VFS 42nd (2025) Annual Student Design Competition
Pioneering Hydrogen-Electric VTOL

REQUEST FOR INFORMATION from SDC Teams
Airbus Responses (March 24, 2025)

Q: Is there a specific format report that judges are looking for? (Research paper, journal article, consulting report, or something else?)
VFS Response: Teams should follow the proposal format information covered in Sections 1.1.4 to 1.1.7 of the RFP.

Q: Will teams receive feedback on their submissions if they do not place in the competition?
VFS Response: All teams will receive judges feedback regardless of placement in the competition. Note, only judges' comments will be shared not scores.

Q: What level of faculty involvement is permitted? Can professors contribute to the technical approach beyond general guidance?
VFS Response: Professors should not contribute to the technical approach and only provide general guidance.

Q: Which software is required for simulating the integrated vehicle, including full-flight simulation with coordinates for loitering, ascent, descent, etc.? Additionally, would it be possible for you to provide the necessary license for the suitable software?
Airbus Response: No specific software is needed for 3D mission visualization. Mission characteristics can be assessed per mission subsegments.

Q: Are there specific flight path requirements for the loitering phase (straight lines, orbit) or can teams choose whatever path is most efficient for our aircraft configuration?
Airbus Response: Loitering within a 2x2 km square with altitude conservation is deemed appropriate. The RFP has been updated accordingly.

Q: Are there any requirements for creating motor-cooling subsystems for safety?
Airbus Response: The relevant certification rules need to be respected. E.g. CS-27 compliant safety for inboarded systems, especially - CS-27 amd10 - CS27.1301 and .1309.

Q: Are there any specific weighting factors for how different mission segments impact the final scoring?
Airbus Response: No. The whole mission must be fulfilled, while maximizing the loiter time.

Q: Should crashworthiness and emergency egress be explicitly considered in the cabin layout?
Airbus Response: The relevant certification rules need to be respected. E.g. CS-27 or equivalent applicable to the proposed solution in the frame of commercial transport.

Q: Is noise minimization a design criterion, or is it assumed that noise is secondary to performance?
Airbus Response: External noise is a significant design criterion but difficult to assess in a pre-design study. We therefore consider designs with a tip speed below 0.65 Mach as a reasonable

assumption. Otherwise we are open to any realistic proposition. Please note that realism is a major driver of scoring.

Q: Is the loiter velocity required to be equal to the cruise velocity(TBD)? *The RFP specifies that the eVTOL should cruise at a velocity "V_be" (TBD). Later, it states that the eVTOL should loiter at the best endurance velocity, "V_be."* If these velocities are required to be the same, much of the flying time would be spent on cruise, since loitering at a high velocity is impractical, please clarify.
Airbus Response: **Well spotted. The RFP has been updated accordingly so that for the cruise segment 6 and 11 the best range speed v_br is used instead of the best endurance speed v_be.**

Q: Is it possible to recharge the battery on the ground with an external source of electrical energy or must it be recharged using the fuel cell? The question arises from the request to use only hydrogen as source of energy.
Airbus Response: **Pre-charging is ok. However, the weight of the integrated battery (cells and casing) shall be limited to 30 kg. The RFP has been updated accordingly.**

Q: In the optimization problem, must the aircraft MTOW be considered an independent optimization variable or is it intended to show how loitering time varies as a function of MTOW, as a sort of sensitivity study?
Airbus Response: **For the optimization problem requested from graduate teams, different strategies are possible to show overall design sensitivities. The payload is imposed, and if the mission time is imposed (e.g. T9=0), the MTOW is a fallout. Then a sensitivity study can be performed on the rotor diameter for example (equivalently on disk loading). This sensitivity can be performed for different input T9.**
Another possibility is to use the MTOW as a design variable, payload imposed, and then the convergence is made on empty weight (EW) and H2-related weights. This way, the total mission time T9 will be a fallout, and a sensitivity analysis can be made with respect to MTOW (alternatively, disk loading).
Minimum (or maximum) bounds should appear, that limit the extent of these sensitivities plots. Advice, prefer showing sensitivity analysis plots for each design variable, instead of a single optimum point. A focus on different EW groups sensitivity (and their physical drivers) will be highly appreciated.

