentation of the proposal requires:

- Self-contained Executive Summary that contains all pertinent information and a compelling case as to why the proposal should win; this 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 proposal requirements (Section 1.6) and design objectives (Section 2)

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 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 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 and an explanation of why you chose the tools and methods.

Section 1.1.6, 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 the primary two files submitted via email or upload.

- A. 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.
- B. The ***Executive Summary***, which presents a compelling story why the VFS evaluators should select your design concept. The Executive Summary should highlight critical requirements and the trade studies you conducted and summarize the rotorcraft concept design and capabilities.

2 System Objectives

This Request for Proposal (RFP) is seeking air vehicle concepts which incorporate technologies and design features enabling threat avoidance to meet critical military needs in highly-contested environments.

The vehicle shall be capable of carrying a payload of 5,000 lb (2,268 kg) within an internal cargo bay with dimensions of 6.5 ft (1.98 m) high, 8 ft (2.43 m) wide, 30 ft (9.14 m) long at a mission Radius of Action of 500 nm (926 km). The vehicle shall have a cruise speed of no less than 450 kt (833 km/hr) at a threat-avoidance altitude greater than 20,000 ft (6,096 m) mean sea level (MSL). In addition to the speed, altitude, payload and range requirements, the vehicle design shall also include features to mitigate the severity of the outwash/downwash environment on ground personnel as well as minimize the susceptibility of the propulsion system to Foreign Object Debris (FOD) ingestion during vertical takeoff and landing (VTOL) operations. (NOTE: here and elsewhere in the RFP, the approximate SI units are provided as a convenience, but the English units are the exact requirements.)

2.1 Operating Concept

This RFP is seeking to resolve the inherent requirements conflict stated in the System Objectives. A vehicle capable of efficient hover and extended VTOL operations tends to require large open rotor systems, which make it difficult to achieve the speed requirement of greater than 450 kt true airspeed (KTAS) (833 km/h) at 20,000 ft (6,096 m) MSL. Similarly, a vehicle capable of high-speed tends to require smaller open or covered rotor systems, which make operations difficult from unprepared surfaces and place ground personnel and equipment in severe downwash/outwash environments.

To satisfy these diametrically opposed requirements and to meet the System Objectives, fundamental research and application of advanced technologies is necessary to enable transformational capability beyond the current state-of-the-art VTOL aircraft. Design teams are encouraged to explore a broad spectrum of technologies including:

- new propulsion systems for power/energy management
- aerodynamic enhancements
- structural efficiency improvements
- flight control systems, autonomy
- novel air vehicle configurations
- and any others

Figure 1 shows demonstrated concepts that have the potential to satisfy the requirements. *This RFP is seeking to understand the applicability of these and other configurations that could best satisfy the System Objectives.*

