October 2, 2013

The Honorable Michael P. Huerta
Administrator
Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591

Dear Administrator Huerta:

Thank you for again taking the time to meet with the Research, Engineering and Development Advisory Committee (REDAC) at our recent meeting. These discussions help us understand your perspective on the issues, objectives and challenges for the agency's future.

I am enclosing the summary detail findings and recommendations from the Fall 2013 meetings of the standing REDAC Subcommittees (Aircraft Safety, NAS Operations, Environment and Energy, Airports, and Human Factors).

The committee would also like to share a few general thoughts for your consideration.

Enabling the Potential of "Big Data" in the FAA - The growth of operational data and advances in data analysis open up exciting new approaches to better understand and improve the safety and efficiency of the NAS. The FAA has taken initial steps in this direction with data driven programs such as ASIAS and ASDI but there is significantly more potential. Realizing the full potential of "Big Data" will require development of data access policies allowing the most open possible access to researchers and other users while providing appropriate data protections. The REDAC recommends that the FAA consider creative approaches to access policies such as multiple access levels to partitioned data structures. The most open level of data could be fully open to the public enabling crowdsourcing and open competitions for researchers/students to creatively analyze and visualize the data, enabling a level of effort in this data analysis greater than can be conducted in-house by the FAA alone.

Emerging Human-Automation Issues - The increasing reliance on automation in aircraft and ATC systems have created emerging vulnerabilities in the aviation system highlighted by recent events. This was an important area of research during the initial introduction of highly automated aircraft such as the A-320 and B-767/757 in the 1980s but the character of emerging issues is changing as both the complexity of the automation increases and the new generation of pilots has different backgrounds. The REDAC recommends increased priority for human-automation interaction research and that the FAA work with related activities at NASA and the DOD.

Validating NEXTGEN Con-Ops - The key to successful delivery of NEXTGEN benefits will be to validate the Con-Ops currently under Concept Maturity and Systems Development at a sufficiently detailed level that operational feasibility can be assured and risks can be identified and managed. This includes definition of candidate operational procedures, addressing human factors issues (often in Human in the Loop Simulations) and considering operational issues such as mixed equipage and off-nominal conditions.

Unmanned Air Systems Research – The REDAC is pleased that the FAA is making progress on UAS integration in the NAS with the reported completion of the UAS Roadmap and UAS Con-Ops. At this point the REDAC has not been able to view these documents so it is difficult for the committee to give specific and effective advice in this important area. The REDAC looks forward to the opportunity to review and respond to the UAS Roadmap.

Thank you for the opportunity to engage and contribute to the safety, efficiency and sustainability of aviation in the United States.

Sincerely,

R. John Hansman

Chair, FAA Research, Engineering and Development Advisory Committee

Enclosure

Federal Aviation Administration

Research Engineering and Development Advisory Committee (REDAC)
Guidance on the FY 2016 Research and Development Portfolio

Subcommittee on Aircraft Safety

Finding: NextGen – General Aviation (GA) Weather Technology in the Cockpit. The Subcommittee finds the continued research in this area focused, adequately resourced, and well-defined. Although the near term and strategic plans are thoughtfully created and appropriate, the expected safety benefits are less clear. The emphasis on price point of equipment and usability of information is realistic and will help the development of effective tools and information. The Subcommittee received briefings from other agency groups that described a significant amount of research in other areas involving Commercial-Off-The Shelf (COTS) products and software. There is a good possibility that some of the research done in other areas can be of benefit to this area also. Additionally, there is a continuing need to coordinate throughout the agency to make sure products and information reach the industry in a timely manner with minimum resistance from other agency stakeholders.

Following a post meeting discussion, the Subcommittee notes that the FAA had previously agreed to provide a better understanding of GA safety benefits in 2014.

Action: The Subcommittee requests a briefing on the status of the analysis of GA safety benefits expected from this research activity.

