Vertical Flight Society

43rd Annual Student Design Competition

2025-2026 Request for Proposal (RFP)

Hybrid Electric Tiltrotor

Sponsored by

LEONARDO

23 March 2026 (REV 2.1)

Clarifications to Sections 2.2.1 and 2.2.2
Highlighted in Yellow

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1.0 Basic Proposal Information

Leonardo extends greetings and invites you to participate in the 43rd Annual Student Design Competition (SDC) of 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 the sponsor Leonardo.

1.1 Rules

1.1.1 Who May Participate

All undergraduate and graduate students from any university or college may participate in this competition, ***except for 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 1.1.3).

1.1.2 Team Information: Roles, Size and Number of Teams

The forming of project teams is encouraged and follows these rules:

- ALL teams MUST name at least one (1) faculty advisor to compete
- Maximum number of students on a single-university team is ten (10)
- Minimum team size is one (1), an individual, in addition to at least one faculty advisor
- 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 (2) industry and/or two (2) government advisors to mentor/advise on the design.

VFS looks 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 1.4. Information in the Letter of Intent must include:

- Name of the university or universities forming the team
- Name of the team

- Identify team as either a Graduate or Undergraduate team. Note: A team's classification (undergraduate or graduate) is based on the educational level currently pursued by the majority of its student members.
- 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
- Identify the team captain and faculty advisor(s): the team captain and faculty advisor will be the POC for ALL SDC communications.
- 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, listed below.

- A team's classification (undergraduate or graduate) is based on the educational level currently pursued by the majority of its student members.
- Undergraduate Category: 1st, 2nd, 3rd
- Graduate Category: 1st, 2nd, 3rd
- New Entrant Category: A new entrant refers to a university team (either undergraduate or graduate) that has *not participated in the last three competitions*. Whether a team qualifies as a new entrant will be determined by VFS during the proposal review process.

1.1.4 Language of Proposal

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

1.1.5 Units Used in Proposal

All teams must submit using both SI and English units: the primary SI units are to be followed by the secondary English units in parentheses.

The use of units shall be consistent throughout the proposal. All engineering units should be expressed in the units of:

- Newtons, N (force)
- Kilograms, kg (mass)
- Seconds, minutes, or hours as appropriate (time)
- Meters, m, or kilometers, km, as appropriate (length or distance)
- Meters per second, m/s (velocity/speed)
- Watts, W, or Kilowatts, kW as appropriate (power)
- Maximum Takeoff Weight (MTOW) and Payload Weight may be expressed in kilograms
- Newtons, N (Force)

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 penalty if either file is missing.

The two mandatory 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 and must be submitted in Adobe PDF and follow these guidelines:

- Undergraduate: Final Proposals shall be no more than 50-pages
- Graduate: Final Proposals shall be no more than 100-pages
- All pages are to be numbered
- Page count includes all figures, diagrams, drawings, photographs and appendices
- 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 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 second file is called the Executive Summary. This is a self-contained *executive* briefing of the proposal and must be submitted in Adobe PDF and follow these guidelines:

- Limited to twenty (20) pages for both undergraduate and graduate categories and can take the form of a viewgraph-style presentation
- No additional technical content should be introduced in the Executive Summary
- All pages are to be 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 (instructions will be provided by VFS).

1.1.7 Signature Page

All submittals must include 1) cover page and 2) a signature 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.

1.1.8 Withdrawal

If a student withdraws from a team, or if a team withdraws their project, including from the competition, the team captain must notify the VFS SDC point of contact by email immediately.

1.1.9 Special Sponsor Rules

Not applicable.

1.1.10 Permission/Proposal Posting

VFS will publish the Executive Summaries of each of the winning entries in the undergraduate and graduate categories on the SDC website *hence written permission MUST appear on the signature page* – the permission page does not count against the page count. ***Therefore, neither the Executive Summaries nor the Final Proposals are considered confidential.***

- The Society does <u>not</u> share or publish any of the non-winning proposals but does keep a record of all proposals.
- VFS makes no claims on the Intellectual Property or ownership rights of the proposals, which remains with the student team members (or the university if it asserts rights to student products), who are free to republish or use all or part of the proposal in future works.
- The permission page merely gives VFS the right to publish the executive summary and other parts of the proposal (e.g., images of the proposed aircraft) for the press release and other promotional purposes.