Q: Is it necessary to write the analytical expression of the objective function (loitering time) in function of other design variables or is it sufficient to obtain the numerical optimal result? Is it necessary to write analytically for all the constraints?
Airbus Response: **Analytical expressions and/or respective sensitivity analysis plots give credibility to the numerical optimum presented.**

Q: Is the Vdescent mentioned in point 12 of Pioneering Mission (Section 2.2) the horizontal or vertical velocity?
Airbus Response: **Vertical descent speed in m/s.**

Q: The target is to maximize the Loitering endurance (T9), but is there a minimum threshold that a design needs to meet?
Airbus Response: **As stated in the RFP the loitering time T9 shall be $\geq$ 0 second.**

Q: Should a radius of action be considered for the Loitering motion required in mission segment 9? If so, what would be a suitable range of radius?
Airbus Response: **Loitering within a 2x2 km square with altitude conservation is deemed appropriate. The RFP has been updated accordingly.**

Q: The RFP specifies the dimensions for cabin space to be allocated, however the height is not mentioned. Do we need to consider a specific value or treat it as a variable design parameter to be used for optimization?
Airbus Response: **A minimum height of 1.45 m at pilot head yz plane section seems appropriate with realistic cabin height elsewhere. Certification compliance (e.g. CS-27) shall guide the design.**

Q: The bus bar voltage requirement is approximately 840 V, referring to the RFP. Is this voltage specifically for motor drives? Other balance-of-plant (Bop) equipment in the PEM fuel cell system, such as the compressor and coolant pump, may require lower voltages. Can we select a lower voltage for these components and step it down using converters?
Airbus Response: **Yes and yes.**

Q: Are there any restrictions on the placement of the H2 cylinder and the PEMFC power pack within the aircraft?
Airbus Response: **Yes, compliance with applicable certification rules (e.g. CS-27) shall guide the design, considering H2 as toxic and flammable gas.**

Q: Can teams use components that are currently available on the market?
Airbus Response: **Yes.**

Q: On Page 11, can the Vbe (best endurance velocity) be the same? or can they deviate from points 9 to 11?
Airbus Response: **For the sake of simplicity, a single v_be speed determined at MTOW is required, no varying speed during segments are allowed.**

Q: Page 14, states "*Hydrogen storage systems, high-temperature / low-temperature cooling systems, air and water management systems must be sized accurately and completely*." Do teams have to use all these components obligatory? Can a team not use any low-temperature cooling system?
Airbus Response: **We are open to any realistic proposition. Please note that realism is a major driver of scoring.**

Q: Figure 3, *'Illustration of the minimum usable floor surface area of the cabin'*: the minimum required dimensions are 1.25x1.5m, but the floor is not rectangular and does not have these exact dimensions. It resembles more of a trapezoid, where the height and the longer base represent the key dimensions. Therefore, what is the actual limitation on the shape of the cabin floor? What are the maximum allowed dimensions and shapes that can deviate from a 1.25x1.5m rectangle?
Airbus Response: **For clarification, the actual usable floor dimensions need to be inscribed in the minimum rectangle of 1.25 x 1.5m. Additionally, we require a minimum cabin useable floor area of 1.64 m^2 (1.5*1.25-(1.5/2*1.25/4)), with the shape to be defined by the applicants. Please note that realism is a major driver of scoring.**

Q: Are the passengers meant to make their observations with the naked eye, or with any equipment?
Airbus Response: **Naked eye is ok.**

Q: There is well-established safety conditions violated in segment 8 and potentially other segments of the mission based on the given mission profile; how should we address those safety concerns, if at all? Should teams adjust their design to accommodate these safety concerns?
Airbus Response: **Indeed CS-27 compliance or equivalent in terms of safety shall guide the design. Partial compliance will degrade the relevant score section. Note that your propulsion system may be able to provide a certain level of redundancies, and therefore improve the current regulatory safety level.**