Figure 1: Tested VTOL Configurations



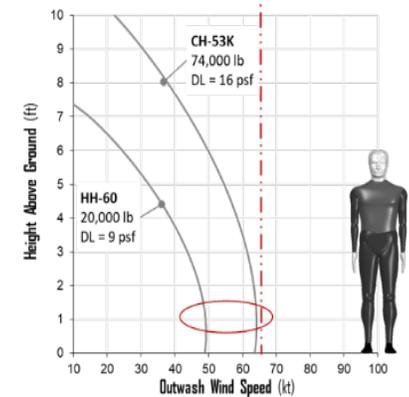
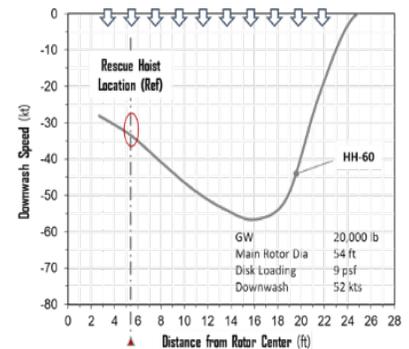
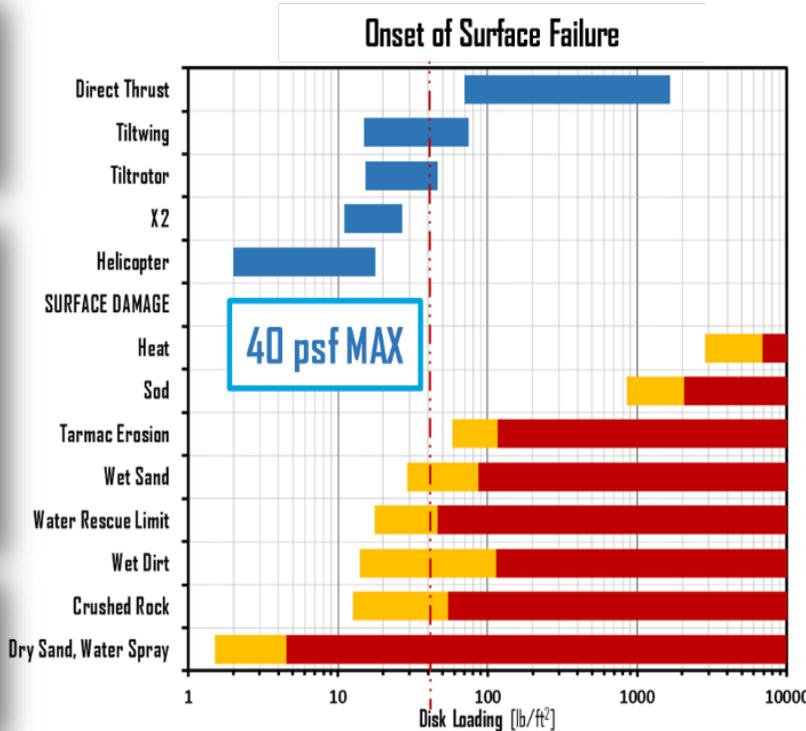
While meeting the speed and altitude requirements, the terminal operations requirement of downwash/outwash severity mitigation for ground crew and equipment must also be met. Generally, the ability to sustain hover operations near the ground is directly tied to the rotor disk loading. As illustrated in Figure 2, high disk loading results in high rotor outwash velocity fields that can significantly impact ground personnel and erode unprepared surfaces in the landing zone.

- The blue bars in the top portion of the plot in Figure 2 show the disk loading ranges of various VTOL configurations. For reference, disk loading for the H-60 helicopter is 7-10 psf (31.4-48.8 kg/m²), the S-97 Raider X2 compound is 12.5 psf (61.0 kg/m²), the V-22 tiltrotor is 22 psf (107.4 kg/m²) and the XC-142 tiltwing was 50 psf (244.1 kg/m²).
- The lower bars show how various landing surfaces begin to degrade in the presence of the rotor downwash as a function of the rotor disk loading. As indicated, water rescue is typically not performed with vehicles having disk loading greater than 10-20 psf (97.6 kg/m²). At higher disk loadings, unreinforced tarmac is shown to fail when subject to disk loadings greater than 100 psf (488 kg/m²).
- The right-hand charts illustrate the effect of rotor downwash directly under the rotor for the H-60 at 9 psf (43.9 kg/m²) and the outwash velocity at 120% of rotor radius from the vehicle centerline of the H-60 and CH-53K helicopters. At 9 psf for the H-60 and 16 psf (78.1 kg/m²) for the CH-53K, outwash speeds can reach up to 50-60 kt (92.6-111.1 km/h) at the knee height of ground personnel.

This RFP is seeking to understand the design trades required to balance sustained hover operations with high speed and high altitude capability with a view toward potential new technologies or design features that can be incorporated into the vehicle to manage the downwash/outwash environment.