Recommendation: The Subcommittee recommends that the sponsors of this research interface with other Research, Engineering, and Development (R,E&D) areas to explore COTS possibilities and with the appropriate areas in FAA to facilitate dissemination of tools and information to industry.

Finding: Flightdeck/Maintenance/System Integration Human Factors. The Subcommittee is pleased to see the progress made in the presentation and relevance of human factors research requirements and the involvement of human factors professionals in many different research efforts throughout the agency. The link between human factors research, the outcome of the research and the various projects that benefit from the research are becoming much more evident. The Subcommittee applauds this progress and hopes to see it continue. One concern the Subcommittee has is the apparent difficulty involved in responding to human factors situations that arise in the near term. With the rapid pace of technology changes and their use in aviation, there needs to be a capability for human factors researchers to respond in real time. The Subcommittee understands that there is an existing process in place to facilitate this capability but the use of this process seems to be infrequent, especially in the area of human factors research.

Recommendation: The Subcommittee recommends that FAA review the process for reallocation of funding for current year or following year pop-up requirements to assure this process is user-friendly and encourage its use when research needs arise from rapidly changing situations.

Finding: The Subcommittee also remains concerned that the funding for human factors research seems to receive a lower priority than might be warranted due to a misunderstanding of how this research supports the broader R, E and D effort it's connected to. The Subcommittee understands the concern from human factors research managers that the proper researchers be assigned to relevant projects and the need for human factors experts to be designing and conducting the research. As the aviation industry moves more toward data driven, evidence based risk management, the contribution that human factors research makes to an R, E, and D effort and its importance might be better recognized if human factors research is embedded in the larger R, E, and D effort rather than conducted independently.

Recommendation: The Subcommittee recommends that, for funding and functional purposes, FAA explore the possibility of closely aligning human factors research requirements with the other research areas they support, even though those issues might fall outside of the traditional human factors portfolio.

Finding: Unmanned Aircraft Systems. The Subcommittee is pleased with the progress made in the area of coordinating and aligning research efforts associated with the routine integration of unmanned aircraft systems. While disappointed that the "integration roadmap" is not yet releasable for the Subcommittee to review, we are pleased to hear of the interagency coordination and the realism associated with the FAA's planning efforts. Based upon comments from the FAA, it appears that the Agency is fully leveraging investments by the National Aeronautics and Space Administration (NASA) and the Department of Defense (DoD) in related research efforts especially in the area of sense and avoid. The subcommittee sees that many open research questions remain and that the Agency has many research challenges ahead as they pursue integration efforts.

Action: The Subcommittee requests a briefing on FAA efforts to document research linkages with NASA, DoD, and the Department of Homeland Security (DHS) as well as efforts to identify potential research gaps.

Finding: Budget Review. The federal budget environment continues to be in a state of uncertainty that is beyond the control of the FAA. The Subcommittee finds that the research planning process has incorporated sufficient flexibility to adjust to this uncertain budget environment. The Subcommittee also notes that the Joint Planning and Development Office (JPDO) continues to be targeted by Congress as an activity that can be eliminated or cut back. The Subcommittee encourages the FAA to explore options to either clarify the role of the JPDO or decide if the JPDO responsibilities should be transitioned to other organizations as appropriate.

Finding: Strategic Plan. The Subcommittee was encouraged by the approach taken to document current research opportunities in the draft Strategic Plan. The Subcommittee strongly supports the development and use of a stable methodology by which research opportunities are developed and routinely assessed against measurable outcomes. Alignment of research initiatives with broader AVS safety goals is critical to ensure research efforts materially and measurably contribute to safety in the years to come.
The current draft strategic plan, as outlined for the Subcommittee, largely captures todays existing opportunities and research already underway or identified. The Subcommittee members look forward to providing feedback and sees opportunities to mature a research priority identification process which includes 'top down' direction and full review among other FAA lines of business and key industry bodies.