Q: Regarding the minimum usable cabin floor space, would a tapered shape with a maximum width of 1.25 m and maximum length of 1.5 m be compliant, considering Figure 3?
Airbus Response: **For clarification, the actual usable floor dimensions need to be inscribed in the minimum rectangle of 1.25 x 1.5m. Additionally, we require a minimum cabin useable floor area of 1.64 m² (1.5*1.25-(1.5/2*1.25/4)), with the shape to be defined by the applicants. Please note that realism is a major driver of scoring.**

Q: Section 2.4.2 indicates that teams need to provide the *"Hydrogen flow rate and consumption during the mission."* For which component(s) of the system do teams need to provide the hydrogen flow rate through? Then, for consumption, are teams being asked for the specific fuel consumption, or the net rate of hydrogen consumption?
Airbus Response: **We understand flow rate as the one flowing out of the tank system, same for global consumption during the mission. If some unused H2 may still present onboard out of the tank system at the end of mission, it can be described as it is, and shall not be subtracted from global consumption.**

Q: For the hydrogen system and its related components, can teams rely on sizing estimations from UMD code, or do teams need to implement specific models of each component that are available on the market?
Airbus Response: **UMD code, as any other code, shall not be trusted blindly. Any well substantiated modifications / improvements, or matching specific market components, would be considered as a plus.**

Q: If a team plans to make an entire hybrid system, combining the fuel cell and battery, would it be considered a part of the buffer battery system as referenced?
Airbus Response: **Yes. However, the weight of the integrated battery (cells and casing) shall be limited to 30 kg. The RFP has been updated accordingly.**

Q: Would incorporating an ultracapacitor or supercapacitor into the buffer battery system be practical, and still be considered part of the same system?
Airbus Response: **The weight of the integrated battery (cells and casing) shall be limited to 30 kg. The RFP has been updated accordingly. Battery here means any kind of electrical storage.**

Q: Can teams use a battery stack as the main power source and the PEM fuel cell just as a replenishment source for the battery's charging?
Airbus Response: **The weight of the integrated battery (cells and casing) shall be limited to 30 kg. The RFP has been updated accordingly. Battery here means any kind of electrical storage.**

Q: Is cost to be considered a factor?
Airbus Response: **Sure.**

Q: Should water or air be used in a vehicle's cooling system?
Airbus Response: **Any liquid or gas installation, compliant with CS-27 or equivalently applicable certification regulation.**

Q: How should the material and design shape be to prevent hydrogen from escaping?
Airbus Response: **Hydrogen onboard shall be considered as flammable and noxious fluid. The relevant installations shall be compliant with CS-27 or equivalent.**

Q: What are the efficiency expectations for the fuel cell system?
Airbus Response: **See Datta, Anubhav. 2021. "PEM Fuel Cell Model for Conceptual Design of Hydrogen eVTOL Aircraft." NASA Technical Reports." https://ntrs.nasa.gov/citations/20210000284**

Q: How should the powertrain be optimized for endurance and efficiency?
Airbus Response: **The powertrain shall be sized according to applicable certification rules (e.g. able to pass CS27.923 tests).**

Q: What are the weight distribution requirements for the aircraft design?
Airbus Response: **Compliance with certification regulations (CS-27 or equivalent) shall guide the design, partial compliance will degrade the relevant score section**

Q: Are there preferred aerodynamic configurations for this competition?
Airbus Response: **We are open to any realistic proposition. Please note that realism is a major driver of scoring.**

Q: Are there any constraints on the material selection for the aircraft structure?
Airbus Response: **We are open to any realistic proposition. Please note that realism is a major driver of scoring.**

Q: What type of rotor or propeller system is most suitable for this VTOL design?
Airbus Response: **We are open to any realistic proposition. Please note that realism is a major driver of scoring.**

Q: Section 2.4 states, "*The design teams shall provide details about the Weights & Balance of the selected aircraft.*" Does this mean that the design teams must provide any specific Weights & Balance information?
Airbus Response: **Yes. Please note that realism is a major driver of scoring.**

Q: What happens if the pem stack operates at more than 90 degrees Celsius?
Airbus Response: **We are open to any realistic proposition about transient phases management. Please note that realism is a major driver of scoring.**

