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The Honorable Michael P. Huerta
Administrator
Federal Aviation Administration
[redacted]

Dear Administrator Huerta:

I am enclosing the summary detail findings and recommendations from the Spring 2015 meetings of the standing REDAC Subcommittees (Aircraft Safety, NAS Operations, Environment and Energy, Airports, and Human Factors).

The committee also identified a few emergent areas where research will be important to position the agency. You are certainly aware of each but the committee wanted to highlight these as potential high priority areas. They include:

Certification of Additive Manufacturing - The rapid emergence of additive manufacturing technologies, materials, and approaches will require understanding of the processes, materials properties and flaw characteristics to develop certification criteria for these new technologies.

Mixed UAS and Manned Aircraft Operations - The committee appreciates the recent progress in UAS operational approval for small UAS but notes that the approaches for low altitude segregated operations do not address the larger UAS integration challenge. Many future UAS operations will require Con-Ops and procedures for mixed UAS and manned aircraft. This will be very challenging and the committee is concerned that the fundamental work to support this has been deferred or neglected.

Evaluating Community Noise Impact of Advanced Terminal Area Procedures - Community noise concerns with advanced PBN procedures at levels below the 65DNL threshold appear to be raising. This is a dual concern as it creates a barrier to implementation of NextGen procedures and creates pressure to revisit noise metrics and evaluation processes. Research is required to improve the noise evaluation process, support a strong scientific basis for any metric adjustments and to enhance community involvement.

Opportunities for Cross Cutting Approaches - The REDAC notes that many emerging technical opportunities (e.g. Big Data Analysis, Cyber-Security, Human-Automation System Integration) impact multiple lines of business throughout the agency. There appear to be opportunities to take cross-cutting approaches in these areas.

I am sorry that we were not able to work out the schedule so that you could attend the recent meeting. I hope you can join us in the future.

Sincerely,

R. John Hansman

Chair, FAA Research, Engineering and Development Advisory Committee

Enclosure

Research, Engineering and Development Advisory Committee
Recommendations for Fiscal Year 2017 Research and Development Portfolio

Subcommittee on Environment and Energy

Finding: Noise Complaints Increasing - Noise continues to be the number one source of environmental complaints for the FAA. Complaints about helicopter noise in North Shore (NYC) and Los Angeles have been challenges. Airport neighborhoods around Chicago O'Hare have also seen an increase in the number of noise complaints.

Recommendation (1): FAA-AEE is encouraged to continue with data-driven decisions in responding to these complaints. The subcommittee recommends the FAA both complete the development of the noise research roadmap and implement elements that would generate the data needed to support these decisions. This includes evaluations to see if changes are warranted to the definition of noise significance.

Finding: Noise Challenges with PBN Implementation - More recently, the number of noise complaints increased significantly at Phoenix airport after the implementation of Performance Based Navigation (PBN) operational procedures that improve efficiency and capacity. Noise is becoming a challenge in the successful implementation of these efficient operational procedures which are a critical element of NextGen.

Recommendation (2): The subcommittee recommends that the FAA support studies to determine if there are appropriate supplemental noise metrics that are a better predictor of community reaction in neighborhoods that have not previously experienced noise and are now experiencing noise from PBN. FAA-AEE and FAA-ATO should work together, share lessons learned from PBN implementations and determine what near-term research actions (including ways to examine community outreach and airport engagement) may increase the success of future PBN implementations.

Finding: FAA-AEE and FAA-ATO Working Together - FAA has been very responsive to the requests of the subcommittee for briefings on specific topics. A manager from FAA-ATO participated in this subcommittee meeting and shared the metroplex procedures development process for improved operational efficiency and how environmental assessment is included in the process.

Recommendation (3): The subcommittee recommends continued cooperation between FAA-AEE and FAA-ATO including integration of environmental assessment tools to enable early and rapid assessments of new operational procedures. The subcommittee also requests that FAA-ATO continue participation in future Environment and Energy Subcommittee meetings.

Finding: F&E Funding Reductions Impacting Plans - Funding reductions in FY15 and FY16 is impacting operational procedures research and development, AEDT2b deployment, NextGen Environmental Management System deployment, alternative jet

fuel testing and analysis, CLEEN technology maturation, and climate research. The sub-committee is pleased to see that the CLEEN-I program is delivering technologies with high readiness level that are ready for entry into service. With the NASA Environmentally Responsible Aircraft (ERA) program ending this year, CLEEN is the primary program to mature environmental technologies in the United States.