Finding: Continued Airworthiness Maintenance and Inspection. The Subcommittee finds this work to be relevant and well defined. The work covers a broad range of activities to include composites and electronic devices. The Subcommittee also commends the FAA for using the flexibility of the pop-up process to deal with Corrosion Prevention and Control concerns and for gathering information to address other upcoming maintenance issues. The Subcommittee encourages the FAA to continue to support this area as planned.

Finding: Continued Airworthiness: Structural Integrity Metallic. The Subcommittee finds this work to be relevant and well defined. It was noted that the future Active Flutter Suppression research could be reduced if the expected funding allocation from Congress is not increased. The Subcommittee finds this particular activity to be aligned with technology trends in future aircraft structural designs and encourages the FAA to support this area as planned.

Finding: Continued Airworthiness: Electrical Systems. The Subcommittee finds that the Electrical Systems research activity is a highly leveraged program taking advantage of industry (Boeing,

Honeywell), University (UDRI), Inter-Agency (DOD, NASA) and industry (SAE, S&T) capabilities to produce results responsive to sponsor requirements.

The Subcommittee encourages the FAA to explore funding alternatives which would support research on non-flammable electrolyte lithium batteries for aerospace applications (currently planned for FY 2016 funding) starting in FY 2014.

Finding: Fire Research and Safety. The Subcommittee finds that the Fire Research and Safety program continues to be responsive to clearly stated and anticipated requirements. Stable funding allows the program to produce timely results with flexibility to respond proactively to both current and emerging needs. The Subcommittee encourages FAA not to overlook research opportunities focused on ignition prevention and sharing of key materials flammability research findings with the small/general aviation aircraft industry to promote adoption of known safe materials.

Readers of this report are encouraged to read the article written by Dr. Ann Harlan, former Director of the FAA William J. Hughes Technical Center. It is an excellent example of the high quality research and analysis being performed in the FAA Fire Research and Safety Program.

Finding: Continued Airworthiness: Flight Control Mechanical Systems. The Subcommittee is pleased to hear FAA research activity in the areas of stall recognition and recovery and low speed awareness/alerting is being coordinated with the numerous other FAA and non-FAA sanctioned bodies of research looking into these areas. Also encouraging is the balance of focus between Part 23 and Part 25 airplane safety opportunities. It is, however, challenging for Subcommittee members to fully grasp the total amount of research underway in the area of 'loss of control'. The interrelation between airplane requirements (envelope protection, alerting/warning methods, etc.), pilot training and human factors aspects must be regularly reviewed to minimize the chance of conflicting risk mitigation strategies.

Finding: Continued Airworthiness (Propulsion Systems): Engine NDE. The research being conducted in this area was found to be relevant and progressing at a pace thought to be reasonable in light of budgetary challenges. The Subcommittee encourages FAA to closely review planned volcanic ash related research for future relevance, given the tremendous amount of work already accomplished through ICAO to maintain safe, efficient operations in times of volcanic eruption.

Finding: Safety Management Systems. The Subcommittee finds this work to be relevant and well defined. The work covers a broad range of data analysis activities. The Subcommittee was curious as to why the FAA feels that all research would be complete by FY 2016.

The Subcommittee notes the absence of FY 2016/2017 funding.

Finding: Software Digital Systems. The Subcommittee finds this work to be relevant and extremely important. The Subcommittee was especially pleased with the newly established collaboration between NASA and the FAA to create joint research teams, conduct technical exchanges, and establish joint research roadmaps. The Subcommittee observed there are similar research efforts at the DoD which may also be synergistic.

Finding: Aeromedical Research. The Subcommittee finds that the ongoing requirements for Aeromedical Research are connected to the outputs and outcomes of the research, and results are being produced as planned. The Subcommittee appreciated the explanation of how requirements are defined and prioritized through the TCRG and AVS processes and coupling to the research is maintained. The Subcommittee further observes that maintaining capabilities in this area can be expensive, and encourages CAMI to continue use of all available funding processes, such as was used to upgrade key facilities.