1.2 Awards

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

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):

- Undergraduate - $500
- Graduate - $750

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 and undergraduate (up to two students) teams are expected to present a technical summary of their design at the Vertical Flight Society's 83rd Annual Forum, May4-6, 2027 in Phoenix, Arizona during an Aircraft Design Technical Session.
- The student(s) presenting the winning design will receive complimentary registration to the Forum.
- In addition, the first-place graduate and undergraduate team's university 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.

The Vertical Flight Society and the Student Design Competition Committee reserves the right to decline to make all the awards in the above categories if there are not enough 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.

1.3 Schedule

Schedule milestones and deadline dates for submission are as follows:

Milestone	Date
VFS Issues the RFP	August 2025
Teams Submit Letter of Intent (LOI) to Participate	**February 1, 2026**
Teams Submit Requests for Information (RFI)/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 TBD, 2026.**	Continuously, but **NLT February 23, 2026**
Sponsor RFI/Question Review	Feb. 23 to March 2026
VFS Issues RFI/Question Responses to Teams	NLT March 23, 2026
Teams Submit Executive Summary and Final Proposal	**May 31, 2026**
SDC Committee & Sponsor Reviews/Scores Final Proposals	June 1 to July 31, 2026
Sponsor notifies VFS of results	August 2026
VFS announces winners	August 2026
Winning Graduate and Undergraduate Teams present at VFS Forum 83 (2026)	Forum 83: May 4-6, 2027 Phoenix, AZ

1.4 Contacts

All correspondence shall be directed to:

Julie M Gibbs, Technical Programs Director
Vertical Flight Society
2700 Prosperity Ave., Ste. 275
Fairfax, VA. 22031
Phone: (703) 684-6777 x 103
E-mail: jmgibbs@vtol.org

1.5 Evaluation Criteria

The proposals will be evaluated in 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 for both phases of the design/analysis
- 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 with 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 and 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 2.0)

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):

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. 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 is the process and substantiation.
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.

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.

1. 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.
2. The second file is an ***Executive Summary***, which presents a compelling story about 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.

2.0 System Objectives

2.1 Operating Concept

For nearly 75 years, the tiltrotor configuration has fascinated engineers and been the subject of extensive testing and development. The tiltrotor configuration has established itself as the primary configuration for meeting advanced, long-range VTOL system requirements.

Today, the industry is seeing a new form of propulsion that can serve to advance the tiltrotor configuration. Hybrid electric propulsion architecture offers the possibility of new power distribution options and new pathways for performance optimization.

Leonardo challenges the engineering academic community to consider options that exist for each architectural aspect of this new hybrid propulsion strategy and are pleased that the XV-15 (Figure 1) represents a well-researched, documented example from which to conduct design excursions.

