NASA Request for Comments on Information Collection: Remotely Administered Psychoacoustic Test for Advanced Air Mobility Noise Human Response

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Thank you for the opportunity to submit this comment regarding NASA's Request for Comments on Information Collection: Remotely Administered Psychoacoustic Test for Advanced Air Mobility Noise Human Response; Docket ID: NASA_FRDOC_0001-0545. The Aviation-Impacted Communities Alliance (AICA) includes 70+ groups across the country dedicated to protecting communities from harmful levels of aviation noise and pollution through campaigns for legislation and industry change nationwide. Studio City for Quiet Skies and UproarLA represent hundreds of thousands of residents in the Southern San Fernando Valley and Santa Monica Mountains, including Studio City, Sherman Oaks, Encino, Bel Air, Beverly Hills, and other parts of Los Angeles.

Our overarching input is for NASA to design, execute, and derive findings from the Varied AAM Noise and Geographic Area Response Difference (VANGARD) test to accurately reflect how impacted communities experience noise. The current FAA noise policy and metrics based on government agency and non-government agency research do not.

The new Advanced Air Mobility (AAM)/Urban Air Mobility (UAM) technologies are expected to have negative impacts from the number and type of aircraft such as: the loudness (including the whirring of the multiple rotors), visual pollution, the sheer frequency of noise events, the hovering, the low altitude of overflight, the time of day (noise in the early AM and late PM hours has greater impact), privacy concerns, threat to wildlife and their habitat, and the safety risk associated with more and different types of aircraft overhead. It is our hope that NASA will do its utmost to represent the lived experience of potentially impacted communities in the design, execution, and derived findings of the VANGARD test.

Respectfully submitted,

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CC:
Members of the Quiet Skies Caucus
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Our comments on questions follow.
Note: Italicized text is used for NASA questions.

(1) Whether the proposed collection of information is necessary for the proper performance of the functions of NASA, including whether the information collected has practical utility.

If the design, execution, and derived findings **truly reflect the lived experience of communities** who may experience AAM/UAM impacts (see response to (3) below) then there is practical utility. Otherwise, no. An overarching concern is that the focus is too narrow to draw reasonable conclusions, some terminology is too vague or will have unrealistic dB levels (e.g., "high" and "low" ambient noise with unspecified dB levels), and the findings will be misused to represent community annoyance when it does not. This would be exacerbated by subsequent hypothesis research questions based on the data being invalid and having no practical utility. The VANGARD findings should clearly state the outcomes including what conclusions cannot be made.

Unfortunately, there is a poor track record of predicting noise annoyance and understanding the factors related to annoyance (communities' experience of noise), despite previous research. This is evidenced by flight path changes for FAA NextGen airspace modernization and communities' feedback on those changes in the Neighborhood Environmental Survey (NES) from 2021. NextGen created new noise impacts many miles away from airports. NextGen moved established historic flight tracks and noise to new communities unaccustomed to overflights and aircraft noise, concentrated air traffic into very narrow flight paths ("NextGen corridors"), lowered altitudes, and changed speeds and altitudes via new or modified waypoints. The NES results show that a much greater proportion of people are highly annoyed by aircraft noise across all levels of DNL than was previously thought. Significant noise annoyance occurs at DNL levels significantly below 65 dB in the new National curve. The Schultz curve corresponds to 12.3% annoyance for DNL 65 dB. Extrapolating the same 12.3% of annoyance on the National NES curve corresponds to DNL 46 dB.

(3) Ways to enhance the quality, utility, and clarity of the information to be collected.
The design, execution, and derived findings of the VANGARD test must truly reflect how communities experience noise. Otherwise, the data will be based on a fictional and theoretical noise experience, not the communities' lived experience. Therefore, our comment in (3) also pertains to ***"allow NASA to test additional hypothesis research questions based on the obtained data."*** If the data does not reflect the communities' lived experience, the subsequent hypothesis research will also be flawed. For (3) we cover Communities Experience of Noise, Disclosure and Scientific/Ethical Integrity, and What to Avoid.

COMMUNITIES EXPERIENCE OF NOISE

Ambient Noise
NASA states in the FRN "Subjects will be drawn from low and high ambient noise areas of geographical regions within the United States that are likely to see initial AAM/UAM operations, such as Los Angeles, Dallas, and New York City. 'High' ambient noise environments are locations proximate to urban centers of each region, while 'Low' ambient environments are suburban areas along likely AAM/UAM flight paths within 100 miles of the urban center."