Recommendations (4): The subcommittee emphasizes that several of these tasks (like operational procedures research and development and AEDT2b) have significant near term benefit and recommends restoring the necessary funds to make these tasks successful. The sub-committee recommends that FAA continue support of the CLEEN program leveraged by industry cost sharing. We support above target funding request for the CLEEN program and alternative jet fuel testing and analysis. The need to better assess the impact of aviation emissions on climate should also be considered in the research planning process.

Finding: Aviation Sustainability Center of Excellence (ASCENT) Functioning Efficiently - The sub-committee recognizes that FAA-AEE has set up the Aviation Sustainability Center of Excellence (ASCENT) projects (including those related to alternate fuels development) with rapid yet smooth transition from the PARTNER Center of Excellence.

Recommendation (5): The sub-committee encourages FAA to continue to define ASCENT Center of Excellence tasks based on needs and gaps in the FAA environmental research roadmaps.

Finding: U.S Leadership in ICAO / CAEP Is Essential - United States leadership in the ICAO CAEP process continues to be an important priority.

Recommendation (6): In order to maintain leadership in the CAEP process, the subcommittee recommends that FAA continue to prioritize the development / enhancement of tools and data needed to guide the development of policy / standards. We also endorse the inclusion of a Global Market Based Measure (GMBM) as one option in a basket of options for improved environmental performance and encourage the FAA to support analysis to inform the design of the GMBM.

Finding: ICAO CO2 Standard Development is Progressing Well - The ICAO / CAEP CO2 standard development effort is going well (with the FAA Environment & Energy R&D program providing the necessary analysis tools) and it is expected that a standard will be established at the CAEP Steering Group meeting in February 2016. For the United States to adopt this standard as a regulation, the EPA and the FAA will need to work together.

Recommendation (7): FAA should invite EPA to the next REDAC subcommittee meeting in August 2015 and participate in the discussion on the CO2 standard progress and plans.

Subcommittee on NAS Operations

Background: The Subcommittee is pleased to observe that the briefings it received on the FAA research program had a stronger focus on how research objectives are related to the delivery of benefits to the NAS. Two specific examples were noted by the Subcommittee: Data Visualization Analysis and Reporting System (DVARS) and NextGen Wake Turbulence / Wake Re-Categorization (Re-Cat).

DVARS provides a data processing capability that adds significant value to the analysis required for the development of 4D trajectory-based operations, in particular, for the verification and validation of trajectory models. The DVARS data architecture concept is well aligned with the global transition toward net-centric technologies. Because of this, the system provides a foundation for scalability for example, for "the rest of the airspace" (that is, for airspace and airports not currently provided with FAA surveillance). As the Subcommittee and the full REDAC has previously noted, the expansion of the quantity and quality of data from systems like DVARS exemplify the need for FAA to vigorously pursue an efficient governance process to make this data available to qualified users.

In recent years, the FAA has focused its wake turbulence research on the development and validation of new procedures and separation standards that have delivered substantial benefit to airspace users. The Subcommittee is pleased that the FAA has responded to its recommendation to continue the implementation of Re-Cat Phase I and notes that its plans for Phase II and III appear sound and well-focused on the delivery of operational benefits and international harmonization.

For several years, the REDAC has urged the FAA to develop a more strategic view of its R&D and use it to identify and prioritize research areas. In 2013, the Subcommittee observed some willingness on the part of FAA to do this as reflected in its stated commitment: "to develop a more strategic, forward looking process, so that there will be an integrated agency-wide view of R&D". During its August 2014 meeting, in response to the FAA's request, the Subcommittee devoted significant time to the identification of research opportunities and issues as a first step in this process. It is not clear to the Subcommittee, however, how or if the FAA will make use of this input or whether it will make significant progress toward its stated commitment. The Subcommittee continues to stand ready to assist.

Finding: 4D Trajectory Based Operations (4D TBO) - The FAA provided a briefing on its recently-published TBO Concept of Operations during the Subcommittee's March 2015 meeting. The Subcommittee notes that, from the perspective of NAS operations, the development and validation of 4D TBO in all NAS domains is of critical importance to delivering benefits to airspace users. There are a number of significant research questions that must be answered in order to achieve the benefits of 4D TBO, among them:

- What is the transition path from near-term NextGen capabilities to the 4D TBO operations envisioned in the Concept of Operations?

- What is the system design required to achieve resilience of operations, including failure detection and recovery?

- What is the allocation of responsibility between flight deck and ground personnel during nominal and off-nominal operations?

- What is the role of humans and automation on the ground and on the flight deck during nominal and off-nominal operations?

- How will 4D TBO operations be optimized to ensure fairness across airspace users while meeting user objectives?

- How will UAS and General Aviation airspace users be accommodated in 4D TBO operations?