Figure 2: Disk Loading Limits for Unprepared Surfaces and Downwash/Outwash

Operation on Unprepared Surfaces



2.2 Aircraft Requirements

The vehicle shall meet the following requirements:

1. The aircraft shall be manned with a crew of three at 250 lb (113 kg) each.
2. Structural Design Gross Weight (SDGW) shall be defined as the Takeoff Gross Weight (TOGW) of the Primary Mission illustrated in Figure 3 while carrying 5,000 lb (2,258 kg) of Payload and a Mission Equipment Package (MEP) of 1,000 lb (454 kg).
3. Airframe limit load factor shall be 3.5g at SDGW.
4. A weight contingency of 5% shall be applied to the sum of the component weights.
5. Landing Gear shall be designed for a sink speed of 10 ft/s (3.0 m/s) at SDGW with 2/3 rotor lift.
6. The aircraft shall be able to fly 450 KTAS (833 km/h) at 20,000 ft (6,096 m) MSL international standard atmosphere (ISA) conditions using no more than 100% Maximum Continuous Power (MCP) or 100% maximum continuous torque from the primary propulsion system at SDGW.
7. The aircraft shall have a mission Radius of Action (ROA) of 500 nm (926 km) while carrying 5,000 lb (2,268 kg) payload and 1,000 lb (454 kg) MEP, comprised of 450 nm (833 km) of cruise speed greater than 450 KTAS (833 km/h) at no less than 20,000 ft (6,096 m) MSL ISA and 50 nm (92.6 km) of cruise speed at the propulsion system’s MCP at an ambient condition of 2,000 ft MSL 85°F.

8. The aircraft shall be capable of executing a Hover Out of Ground Effect (HOGE) at the mid-mission segment of the Primary Mission illustrated in Figure 3 using no more than 90% of the engine Maximum Rated Power (MRP) or 100% of the gearbox and/or motor torque at an ambient condition of 2,000 ft (609.6 m) MSL and 85°F (24°C).

2.3 Mission Requirements

The Primary Mission profile and takeoff criteria are illustrated in Figure 3. The takeoff condition shall be 2,000 ft (609.6 m) pressure altitude and 85°F (24°C) outside air temperature (2k/85°F). The mission profile shall include:

1. 10 minute flight idle
2. 2-min Hover In Ground Effect (HIGE) takeoff
3. Cruise-climb at best climb speed (V_{BROC}) where range credit may be taken for the total Radius of Action (ROA) in Segments 4 and 6
4. Cruise 450 nm (833 km/h) at be no less than 20,000 ft (6,096 m) ISA conditions or best cruise altitude at the best range speed (V_{BR}) or no less than 450 KTAS (833 km/hr)
5. Descend to 2,000 ft MSL 85°F (no range credit may be taken)
6. 50 nm (92.6 km) of low-altitude, high-speed penetration
7. 2-min mid-mission Landing Zone (LZ) Hover Out of Ground Effect (HOGE) at Mid-Mission Gross Weight (MMGW). Segments 3-6 are repeated, followed by a 2 min HOGE landing segment. Fuel/Energy reserves shall be 20 min at V_{BR} and 2k/85°F.

Takeoff Criteria:

- 2k/85°F
- HIGE Takeoff
- HOGE at Mid-Mission (MMGW)
- 90% Engine MRP, 100% Cont. XMSN Torque.