We concur that ambient noise needs to be a major consideration in assessing noise impacts including AAM/UAM. We applaud the effort by NASA to look at ambient noise. One concern is regarding the noise levels assigned to "High" and "Low" ambient environments and additional factors associated with site

selection, such as “within 100 miles of the urban center”. In addition, communities that, prior to NextGen, had low ambient noise but might be now, falsely, considered a high ambient noise environment. Moreover, the existing or non-existing aviation noise environment for participants could be a major factor for annoyance that does not seem to be part of the NASA test consideration.

A Mitre study[1] used ambient noise and N-Above (NA) for a fictional US airport using the NES data. Mitre defined “detectable” events as events with L_{max} at least 3 dB above the ambient sound level. Mitre simplified the Environmental Protection Agency’s (EPA) ambient sound levels into three categories: urban, suburban, and rural with designated L_{max} of 65 dB, 55, dB, and 45 dB, respectively. Larger changes in NA were found in quieter rural areas compared to urban areas, thus confirming that ambient noise is critical in evaluating noise impacts. Note however that the Mitre categorization of ambient noise levels is overly simplistic. Palo Alto (CA), is known as a quiet suburban community, had ambient noise of 35 dB[2], which is 10 dB below the rural ambient noise of 45 dB used by Mitre. NASA’s “Low” and “High” ambient environments are ambiguous without a dB level. Ambient noise estimates in the VANGARD project should be evidence-based and transparent, e.g., informed by noise monitoring data already collected by airports if available or through temporary monitoring by airports. In the absence of noise monitoring data, ambient noise could be estimated using evidence-based community characteristics (for example, ambient of 35 dB for rural or very low-density suburban, 40 dB for low-density suburban, 50 dB for medium-density suburban, 60 dB for urban, etc.).

A “low” ambient environment determined by “within 100 miles of the urban center” is too generalized, because there are many low ambient environments at far less than 100 miles of the urban center. Characterizing an ambient environment should be on the environment’s level of ambient noise and the important factor of existing or non-existing noise traffic not solely on the miles from the urban center to have adequate representation of Communities.

Counts of Events and Associated Characteristics

People are disturbed by the count of noise events (how many), the level of noise above ambient that is associated with each event (how loud), the times the events occurred (when), and the cadence of events (how frequent). Today, the community's annoyance is related to these 4 factors. Looking at the loudness of a single AAM and UAM event in isolation is incomplete and inconclusive. Rather than considering AAM and UAM in a vacuum, the communities’ cumulative lived experience, including aircraft overflights, in addition to AAM and UAM from multiple airports/vertiports, must be reviewed. Annoyance is from the total experience[3] of aviation impacts above ambient noise: multiple airports/helipads/vertiports, multiple vehicle types, multiple flight paths, multiple phases of flight including takeoff, landing, cruise, and hovering.

Existing or Non-Existing Aviation Noise

Today the FAA assesses noise impacts independently of a community’s ambient noise. Since ambient noise is the typical average noise in a community **without the noise caused by air vehicles** and is calculated as the noise level that is exceeded 90% of the time by all noise events (L90 in statistical terms). Tests should be run in the context of existing or non-existing aircraft noise. This means having

[1] Rimja, Mihir, Joseph J. Czech, Synthesis of NES Follow-up Analyses, Consolidated Report, HMMH Report 311950.001, Publication pending.

[2] M. Fremont, Aircraft Noise Impacts - A Community Perspective, *Aviation Noise and Emissions Symposium* 2024, available at https://anesymposium.aqrc.ucdavis.edu/sites/g/files/dgvnsk3916/files/inline-files/3.%20Marie-Jo%20Fremont.pptx

[3] Ibid.

different groups 1) not based solely on rural, suburban, and urban ambient noise, and 2) not based on DNL because DNL does not reveal the number of aircraft noise events. The groups would be ones without AAM/UAM.

Each group would be asked the questions:

- What happens when they start getting AAM/UAM noise events? During the day AND during the night?

The groups:

- Group A currently does not have any aircraft noise events.
- Group B currently has <10 aircraft noise events/24 hours.
- Group C currently has >=10 but <50 aircraft noise events/24 hours.
- Group D currently has >=50 but <100 aircraft noise events.
- Group E currently has >=100 but <250 aircraft noise events.
- Group F currently has >=250 but <500 aircraft noise events.
- Group G currently has >= 500 aircraft noise events.