Recommendation (1): 4D Trajectory Based Operations (4D TBO)

The Subcommittee recommends that the FAA expand upon its TBO Concept of Operations to define the transition path (at the conceptual level) and the associated research objectives as a first step toward defining a coherent research program to refine and validate the TBO concepts. The Subcommittee recommends that the FAA provide an update on this process during its August 2015 meeting so that it can provide recommendations for a strategic research agenda for TBO implementation in 2025 and beyond.

Subcommittee on Airports

Finding: Airport Planning (RPD 132 - The Subcommittee generally accepts and supports the Airport Technologies Program's FY2017 budget. However, research needs identified by FAA staff in the field of Airport Planning (RPD 132) appear to exceed the amount allocated to this research project area. These identified needs include modernizing the FAA's runway exit design interactive model (REDIM), research to support improved FAA guidance regarding critical design aircraft designations, and developing training and guidance materials to support the FAA's new runway simulator model.

Recommendation (1): The Subcommittee recommends that the FAA review the RPD 132 budget and determine if sufficient funding exists to meet FY2017 needs as well as if ongoing planning projects need to be reprioritized in light of new planning research needs.

Finding: Airport Technologies Research Program (RPD 157) - Although the Subcommittee supports many of the proposals for new environmental research projects that will be funded within the Airport Technologies Research Program (RPD 157), we note that both safety and capacity must be considered included when assessing new types of noise mitigation techniques that can be applied to flight procedures, particularly higher glide slope approaches, delayed deceleration approaches, and the use of displaced arrival thresholds for noise abatement. Safety and operational risk assessments should be integral to the assessment of all of these techniques. Such assessments should involve subject matter experts from the pilot, air traffic, flight standards, and airport operator perspectives.

Recommendation (2): The Subcommittee recommends that the FAA take steps to incorporate safety and capacity assessments into the RPD 157 research program as well as better define how the aforementioned perspectives from the pilot, air traffic, flight standards and airport operator communities will be incorporated onto its research plan.

Finding: Low Cost Ground Surveillance Systems (LCGSS) - The Subcommittee appreciates that the proof of concept work associated with the low cost ground surveillance systems (LCGSS), particularly the optical surveillance system that has been pilot tested at Seattle-Tacoma International Airport. However, given the ongoing development of alternative surface surveillance systems, continuing reductions in the costs associated with automated dependent surveillance-broadcast (ADS-B) transponders, and the oncoming 2020 ADS-B equipage deadline, the Subcommittee is interested in understanding the role LCGSS are likely to play at airports if and when they are available for implementation before significant additional research into these systems is conducted.

Recommendation (3): The Subcommittee recommends that Branch staff develop a concept of operations that defines the roles and applications of the LCGSS in the National Air Transportation System given other surface surveillance programs and technology deployments that are underway, particularly surface surveillance systems that rely on ADS-B technology. The concept of operations should consider what unique capabilities or deployment opportunities would exist for LCGSS as well as those capabilities that are likely be duplicated by ADS-B based surface surveillance systems.

Finding: Aircraft Braking Friction (RPD 147) - The Subcommittee continues to be pleased by the progress Branch staff are making to manage risks and reduce uncertainties associated with RPD 147, Aircraft Braking Friction. These efforts include addressing safety issues associated with the test aircraft, enhancing the test aircraft's braking systems to better represent those currently in use, and securing the services of a highly qualified test pilot. Branch staff have responded positively to Subcommittee concerns about the project and the Subcommittee believes that the Branch be in a good position to collect high quality data in early FY2016.

Subcommittee on Human Factors

Background: The Subcommittee met February 24-26, 2015 at Wright-Patterson AFB in Dayton, Ohio. The group received updates on Human Factors and Engineering, Human Factors Research Processes, ANG Human Factors Action Items, and reviewed progress on past Findings, Recommendations, and Action Items. The primary thrust of this meeting was to review and assess the FY17 FAA Human Factors budget. In addition, the Subcommittee toured the Air Force Research Laboratory in specific areas of autonomy and neuroscience efforts. Specific Findings and Recommendations are below.

Finding: UAS Human Factors Research - The HF Subcommittee is concerned that HF research is not receiving the appropriate priority in UAS research programs. Even though there is current and planned research on UAS ground station design, we are concerned that it is insufficient and will result in being late to address future regulatory and standardization needs.

Recommendation (1): The FAA should review the HF activities within its UAS research portfolio to ensure it is sufficient and timely to address appropriate research for operator stations and terminal operations.