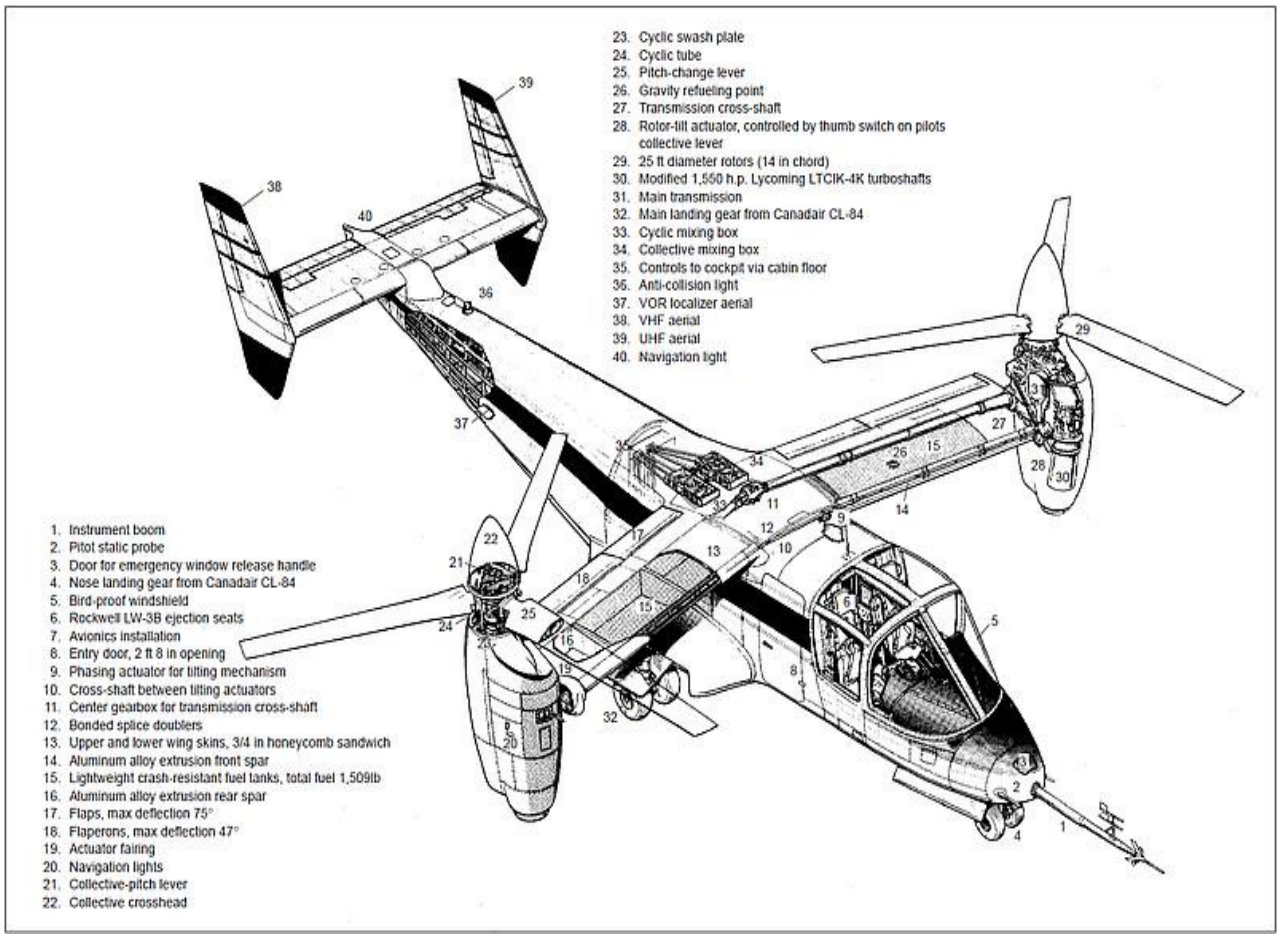

Figure 1. The XV-15 Tiltrotor

To support a thorough academic understanding of the impacts of hybrid electric propulsion, we are requesting a two-phase approach to the proposal design and analysis, as depicted in Table 1.

Table 1. Two-Phase Proposal Approach.

Respondents must submit proposed configurations for both phases of design/analysis.

Phase I - Constrained Hybrid Propulsion Design of the XV-15	Phase II - Minimally Constrained Hybrid Electric Tiltrotor Design
• Historical XV-15 Physical Configuration and Performance • Modern Hybrid-Electric Propulsion System	• Historical Flight & Mission Performance • Hybrid-Electric Propulsion Derived from Constrained System Approach

2.2 Aircraft or other Specific Requirements

The reviewers will permit a certain amount of liberty related to subsystems unrelated to the primary lift/power/propulsion/control system design.

The level of accuracy or fidelity of any analysis should reflect the level of detail required to confidently demonstrate the rationality as well as key features and benefits of the proposed configuration.

The proposed configuration must meet civil/commercial operating standards for OEI conditions as documented by the respondent.