Basically N-Above, and most likely N-Above-Ambient, needs to be the metric for NASA to use to characterize the various communities and the effects of AAM/UAM on these communities.

DISCLOSURE AND SCIENTIFIC/ETHICAL INTEGRITY

To ensure scientific and ethical integrity we request:

- Peer review and disclosure of reviewers.
- Disclosure of organizations involved with the design, execution, and findings (e.g., review of documents) by including who, organization, and how they were involved.
- Make available the raw data (or open data) so it is accessible and discoverable for additional researchers to build on the findings.
- Document participant selection criteria and process.
- Disclosure of AAM/UAM aircraft types, mix, error bars, altitudes, hovering, and what noise levels were used for the test.

The study should explicitly state important areas it is <u>not covering</u> such as:

- Only covering a single AAM/UAM event (with single vehicle type and manufacturer), not the annoyance from the total count of AAM/UAM event overflights (multiple AAM/UAM events with a fleet mix).
- Only covering an AAM/UAM event (with single vehicle type and manufacturer) and did not consider the annoyance from the cumulative aviation impacts on the participant (existing aircraft noise included from multiple vehicles and multiple airports) that is a major factor in annoyance.

WHAT TO AVOID

The concern of the community is always about accurately reflecting how impacted communities experience noise whether it is research, policy, or other efforts. Based on our experience and review of previous research we share the following areas of "**what to avoid" for the VANGARD test**:

- Testing aircraft that are not representative of the noise impacts that communities will experience - the quietest aircraft versus a more complete range of aircraft. Consider reactions to different expected AAM/UAM aircraft types to report on the variation based on the expected fleet mix (e.g., high drone, high commuter aircraft, etc.). Annoyance will vary depending on the aircraft type.

- Selecting test subjects that don't represent the future AAM/UAM impacted community. This includes a range of criteria that would be considered as biased. Instead, we need realistic and disclosed ambient dB levels for the categorization of "high" and "low" and not the use of distance from urban centers alone as criteria because it should be based on ambient dB levels and existing aviation noise.
- A single event of annoyance is over simplistic and does not represent annoyance from AAM/UAM. Annoyance is the count of noise events (how many), the level of noise above ambient that is associated with each event (how loud), the times the events occurred (when), and the cadence of events (how frequent).
- Modeling that underrepresents the noise of AAM/UAM such as not fully capturing the sound of the multiple rotors or implications of AAM/UAM corridors (or any new ways noise can be created in all phases of flight or how the aircraft are flown) and any known considerations based on NASA and FAA work it is pursuing related to noise from AAM/UAM.
- Not examining the objective parameters to understand the variability based on our input later of what should be included and concluding with that it is based on different subject sensitivity to noise.
- Not including in your findings what was not examined such as any of the objective parameters we have recommended.
- Not anticipating how the data could be misinterpreted to represent the communities' lived experience.
- Not being transparent so that assumptions and specifications are disclosed for the findings and can be revisited based on noise monitoring.
- Using anything that does not represent the true experience of communities e.g., DNL (does not reveal the count of events and SEL (people do not hear SEL).
- Not getting additional feedback, beyond this Federal Register Notice, from select community members who can provide a balanced perspective and who are expected to be impacted by AAM/UAM.

Meeting this primary research objective is critical to allow NASA to test additional hypothesis research questions based on the obtained data, including:

- ***Do annoyance responses differ significantly by phase of flight (takeoff, landing, and level cruise) of the AAM/UAM aircraft noise stimuli?***

Annoyance levels will vary based on the phase of flight. The varying phases have different noise levels, and it will also depend on the type of aircraft (e.g., a drone versus an 8-passenger taxi). Aircraft type must be part of the analysis given the varying noise by phase of flight and should use actual test flight data of AAM/UAM aircraft. Hovering must also be considered as a new variable for AAM/UAM aircraft. What vehicle types, how long, and how loud will there be hovering should be included. Careful examination should be performed on each phase because there can be vast variation; the noise levels from NextGen approaches vary widely based on the use of slats, flaps, and speed brakes. The expected quiet gliding of aircraft for NextGen arrivals has not been realized in practice.