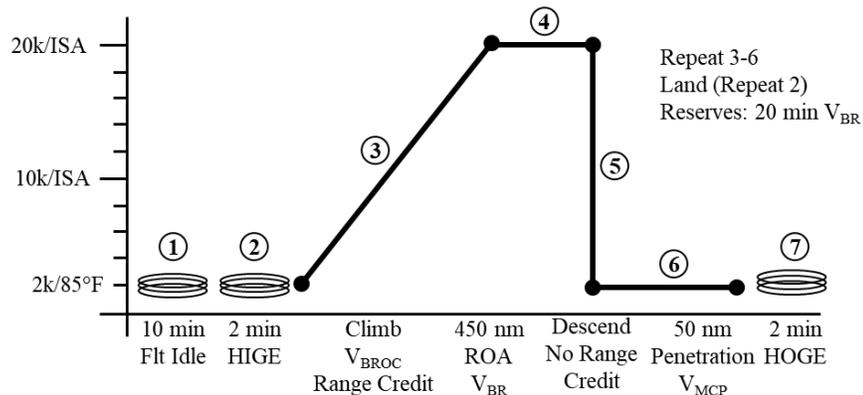


Figure 3: Primary Mission Profile

Engine power shall be no greater than 90% Maximum Rated Power (MRP) and gearbox and/or motor torque shall be no greater than 100% continuous transmission (XMSN) torque at the hover conditions.

2.4 Documentation Requirements

This section details the documentation requirements.

2.4.1 Conceptual Design Trade Studies

The teams shall provide a conceptual design trade study to substantiate their design. The trade study should document the types of vehicle configurations explored (open vs. ducted rotor, single vs. multi-rotor, etc.), propulsion systems explored (electric, fuel cell, solar, thermal engine, etc.) and general vehicle attributes varied/optimized (disk loading, rotor speed, etc.).

2.4.2 Vehicle Description

The teams shall provide a general description of the vehicle which highlights how it meets the stated requirements.

2.4.3 Propulsion System Data

The teams shall provide installed propulsion system performance estimates including power available at engine output shaft and energy consumption characteristics such as fuel flow per power setting at static conditions between idle and Maximum Rated Power (MRP).

2.4.4 Hover Performance Data

The teams shall provide hover performance estimates including total aircraft power required, total air vehicle Figure of Merit (FM) vs gross weight, and download as a percentage of gross weight.

2.4.5 Forward Flight Performance Data

The teams shall provide forward flight performance estimates including total power required versus airspeed from hover to maximum continuous power speed.

2.4.6 Mission Performance Data

The teams shall provide a segment-by-segment mission profile description that includes the following for each mission segment (assume sea level standard conditions):

1. Type of mission activity (HOGE, HIGE, Cruise, Reserve etc.)
2. Atmospheric condition (pressure altitude and free air temperature)
3. Average Gross Weight of mission leg starts and end
4. Airspeed
5. Distance or time
6. Fuel flow or energy consumption and specific range/endurance
7. Total power required and power available

2.4.7 Air Vehicle Design & Subsystem Drawings

The teams shall provide the following drawings:

1. General Arrangement: Three-view representation that defines the external geometry and design of the vehicle. Includes principal dimensions and general data table (surface area, span, chord sweep angles, etc.)
2. Inboard Profile: Defines the internal geometry and design of the vehicle. Includes propulsion, drive system, landing gear, Vehicle Management System (VMS), payload systems, etc.

3. **Structural Arrangement:** Three-view and isometric representations of the CATIA model that defines the internal structural arrangement of the product. Includes propulsion, drive system, landing gear, VMS, payload systems, etc.
4. **Subsystem Functional Schematics:** Clarifies the components of a system as well the system spatial relationship and interface within the vehicle. Included, as appropriate, are weight and power attributes, kinematics, dynamics and loads.

2.4.8 Aerodynamic Data

The teams shall provide isolated non-dimensional main rotor flight performance, including:

1. **Vertical Flight:** The ratio of ideal Hover Out-of-Ground-Effect (HOGE) power to actual HOGE power required, main rotor Figure of Merit, vs. blade-loading coefficient (C_T/σ).
2. **Forward Flight Edgewise Mode:** The ratio of main rotor lift to equivalent main rotor drags (L/De) as a function of rotor advance ratio, (μ). The rotor lift (L) and details of the rotor drag (De) calculation shall be documented in tabular form.
3. **Forward Flight Axial Mode (if applicable):** The propulsive efficiency (η) as a function of propeller advance ratio, (J).