Finding: ATC Tech Ops Core Program - The Subcommittee identified a significant risk area within the 2017 ATC/Tech Ops Core program research portfolio due to a lack of sustained research efforts past 2016 in some specific areas of training and safety. The Subcommittee observed that there is a lack of required research to provide guidance and new capabilities to: 1) implement practical Human Systems Integration (HSI) within the FAA ATC acquisition process; 2) implement efficient and effective safety analysis from a human performance perspective; 3) and continue development of tools that support the identification, classification and detection of ATC risks and associated mitigation strategies. This builds increased risk into the system as the training burden is increased for poorly implemented systems where the H/W and S/W components are emphasized with insufficient consideration for HSI. Time and again, significant savings in system implementation and training, as well as enhanced safety, has been demonstrated where HSI was incorporated into the design, implementation process, and adequate human performance safety assessments. With little or no research in this area, the FAA is creating unnecessary risk in ATC operations.

Recommendation (2): Create a research portfolio under ATC/Tech Ops Core program that achieves the following:

- Generation and incremental revisions of training requirements and standards
- Development of an ATC critical incident analysis capability
- Development of an early warning tool for consideration of human performance in ATC related safety reports
- Development of a safety tool to augment the Risk Analysis Process developed jointly by ATO/EUROCONTROL—the objective of this safety tool would be to consider human performance in the risk analysis events process

Finding: TRACON Developmental Training - The Subcommittee was pleased to learn that the HF ATC group was called upon to help solve the low through-put of controller candidates being trained at the New York TRACON. The HF team has proposed a solution that will create more effective and efficient training methods, including training standards for the New York TRACON, which promise to increase the training through-put and increase the number of qualified controllers. The amount of resources required to achieve this goal is at a critical level and hence the outcome may be at risk. There also needs to be sufficient data collection once implemented to ensure that the new methods and standards are efficient and effective.

Recommendation (3): Ensure adequate research is performed to measure the effectiveness of the new methods and tools at the New York TRACON. Then, once the tools and methods have been proven at the New York TRACON, conduct the needed RE&D to ensure that these can be successfully employed at other high density TRACONs.

Finding: Operational Concepts and Design - Significant improvements in throughput, operational efficiency, and overall system performance while maintaining the highest level of safety, are expected from the implementation of NextGen operational concepts. In order to be successfully implemented, it is critical to consider human factors issues throughout the concept exploration, design and implementation process. One such area is the focus on the operational concepts and designs associated with Performance Based Navigation (PBN) and advanced techniques for separation assurance.

In support of the implementation of these operational concepts and designs, important HF work has been conducted focusing on the design, presentation, and implementation of associated new flight deck procedures, providing significant insights into the factors that affect procedure complexity and the effective use of automated flight-path management systems to deal with the precise speed, altitude, and lateral path constraints fundamental to the application of PBN.

Continuation of HF work focusing on the design and implementation of effective flight deck procedures for PBN is necessary to help ensure that the safety and efficiency goals of PBN are achieved. This flight deck research needs to be complemented with human factors work focusing on the successful design, adoption, implementation and evaluation of PBN in the performance of ATC, Traffic Flow Management (TFM) and Flight Operations Control (dispatch) tasks. This coverage is important in order to ensure an effective overall human-centered approach to system integration.

Recommendation (4):

- Continue to pursue HF work focusing on the design and implementation of effective flight deck procedures for PBN, and on the associated implications for the design of automated flight-path management systems
- Complement this flight deck focused work with studies concerned with the HF issues that impact the successful design, adoption, implementation and evaluation of PBN in the performance of ATC, Traffic Flow Management (TFM) and Flight Operations Control (dispatch) tasks
- Ensure that this work is completed in a cohesive collaborative manner that provides guidelines grounded on an integrated systems perspective
- Provide a status briefing to the REDAC Human Factors Subcommittee on plans to accomplish this work

Finding: ATC Strategic Planning Resource Allocation - A recent finding of the Subcommittee (Spring 2014) applauded the efforts of ATC/Tech Ops Core program to initiate a more strategic planning effort for their area of research. However, the Subcommittee observed at this meeting that the ATC/Tech Ops Core program is no longer pursuing a strategic research planning effort due to a lack of resources. The Subcommittee had previously found that the strategic research planning effort being initiated within ATC/Tech Ops Core program was of high value, as it would help the FAA uncover emerging risks as well as position itself for doing the appropriate research in a timely manner. Without this strategic research component, there is once again risk being built into the ATC system for both current operations as well as for NextGen implementations.

Recommendation (5):

Reconsider the prioritization of this work and look to allocate necessary resources to re-start this important strategic research planning effort including resources to execute the projects in the strategic plan.