2.2.1 Phase I - Constrained Hybrid Propulsion Design of the XV-15

Leonardo seeks hybrid design alternatives working from the NASA XV-15 as a baseline, (with data available from NASA archives). For the first phase of this hybrid XV-15 tiltrotor redesign, teams should assume the following:

- Same rotor, wing size, and blade aerodynamic properties
- Same MTOW/DGW
- Same empty weight, except for the systems impacted by the hybrid installation

Some reference works include:

- XV-15 Book (NASA SP-2000-4517) - https://www.nasa.gov/wp-content/uploads/2023/04/sp-4517.pdf
- NASA Report of the Model 300 (a preliminary configuration of the XV-15) (NASA-CR-114614) - https://ntrs.nasa.gov/api/citations/19730022217/downloads/19730022217.pdf
- NASA CR-114-682 is authorized as a source solely for wing and blade detailed geometry. https://ntrs.nasa.gov/api/citations/19740003720/downloads/19740003720.pdf
- Information outside of these documents may not supersede the design represented in these documents.

Teams should reconfigure the XV-15 to incorporate a hybrid electric propulsion architecture with:

- At least 10% (and up to 100%) of total mission power requirements must come from electrically generated sources.
- And/or at least 10% (up to 100%) of total mission power being distributed electrically.

The following assumptions are included:

- Thermal engine is the original T53 or downscaled, with same specific fuel consumption and similar rating structure.
- If batteries are desired for energy storage, they shall consist exclusively of the following specification: 250 Wh/kg; 2500 W/kg; 600 Wh/l @ Pack Level.

Air vehicle shape changes with respect to the original XV-15 must be related to hybrid system design - noting benefits or impacts - and must be justified by analysis. Changes to improve the aircraft that are not related to the hybrid system in this phase are not allowed.

- As an example, a design may put batteries in the sponsons enlarging them or may move fuel or engine locations due to hybrid system incorporation, however, a design may not shrink the fuselage or remove sponsons.

2.2.2 Phase II - Minimally Constrained Hybrid Electric Tiltrotor Design

In this second phase, the original design may be modified or improved, maintaining only the following design parameters derived from the Model 300 report:

- Mission Payload: 1600 lb
- Rotor Design Configuration: 25 ft (limited to the size that may be tested in the NASA 40x80 wind tunnel, as before) with the same blade number. ~~and airfoil/twist characteristics~~.
- Wing Design Configuration: Same span ~~and airfoils~~.
- Maximum Airspeed (V_{NO}): Not less than 300 ktas at 15,000 ft, Std Day; limit airspeed (V_{NE})not less than 350 ktas.
- Hover Out of Ground Effect capability: Not less than 10,000 lb at 4000 ft/95degF (4K/95)
- Maneuverability at 95% mission TOGW: As required for 2025 FAA Powered Lift/standard ATM flight maneuver requirements, 2G structural load factor in helicopter/conversion mode, 3.5G structural load factor in airplane mode
- Autorotation: Entry into autorotation maneuvers at any airspeed or flight mode
- Electrical power proportion, battery and thermal engine sizing as in Phase I
- Nominal cabin volume and capacity to accommodate 6 passengers plus crew at 200lb each.

To reduce the complexity of this design challenge, improved rotor, structural, or flight control system design changes yielding weight or drag improvement are not desired **but will be accepted with appropriate rationale.**

Scoring will be primarily based on the approach to hybridization. If a respondent is more inventive on other design improvements, this may be considered in evaluating originality and creativity of a proposal.

Air vehicle shape changes with respect to the original XV-15 may extend beyond the hybrid system design – noting the benefits or impacts – and must be justified by analysis. Changes to improve the aircraft in addition to the hybrid system modifications (identified in Phase I) in this phase are also permitted, except as noted above.

2.3 Mission Requirements

For the purpose of simplified mission analysis, the following segments are provided:

- 5 min HOGE, taking-off @ MTOW, 4K/95ºF
- Change altitude to 10,000 ft, ISA: no enroute range benefit
- Cruise, 260kcas
- Descend and land for a total distance of 306 nm with 10% fuel reserve
- 5 min HOGE, landing, ISA-SL
- 2 pilots @ 100kg each along with the initial mission payload

2.4 Document, Experimental or Other Requirement Task

Exotic, complex, or low-TRL designs are discouraged and will be scored accordingly.

