Request for Information: Designing Next Generation VTOL UAS

1. Objective

The objective of this Request for Information (RFI) is to gather input to inform future NASA Aeronautics Research Mission Directorate (ARMD) research in Vertical Take-off and Landing (VTOL) Unmanned Aircraft Systems (UAS) technology. NASA seeks to identify major technical barriers to increased use of 5- to 1000-lb VTOL UAS for civil missions. NASA will focus research efforts on vehicle technologies to enable a new generation of VTOL UAS that are low-noise, low-emission, and significantly more durable, efficient and reliable than current configurations. Integration of UAS in the airspace is also being addressed by NASA but this RFI is specifically targeted at *vehicle* technology.

Table 1 shows three vehicle weight classes for a few notional low-altitude flight environments and missions. Also shown are capability improvements that NASA intends to push well beyond current state of the art levels. NASA seeks information from developers and end-users on the vehicle technology gaps that must be addressed to realize the capability improvements for Vehicles A, B, and C.

Table 1. Notional Vehicle Characteristics and Missions

Vehicle ID	Vehicle Gross Weight (lb)	Example Flight Environment/Mission (Low Altitude)	Capability Improvements
A	5 to 55	surveillance, photography, policing, agriculture, delivery, surveying (park/wildlife), inspection, emergency services, search in inclement weather, time-critical deliveries, etc.	noise, emissions, range, endurance, and all-weather operations
B	< 350		
C	< 1000		

2. Background

This is a Request for Information (RFI) to support the planning, advocacy, prioritization, and execution of research related to VTOL UAS in the next five years. The requested information is intended to support the NASA ARMD Strategic Implementation Plan. The current versions of the Strategic Implementation Plan can be downloaded from:

http://www.aeronautics.nasa.gov/strategic-plan.htm

Part of the Strategic Implementation Plan is to enable a broad expansion of vertical-lift applications by improving speed, payload, and safety while reducing noise and cost. Advances in the aforementioned areas will enable new vehicle capabilities and new markets.

Historically, NASA has conducted research on rotorcraft configurations and components of full- and scale-models of manned configurations. The ease of assembling inexpensive off-the-shelf parts to create new and different configurations has dramatically expanded the number of VTOL UAS configurations appearing on the market. The potential for expanding the use of these vehicles for civil missions is very high, assuming the configurations are robust, reliable, and safe. NASA intends to apply a suite of analysis tools, unique testing facilities, advanced measurement techniques and technologies to VTOL configurations to address major technical issues defined by the community as barriers to developing the next generation of VTOL UAS. This RFI is targeted at developers and commercial operators of VTOL UAS in the 5- to 1000-lb weight class.

3. RFI Response Instructions

NASA seeks responses to the questions in Appendix A. Partial responses are welcome. Responses will be used to aid NASA in prioritizing future research to focus on areas that have significant and broad impact for a large segment of the community. NASA may use a summary of responses to represent the community input without identifying individual responses.

It is emphasized that this RFI is NOT a Request for Proposal, Quotation, or Invitation for Bid. This RFI is for information and planning purposes only, subject to FAR Clause 52.215-3 titled “Request for Information or Solicitation for Planning Purposes,” and is NOT to be construed as a commitment by the Government to enter into a contractual and/or binding agreement, nor will the Government pay for information solicited. The Government may request follow-on discussion with one or more respondents, at the Government’s discretion, to obtain clarification or additional detail of the material submitted. Respondents will not be notified of the results of the evaluation.

It is not NASA’s intent to publicly disclose Respondents’ proprietary information obtained in response to this RFI. Proprietary and export controlled information should be marked appropriately in your response. To the full extent that it is protected pursuant to the Freedom of Information Act and other laws and regulations, information identified by a Respondent as “Proprietary or Confidential” will be kept confidential. NO CLASSIFIED INFORMATION SHOULD BE INCLUDED IN ANY RFI RESPONSE. No solicitation exists; therefore, do not request a copy of the solicitation. If a solicitation is released, it will be synopsized in the FedBizOpps and/or NASA Acquisition Internet Service websites. It is the responsibility of any potential offerors/bidders to monitor these sites for the release of any solicitation or synopsis.

The Point of Contact (POC) for questions regarding this RFI is:

Susan A. Gorton
Email address: LARC-RFI-UAS-2017@mail.nasa.gov

4. Schedule

All responses shall be submitted via e-mail to LARC-RFI-UAS-2017@mail.nasa.gov by close-of-business (COB) May 26, 2017. Files may be submitted in MS Word, PDF, or RTF format. Paper submissions will not be accepted. All responses shall be no more than ten (10) pages including questions, graphs, charts, tables, illustrations, and other figures. A page is defined as one (1) sheet 8 ½ x 11 inches using a minimum of 12-point font size for text. After May 26, 2017, NASA may contact a responder for further information and/or to inquire whether the responder may be interested in engaging with NASA to pursue specific research topics.

Appendix A. RFI Questionnaire

Please answer as many questions as possible (10-page limit).