Subcommittee on Aircraft Safety

Finding: UAS Safety Research - The subcommittee was fully briefed on the UAS safety research plan. We are encouraged by the progress made in the past year regarding organization and networking of different stakeholders. We encourage the continuation of this integrated research planning. There appears to be a focus on real problems and growing consideration of evolving issues.

Recommendation (1): We recommend building flexibility into the FY17 UAS budget that can address emerging issues that may not be understood currently. We also recognize the focus on Beyond Line of Sight (BLOS) operations but recommend consideration of other emerging "long term" issues such as complete autonomous operations. We also recommend that UAS NAS integration R&D focus on sense and avoid technology vs aircraft robustness in case of impending collision.

Finding: **Strategic Research Planning and Roadmaps** - There has been visible progress in terms of developing a process to prioritize research based on priorities and need. Review of the 2017 strategic guidance, quad charts, and list of emerging issues highlighted a need to provide greater linkage between the proposed and funded research and the FAA's strategic plan. The strategic plan should not be a static document; it will require regular updates to address the changing needs of the FAA and the NAS and to ensure that the research is appropriately targeted.

Recommendation (2): SAS understands and recognizes the ongoing need for research focused on operational safety of the current fleet. Notwithstanding, focused research must be conducted to address emerging issues. The FAA should develop and implement a process to produce 5 to 10 year research roadmaps to guide sponsors in the development of research requirements and to assist in prioritizing and focusing research on strategically significant elements. The roadmaps should define the FAA's vision for the future, quantify success measures to the greatest extent possible, and identify the research areas necessary to support the roadmap vision. It is further recommended that the FAA make available and use the roadmaps as the basis for its comprehensive strategic research plan, research needs, program initiatives, and intended outcomes for aviation safety.

Finding: **Additive Manufacturing Technologies** - There have been significant developments in additive manufacturing technologies and capabilities that are expected to rapidly proliferate in aviation applications due to many potential benefits including reduction in material cost, fewer part details, and enabling of more complex designs. However, additive manufacturing technologies have a number of technical risk factors that could have significant impact on design, production, and maintenance. The FAA must be prepared to address these factors in order to ensure appropriate airworthiness and certification standards and methods of compliance. The subcommittee received a briefing from the FAA fatigue and damage tolerance Chief Scientific and Technical Advisor (CSTA) on the establishment of an FAA Additive Manufacturing Steering Group to address these issues. The SAS strongly supports the high level of coordination with other government and industry initiatives and development of a detailed roadmap identifying near-term and strategic areas that focus FAA's activities on the safe implementation of these technologies. Current planning is to develop the additive manufacturing roadmap over the next 18-24 months. This roadmap will inform regulatory, policy, and R&D program needs. The subcommittee also noted and strongly endorsed the addition of additive manufacturing materials into the Metallic Materials Properties Development and Standardization (MMPDS) process and handbook (under

research requirement A11E.SIM.4) to provide standardized and acceptable design and compliance data and tools.

Recommendation (3): There is significant activity across all major aviation industry sectors in the application of additive manufacturing technologies affecting current production systems and new product designs. The subcommittee recommends that the FAA accelerate the development of the additive manufacturing roadmap over the next 12 months in order to inform FAA's existing regulatory, policy, and R&D program needs. In addition, the subcommittee recommends that the FY17 and FY18 R&D portfolio includes consideration of proactive research necessary to ensure an understanding of key properties/characteristics of additive manufacturing to identify hazards and mitigations necessary to establish the appropriate standards and methods of compliance necessary to enable safe implementation of these technologies.

Finding: The Subcommittee continues to emphasize the importance of human factors research in all aspects of aviation safety. The Subcommittee also recognizes the importance of the human factors issues that AVS has identified for funding and further research. Human factors research covers a broad spectrum of regulations and guidance. Unfortunately, this significance and importance has not always been consistently recognized. As a result of this observation, the Subcommittee previously recommended that AVS closely align human factors research requirements with the other research areas they supported, even though those issues fell outside of the traditional human factors portfolio.

The committee is pleased to hear that FAA human factors specialists are closely involved (rather than just consulting) with many research efforts throughout the portfolio. The committee also sees value in human factors specialists' involvement during the requirements phase of research efforts and is pleased to be advised that this is happening.

Finding: Based on the feedback received from multiple REDAC subcommittees, it is evident that crosscutting capabilities should be engaged at earlier stages of setting requirements and concept development. As operational concepts are explored, experts from all research disciplines should work jointly to establish operational requirements and objectives. Earlier coupling across multiple disciplines may result in reduced development time and costs. .