Q: If the pem stack exceeds 90 degrees, could it be an alternative to use a larger radiator?
Airbus Response: **We are open to any realistic proposition about transient phases management. Please note that realism is a major driver of scoring.**

Q: Are there any specific safety restrictions on the placement location for the hydrogen tank's physical integration in Section 2.5, and what other safety restrictions must we follow besides the 700 bar pressure limit?
Airbus Response: **Hydrogen onboard shall be considered as flammable and noxious fluid, and relevant installations compliant with CS-27 or equivalent.**

Q: Beyond the 1.25 m x 1.5 m floor area and 185 kg capacity specified in Section 2.3, what could be the minimum requirements for the cabin area? Are there any additional lower limits or expectations?
Airbus Response:
For clarification, the actual usable floor dimensions need to be inscribed in the minimum rectangle of 1.25 x 1.5m. Additionally, we require a minimum cabin useable floor area of 1.64 m² (1.5*1.25-(1.5/2*1.25/4)), with the shape to be defined by the applicants. Please note that realism is a major driver of scoring.

Q: Can we use a simple method to calculate weight distribution, or do we need to do a detailed analysis for every step?
Airbus Response: **A simplified method, using weight update only at mid mission, is deemed appropriate.**

Q: Is the number and positioning of hydrogen tanks entirely up to our preferences or is there a set number and location?
Airbus Response: **Hydrogen onboard shall be considered as flammable and noxious fluid, and relevant installations compliant with CS27 or equivalent.**

Q: How to know that PEM systems are stable.
Airbus Response: **No specific control analysis of the PEMFC fuel cell is required.**

Q: Hydrogen Storage and Power Distribution: The specifications require the use of high-pressure gaseous hydrogen for storage. What are the recommended design requirements regarding the placement of hydrogen tanks and their impact on the center of gravity? Additionally, since a buffer battery is allowed for peak power shaving, what criteria should be considered for its optimal sizing?

Airbus Response: **Hydrogen onboard shall be considered as flammable and noxious fluid, and relevant installations compliant with CS-27 or equivalent. The weight of the integrated battery (cells and casing) shall be limited to 30 kg. The RFP has been updated accordingly.**

Q: Flight Performance and Mission Profile: The mission profile emphasizes maximizing the loitering time. What methodologies are recommended for determining the best endurance speed (Vbe)? Considering the specified maximum altitude, air density, and zero-wind conditions, what critical design parameters should be prioritized to achieve the most efficient flight regime?
Airbus Response: **Standard helicopter aerodynamics required power breakdown can be used. E.g., please refer to Johnson's or Leishman's aeromechanics handbooks.**

Q: Aerodynamic and Structural Constraints: Given the dimensional constraints of 10m x 10m x 4m and the minimum cabin size requirements, what recommended configurations exist to enhance the aerodynamic efficiency of the VTOL aircraft? Specifically, what innovative solutions can be employed in rotor or wing design to improve performance?
Airbus Response: **We are open to any realistic proposition. Please note that realism is a major driver of scoring.**

Q: System Integration and Thermal Management: The PEM fuel cells must not exceed a steady-state temperature of 90°C. What passive or active cooling solutions are recommended for ensuring optimal thermal management? Furthermore, what control mechanisms should be implemented to maintain efficient and reliable operation of the power distribution system (including motors, batteries, and fuel cells)?
Airbus Response: **We are open to any realistic proposition. Please note that realism is a major driver of scoring.**

Q: Typical Environmental Conditions of the Competition Region: What are the expected environmental conditions of the competition region, including temperature, altitude, and wind speed, that should be considered for the aircraft design?
Airbus Response: **As stated in the Mission description 2.2, all segments are in ISA no wind conditions. No additional environmental conditions than the ones encountered in the mission are required. HOGE ceiling diagrams / maximum speed charts are required in ISA / ISA+20 though, to highlight the limiting systems.**

Q: Endurance Time Requirements: Is there a minimum requirement for the maximum endurance time? If so, what is the exact limit?
Airbus Response: **As stated in the RFP the loitering time T9 shall be $\geq$ 0 second.**

Q: Material and Cost Restrictions: Are there any restrictions regarding the materials used for the aircraft structure or the overall production costs?
Airbus Response: **We are open to any realistic proposition. Please note that realism is a major driver of scoring.**