- ***Do annoyance responses differ significantly as a function of sound level, based on distance from flight operation?***

At the Advanced Air Mobility - Community Engagement Webinar, April 17th 2024[4] the FAA spokesperson asserted, "Dedicated AAM airspace corridors or procedures are not expected to be implemented prior to 2028" and "Planning includes leveraging existing or modified low-altitude VFR operational areas and constructs to the extent consistent with regulation, such as: VFR flyways, VFR corridors, VFR transition routes, and special flight rules". AAM/UAM is likely to create a new type of noise similar to how NextGen created a new type of noise. In fact, FAA affirmed during a Noise Policy Review Webinar that AAM "operations are coming and they're likely going to change the character of how people experience aircraft noise and …could expose some communities that already experienced aviation activity to different kinds of noise and it also could expose communities that don't have a lot of aircraft noise to new noise...and are likely to operate at lower altitudes."[5] This new type of noise should be investigated and included in the design of the VANGARD study. Accurately include the anticipated noise level implications of the new dedicated AAM corridors or procedures and the VFR for transition routes, etc. that are in addition to the take-off and landing phase of flight. There was a failure to reflect the new noise impacts of NextGen that accurately represented the communities' lived experience. The same inability to accurately predict noise impacts for NextGen should not be repeated for AAM/UAM.

To what degree are the results explained by objective parameter analyses of the data (e.g., sound quality metrics; spectra; amplitude envelope)?

- ***To what degree are the results explained by noise sensitivity, obtained via post-experiment questionnaires?***

Although the above are examples, they do not include many objective parameters of data that reflect how communities experience noise. Schultz's 1978 study[6] stated potential reasons for the data scatter in surveys and data points regarding annoyance, such as the differences between measured noise and the actual noise exposure and background noise. The FAA presentation on FAA Aircraft Noise Impacts Research Roadmap at NOISE-CON 2010[7], emphasized the need to address the large scatter, data variability of community survey data on annoyance such as looking into the number and types of aircraft operating, when aircraft operate, step changes in noise levels versus gradual or very small changes, background noise, and frequency of noise events. Despite the Schultz and FAA comments 45 and 14 years ago respectively, the understanding of data variability for annoyance for reasonable factors remains unanswered.

Objective parameters to understand variability should include:

- **Ambient noise:** use realistic categories as suggested in our answer in (3) above). Distance to the city center alone cannot be the qualification.
- **Count of events:** include the number of AAM/UAM and the total cumulative noise experience of multiple aircraft types (non-AAM/UAM) and multiple airports.
- **Time of occurrence:** early AM, evening, nighttime during sleeping hours.
- **Cadence:** frequency of all aircraft events (including non-AAM/UAM), time between each event.

[4] FAA A New Era of Aviation: An Advanced Air Mobility Webinar - Community Engagement, https://www.youtube.com/watch?v=1sfVuJlPQoY

[5] FAA Noise Policy Review Webinar #4, May 25, 2023, https://www.youtube.com/watch?v=ytA2kHf6Wlk

[6] T.J. Schultz, Synthesis of Social Surveys on Noise Annoyance, *J. Acoust. Soc. Am.,* 64, 377-405, (1978)

[7] R. Girvin, FAA Aircraft Noise Impacts Research Roadmap, *NOISE-CON,* April 2010

- **Metrics:** use N-Above Ambient and Lmax. Do not use SEL because people do not hear SEL.
- **No averages:** people do not hear averages.
- **Estimation errors:** use, disclose, and develop findings to include error bars: there is little data available on actual noise from different AAM/UAM aircraft so a range of noise levels will be estimated.
- **Low altitudes:** noise at low altitudes for specified AAM/UAM vehicle types that are highly representative of what will fly low over communities including drones or "UAS (Unmanned Aircraft System) operation at or above 400 ft AGL".[8]
- **AAM/UAM fleet mix versus a single aircraft:** people will experience a mix of AAM/UAM aircraft not a single type of aircraft which makes the importance of getting the fleet mix as close to what will be overflown along with the accuracy of the noise profiles per aircraft type to adequately predict noise levels.
- **AAM/UAM and traditional motor noise:** there will be very few eVTOLs in the initial rollout. Many AAM/UAM will have traditional motors so there will be traditional motor noise in addition to loud rotor noise. This must be factored into to noise testing for both vehicle type and fleet mix to be realistic.
- **Existing or non-existing aviation noise:** tests should be run in the context of existing or non-existing aircraft noise.
- **Phase of flight variations:** as an example, the noise from NextGen approaches vary widely based on the use of slats, flaps, and speed brakes so the variations during phase of flight should be examined.

[8] Concepts of Operations v1.0 Urban Air Mobility, https://nari.arc.nasa.gov/sites/default/files/attachments/UAM_ConOps_v1.0.pdf