The teams shall provide the aerodynamic data describing the airframe. The airframe excludes all items in the rotor system and aerodynamic surfaces (such as wings, if any). The following airframe equivalent areas (normalized by the freestream dynamic pressure, q) shall be documented:

1. Lift area (L/q) at zero degrees of vehicle pitch and yaw.
2. Parasite drag area (D/q) at zero degrees of vehicle pitch and yaw.
3. Pitching moment volume: (M/q) at zero degrees of vehicle pitch and yaw.
4. Parasite side force area (Y/q) at zero degrees of vehicle pitch and yaw.

The teams shall provide a component drag build-up. A table shall be provided which includes a list of the drag items, their horizontal and vertical drag coefficients (C_d), an equivalent flat-plate drag area, and an indication of the source of the drag estimate.

2.4.9 Loads & Criteria Data

The teams shall provide the following:

1. Limit load factor structural and aerodynamic envelope at structural design gross weight and maximum gross weight
2. Velocity-load factor ($V-N_z$) diagrams
3. Component design loads

2.4.10 Mass Properties Data

The teams shall provide the following:

1. Weight Empty Derivation (methods, fixed equipment lists, etc.)
2. Mission Weight Build-up
3. SAWE RP8A Part I Group Weight Statement.
4. Center of Gravity Analysis (laterally and longitudinally)



2.4.11 Manufacturing & Cost Data

The teams shall provide an estimate of the cost and schedule required to produce the vehicle based on assembly labor and bill of materials. These estimates shall be part of the trade studies discussed in Section 2.4.1.

2.5 Additional Tasks for Graduate Students Only

For the graduate category, a deeper technological investigation of the aircraft key elements is required. The Graduate Student Design Teams are required to complete one (1) of the following tasks:

1. Simulation & Flight Control Laws Development: The graduate design teams will be required to create a flight simulation of the aircraft so that a pilot may fly it in a simulator and give feedback to the team. X-Plane, FLIGHTLAB or a similar software package may be used. This includes the development of flight control laws to demonstrate the vehicle is stable and controllable in hover and forward flight throughout the duration of the mission.
2. Stress Analysis & Fatigue Substantiation: This will entail a Preliminary Design 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 teams should select at least one dynamic system component (blade, hub, or transmission) and one airframe component (frame, tail boom, etc.).
3. Aerodynamic Design Substantiation: The teams shall provide design substantiation of the rotor system and the airframe, showing that the performance objectives of the RFP are met.
4. Propulsion System Details: The teams shall provide design substantiation of the propulsion system (energy collection and storage mechanism, power conversion device, thermal management systems, etc.) to meet the performance objectives of the RFP.



3 Glossary

- AGL Above Ground Level
- cg Center of Gravity
- FAR Federal Aviation Regulations (US)
- FM Figure of Merit
- FOD Foreign Object Debris
- HIGE Hover In Ground Effect
- HOGE Hover Out of Ground Effect
- HSVTOL High-Speed Vertical Takeoff and Landing
- ISA International Standard Atmosphere
- KTAS knots true airspeed
- LOI Letter of Intent
- LZ Landing Zone
- NLT No Later Than
- MCP Maximum Continuous Power
- MEP Mission Equipment Package
- MMGW Mid-Mission Gross Weight
- MRP Maximum Rated Power
- MSL Mean Sea Level
- PDF Portable Document Format
- psf pounds per square foot
- RFI Request for Information
- RFP Request for Proposals
- ROA Radius of Action
- ROC Rate of Climb
- SAWE Society of Allied Weight Engineers
- SDC Student Design Competition
- SDGW Structural Design Gross Weight
- SI Système Internationale
- TBD To be determined
- TOGW Takeoff Gross Weight
- US United States
- V velocity/speed
- VFS Vertical Flight Society
- VTOL Vertical Takeoff and Landing
- XMSN Transmission