Q: Main Rotor Performance Limitations and Targets: What are the specific limitations and performance targets set for the main rotor design?
Airbus Response: **Rotors limitations must of course be higher than performances required to fulfil the mission, including climb / HOGE requirements.**

Q: Evaluation Criteria for the Main Rotor Design: Which criteria will be prioritized in the assessment of the main rotor design?
Airbus Response: **We are open to any realistic proposition. Please note that realism is a major driver of scoring.**

Q: Are there any restrictions on the avionics systems to be used for the mission of detecting crocodiles in the river? (must be local, number of units, suitable for different concepts)
Airbus Response: **Naked eye is fully sufficient.**

Q: Can an existing Airbus helicopter fuselage be used as a basic configuration for the design? For example, is it permissible to modify the fuselage when integrating a hydrogen-electric propulsion system? If so, what are the restrictions and considerations regarding structural modifications, weight distribution and aerodynamic performance?
Airbus Response: **We are open to any realistic proposition. Please note that realism is a major driver of scoring.**

Q: In the cabin sizes (drawing from Fig. 3), the internal usable cabin floor depicts a minimum width of 1.25 m. However, considering the fuselage thinning that appears in the drawing, the drawing looks more like a maximum of 1.25 m. Can Teams consider this thinning and keep certain internal areas for the crew, or should the design stick with the requirement but set a squared region with those sizes that the fuselage needs to conform to?
Airbus Response: **For clarification, the actual usable floor dimensions need to be inscribed in the minimum rectangle of 1.25 x 1.5m. Additionally, we require a minimum cabin useable floor area of 1.64 m² (1.5*1.25-(1.5/2*1.25/4)), with the shape to be defined by the applicants. Please note that realism is a major driver of scoring.**

Q: Does the 10x10x4 box requirement apply only to storage and ground operations? or must it be maintained throughout the entire flight?
Airbus Response: **10x10x4 m box requirement applies only to storage and ground operations. Please note that realism is a major driver of scoring.**

Q: Mission segments for Cruise (6 and 11) call out for V_be as the flight speed. Is V_be mandatory if our concept has an alternative flight speed in cruise so that we can extend endurance segment 9 (loiter)?
Airbus Response: **The RFP has been updated accordingly so that for the cruise segment 6 and 11 the best range speed v_br is used instead of the best endurance speed v_be.**

Q: Does the aircraft footprint of 10x10x4m require the aircraft to be in full flight configuration for any flight regime? For example, parts of the aircraft could be folded or stowed to fit in this footprint, and then the full-flight aircraft configuration would unfold to be larger than this footprint.

Airbus Response: **10x10x4 m box requirement applies only to storage and ground operations. Please note that realism is a major driver of scoring.**

Q: Are dual controls required? Dual controls are depicted in the reference cockpit figure.
Airbus Response: **Yes, dual controls are required.**

Q: Can more specifics be provided on the statement to *"not use forward-looking statements for weight opportunities"*? Does this apply only to material properties and not to other advanced technologies?
Airbus Response: **We are open to any realistic proposition. Please note that realism is a major driver of scoring.**

Q: Does the mission require an energy reserve?
Airbus Response: **No.**

Q: Please provide clarification on the minimum interior usable cabin floor dimensions of 1.25m (width) x 1.5m (length)? The way the statement is worded sounds like any shape with maximum orthogonal dimensions of 1.25m and 1.5m would fit this.
Airbus Response: **For clarification, the actual usable floor dimensions need to be inscribed in the minimum rectangle of 1.25 x 1.5m. Additionally, we require a minimum cabin useable floor area of 1.64 m² (1.5*1.25-(1.5/2*1.25/4)), with the shape to be defined by the applicants. Please note that realism is a major driver of scoring.**

Q: Is there a dimension for the luggage space?
Airbus Response: **No. Not required.**.