1. **Information about your organization**
    a. Name
    b. Address/Location
    c. Please select the category that describes the function(s) of your organization (circle all that apply):
        i. Designer
        ii. Manufacturer
        iii. Operator
        iv. Consultant
        v. Other (please describe)
    d. Size of business (large, small, small disadvantaged, 8(a), veteran-owned, service disabled veteran-owned and/or women owned or HUBzone, etc.)
    e. Number of full-time employees
    f. Years in business
    g. Primary source of funding (e.g., government, commercial sales, private, etc.)
    h. Description of facilities
    i. What vehicle configuration(s) do you manufacture? Please indicate dimensions, gross weight, number of rotors, number of motors.
    j. What missions and vehicle capabilities are you targeting for the vehicles that you manufacture?
    k. What long-term vision do you see for the market, vehicle performance and operational characteristics?

2. **Design Tools and Design Processes**
    a. What types of analyses do you use to size your aircraft and components?
    b. What design and engineering work is performed within your organization? What design and engineering work is outsourced?
    c. What analyses do you need to improve your design process?
    d. What types of testing and validation are part of your design process?
    e. If you perform predictions of vehicle characteristics (e.g., noise, dynamics, aeromechanics, etc.), what type of codes do you use for your analyses (e.g., spreadsheets, Computational Fluid Dynamics (CFD) codes, etc.)? Are you willing to use other prediction methods if made available to you? What is the most important parameter to be able to predict accurately for your vehicle?
    f. What types of computational resources do you have access to?
    g. If you were to perform predictions (noise, aeromechanics, etc.) on your vehicles during the design phase, what level of detail and/or what "turn-around time" would be acceptable in order to have an impact on your vehicle design?

h. If modifications were made to your design after production started (for example, if you found a way to make the rotor noise significantly lower), what would drive your decision on whether or not (or even when) to incorporate such an "improved design" in your production line?
i. If you were tasked to develop Vehicle(s) A, B, and/or C (from Table 1 in RFI) today, what would be the main obstacles in your development process? You may address one or more vehicles.
j. What technical advances (e.g., propulsion, materials, analysis tools, sensors, etc.) are needed to improve the following characteristics of your vehicle?
    i. Robustness/durability
    ii. Efficiency (range, endurance)
    iii. Noise
    iv. Emissions
    v. All-weather operations
    vi. Safety
    vii. Other
k. Describe any built-in, fail-safe capabilities in your design.

3. Vehicle Components and Assemblies

a. What components and assemblies do you manufacture yourself?
b. What manufacturing processes do you use (e.g., additive manufacturing, injection molding, etc.)?
c. What components and assemblies do you buy? Please indicate whether the item is custom-made or commercial-off-the-shelf.

4. Operations

a. What service do you provide using your vehicles? Would you say that your service is for a city, county, state, federal, or other organization(s)?
b. What vehicle configurations do you operate (i.e., manufacturer, model)? How many of each configuration is included in your fleet?
c. What criteria did you use to select this specific vehicle (e.g., operational constraints, cost, environmental constraints, etc.)?
d. Please describe any suggestions you have regarding: 1) type of targets or metrics for environmental (noise/emissions) acceptability, and 2) ideas and procedures for measuring the targets/metrics.
e. Please describe your maintenance guidelines and/or periodic inspection procedures for your vehicle system(s).
f. What is the estimated service life of your vehicle(s)?
g. What are the primary vehicle maintenance issues for your vehicles?
h. What system failures are of most concern, particularly for your operations? What technologies should be pursued to minimize system failures of future vehicles?

i. What are the primary technical (non-regulatory) barriers limiting operations of your vehicles (e.g., controllability, endurance, noise, winds, precipitation, etc.)?

5. **Business/Market**
    a. What types of entities (i.e., academia, commercial firms, non-profits, small business) are you collaborating with and in what capacity?
    b. Who are your main customers? For example, hobbyists, firefighters, police, entertainment industry, sporting industry, military, etc.
    c. How many vehicles per year do you plan to manufacture or buy?
    d. What vehicle capabilities are essential to support your business case (e.g., low-noise, all-weather ops, fail-safe, beyond line of sight operations, range, speed, endurance, cost of vehicle, etc.)?
    e. What factors influence the insurance cost of operating your vehicle(s)?
    f. What information or technology improves the ability to get cost-effective insurance?

6. **Community Acceptance**
    a. What do you perceive are the obstacles, if any, to improving public perception of VTOL UAS?
    b. What do you see as the main technical challenges or gaps to the increased use and acceptance of these types of vehicles?

7. **Recommendations for Advancing VTOL UAS Technology**
    a. What do you see as the main technical barriers to developing the next generation of VTOL UASs?
    b. Do you have any additional thoughts on the type and scope of vehicle technology research activities that NASA should perform to benefit the VTOL UAS industry?

8. **Collaboration Interest**

    NASA is interested in applying a suite of in-house analysis tools to a wide range of vehicles. To that end, characterizing the acoustics and performance of the vehicles is necessary. Would you be interested in collaborating with NASA? Examples of collaboration include: providing one or more of your vehicles to be tested (wind tunnel test and/or flight test) by NASA, using NASA tools to analyze your vehicle(s), providing your own test data to NASA for analysis, providing mission scenarios to NASA for analysis, participating in standardized acoustic tests, etc. To the greatest extent possible, all measurements made by NASA will be published openly. If you are interested in collaborating with NASA, please describe the proposed activity, including any concerns/issues you have regarding the collaboration.