For Phase I configurations, with consideration that the MTOW of the hybrid design shall not exceed that of the XV-15, a key evaluation criterion is the impact of hybridization on the payload weight relative to the original XV-15 payload.

- The original XV-15 payload and the final payload must be estimated in the proposal.
- Careful attention to limiting empty weight growth is a top priority.
- Proposals shall include the estimated payload-range diagrams for the original XV-15 and the modified aircraft.
- Similar or improved aircraft flight envelopes (Altitude, Airspeed, Service Ceiling, CG range, Height-Velocity diagram) are desired and should be included in the proposal, where the XV-15 and modified aircraft cases should be assessed.

For Phase II configurations, aircraft weight should be minimized and will be evaluated as such.

Proposals shall elaborate on the chosen hybrid electric system architecture and options, if desired.

- Discussions shall include all key aspects of the hybrid electrical system design, its requirements, operational impacts, benefits, and any trade studies or cost-benefit analyses that substantiate the modified design.
- Technology risk assessments, as well as manufacturing discussions, aircraft operations, and sustainment impacts should also be discussed along with benefits of the chosen architecture.

Teams shall include a table that specifies the information in **Table 2** below for the aircraft design in both phases of their proposal.

Briefly describe the make-up of the team and the skills or expertise that provide your team with the best perspective on the total integrated system design.

Table 2. Design Parameters.

XV-15 Baseline Parameters						Final Configuration Parameters							
Maximum Gross Weight, VTOL		Maximum Gross Weight, STOL		Installed Power		Maximum Gross Weight, VTOL		Maximum Gross Weight, STOL		Power Generation/ Distribution			
										Turboshaft		Electric	
Kg	Lb	Kg	Lb	KW	HP	Kg	Lb	KG	Lb	KW	Hp	KW	Hp
Payload VTOL		Payload STOL				Payload VTOL		Payload STOL					
Kg	Lb	Kg	Lb			Kg	Lb	Kg	Lb				
Rotor Diameter		N/A				N/A							
M	Ft												
Turboshaft Engine Weight						Battery Weight				Scaled Turboshaft Engine Weight			
Kg		Lb				Kg		Lb		Kg		Lb	
Fuel Weight						Electrical Power Distribution System Weight				Fuel Weight			
Kg		Lb				Kg		Lb		Kg		Lb	
N/A						Electrical Power Generation System Weight							
						Kg		Lb					
						Other Weight additions				Other weight deletions			
						Item	Kg	Lb		Item	Kg	Lb	
						Item	Kg	Lb		Item	Kg	Lb	
						Item	Kg	Lb		Item	Kg	Lb	
						Item	Kg	Lb		Item	Kg	Lb	

Add rows as needed

2.5 Graduate Task

The following task is required for graduate teams. And optional for undergraduate teams:

- Provide a detailed analysis of alternative or creative proprotor RPM strategies beyond the normal two-step RPM change between hover and forward flight: specifically related to the hybrid tiltrotor, not as a pure aerodynamic improvement strategy.
- Discuss the design impacts or implications to system components.

3.0 Glossary

- DGW design gross weight
- HIGE hover in ground effect
- HOGE hover out of ground effect
- IGE in ground effect
- LOI letter of intent
- MCP maximum continuous power
- MDO multidisciplinary design optimization
- MSL mean sea level
- MTOW maximum takeoff weight
- NLT no later than
- OGE out of ground effect
- PDF portable document format
- RFI request for information
- RFP request for proposals
- ROC rate of climb
- SAWE Society of Allied Weight Engineers
- SDC Student Design Competition
- SI Système Internationale
- TRL Technology Readiness Level
- TOGW takeoff gross weight
- USA United States of America
- V velocity/speed
- V_{be} best endurance speed
- V_{climb} climb speed
- $V_{descent}$ descent speed
- VFS Vertical Flight Society
- VTOL vertical takeoff and landing