Q: For the interior usable cabin floor, is there a cabin height requirement?
Airbus Response: **A minimum height of 1.45 m at pilot head yz plane section seems appropriate with realistic cabin height elsewhere. Certification compliance (e.g. CS-27) shall guide the design.**

Q: Please clarify the constraint of steady state? The RFP says that the PEM stack should not operate at a steady-state temperature of more than 90 deg C. How long can the stack operate outside of that range?
Airbus Response: **The steady-state refers to the control dynamics of the PEM stack, transient states should not be longer than 2 seconds.**

Q: As detailed under Section 2.4.2. Vehicle Performance, what is the difference between total power and aerodynamic power?
Airbus Response: **On top of the aeromechanic shaft required power to sustain the flight conditions, total power includes any other sources of power / losses required, including balance-of-plants items.**

Q: Are there any reserve fuel/time requirements?
Airbus Response: **No.**

Q: Are there any limitations on the size of the battery?
Airbus Response: **The weight of the integrated battery (cells and casing) shall be limited to 30 kg. The RFP has been updated accordingly. There is no limitation of the volume.**

Q: Autorotation in Mission Profile: please clarify the specific requirements regarding autorotation? Should the term be interpreted as requiring the capability for a landing via autorotation
Or does it simply refer to descending with minimal power consumption?

Airbus Response: **This segment is imposed to describe a rapid step between minimal power consumption and the HOGE required power. This is not necessarily performed by a conventional helicopter autoration, any other controlled zero power state might be accepted if correctly substantiated.**

Q: Transmission Modeling Clarification: regarding the statement "Vehicle transmission efficiency for all mission segments," could you specify the expected scope? Does this requirement pertain solely to the mechanical gearbox, or should it also include elements such as wiring and associated electrical components?
Airbus Response: **Yes, transmission efficiency refers to any mechanical and electrical components losses during the mission that shall be described.**

Q: Regarding the minimum internal useable cabin floor area: is it allowed to modify the cabin floor area geometry as shown in figure 3 (not stick to a rectangular shape)? Could the minimum height of the cabin room be given? Can teams estimate the height of the cabin room considering pilot's sitting height?
Airbus Response: **For clarification, the actual usable floor dimensions need to be inscribed in the minimum rectangle of 1.25 x 1.5m. Additionally, we require a minimum cabin useable floor area of 1.64 m² (1.5*1.25-(1.5/2*1.25/4)), with the shape to be defined by the applicants. Please note that realism is a major driver of scoring.**
A minimum height of 1.45 m at pilot head yz plane section seems appropriate with realistic cabin height elsewhere. Certification compliance (e.g. CS- 27) shall guide the design.

Q; Regarding the parameter V_BE {best endurance velocity): should this be considered a single value across all mission segments? or is it expected to vary for each segment?
Airbus Response: **For the sake of simplicity, a single v_be speed determined at MTOW is required, no varying speed during segments are allowed.**

Q: The mission profile instructs teams to fly between 30-300m over the Alligator river wildlife refuge near Kitty Hawk, North Carolina (Figure 1) However, in an online VFR map and by courtesy of the FAA regulations (AC 91-36D, screenshot below), for the wildlife refuges there is a minimum flight level of 2000 ft (700m). Is there a certain way to bypass this regulation? Or should teams adjust the mission profile to go through a longer but legal route?

8. VOLUNTARY PRACTICES.

a. Avoidance of noise-sensitive areas, if practical, is preferable to overflight at relatively low altitudes.

b. Pilots operating noise producing aircraft (fixed-wing, rotary-wing and hot air balloons) over noise-sensitive areas should make every effort to fly not less than 2,000 feet above ground level (AGL), weather permitting. For the purpose of this AC, the ground level of noise-sensitive areas is defined to include the highest terrain within 2,000 feet AGL laterally of the route of flight, or the uppermost rim of a canyon or valley. The intent of the 2,000 feet AGL recommendation is to reduce potential interference with wildlife and complaints of noise disturbances caused by low flying aircraft over noise-sensitive areas.

Alligator river is classified as a wildlife refuge (marked by the dark green borders):

Airbus Response: **Well spotted. As the mission is only a virtual exercise, no diversion from the current mission profile is required.**
As a general guidance: Highlighting real-life operational or other regulatory constraints that may not have been considered in the RFP is certainly considered as a plus in the final scoring.