Finding: Advanced Materials and Structures. The application of a safety management approach to define future research and desired outcomes is strongly supported by the Subcommittee. Further, it is encouraging to see research efforts to improve certification efficiency to help introduce products and technology that increase safety but are currently faced with significant certification costs. The Subcommittee encourages FAA to continue the good coordination and involvement with industry stakeholders.

Finding: Propulsion & Fuel Systems. The Subcommittee finds this work to be relevant and well defined. The development and refinement of DARWIN is planned to be completed in FY 2015. This activity has provided industry with a critical tool for improving and certifying the damage tolerance of engine rotor components. Although follow on work has not yet been identified beyond FY 2015, the Subcommittee anticipates legitimate requirements will emerge.

Finding: Aircraft Icing. The Subcommittee finds this work to be relevant and well defined. The new SLD rule, anticipated in 2014, still lacks readily available and proven means of compliance to capture the anticipated safety benefits. The Subcommittee encourages FAA to maintain focus in this area. As new aircraft designs are introduced and operational capabilities expand, the need for research in aircraft icing will continue to be critical into the foreseeable future. The experience, skills, and capabilities needed to support icing research are unique and must be intentionally nurtured and groomed. Although the FAA currently has world class icing expertise, the Subcommittee continues to be concerned that without a concerted focus the FAA will have difficulty replacing and maintaining this unique and necessary capability overtime.

The Subcommittee encourages the FAA to plan for and implement a process to ensure that the skills and technical capabilities to support future icing research and certification requirements are developed and maintained.

Finding: Weather Program. The Subcommittee recognizes the important of the weather research program in improving safety and efficiency in the national airspace system. The program is large and diverse, thus creates challenges in ensuring the activities are appropriately coordinated. While the research is well articulated and appears appropriate, the operational outcomes in terms of impacts on safety and efficiency are sometimes obscure. This program could benefit from the FAA's movement to articulate operational outcomes associated with its research especially in efforts to prioritize research efforts.

Finding: Terminal Area Safety. The subcommittee supports the research being performed in the area of Terminal Area Safety and finds it is well structured and relevant. The stall recovery training research is progressing well with clear recognition of the degree of difficulty in accurately simulating this condition. The close coordination between this research and related research in other areas is commendable and needs to continue. The runway friction research aimed at reducing runway excursions is progressing well. As this research continues, additional focus will need to be placed on transport category aircraft. The effort on quick turning information from incidents and issues to simulator training is especially noteworthy. The subcommittee supports and encourages high quality, positive, effective training but also hopes that it will not take an inordinate amount of time for the loss-of-control training to reach the industry.

Finding: NextGen - Alternative Fuels for GA. The Subcommittee received a presentation on the status of the two-phase program to implement the recommendations of the Unleaded Aviation Gasoline Transition Aviation Rulemaking Committee to support availability of a replacement fuel for leaded aviation gasoline. The Subcommittee noted that although not performing every option that the ARC recommended, the FAA program of research is in line with the recommendations. It was further noted that a steering group has been formed, and industry's direct involvement is expected to be heavily leveraged in order to deliver the outputs.

Finding: Aircraft Catastrophic Failure Prevention Research. The Subcommittee found the briefing on the Aircraft Catastrophic Failure Prevention Program thorough and reflected positive activity in an area considered to be of high value. The Subcommittee was encouraged to see an upcoming transition of focus from metals to composite material in the coming years. The Subcommittee noted the continued refinement of analytical tools created by this activity is considered to be of high importance.

NAS Operations Subcommittee

Findings: NextGen Wake Turbulence and Re-Categorization. The Subcommittee found that NextGen Wake Turbulence and Re-Categorization programs have made excellent progress in delivering quantitative operational benefits to the user community. It was gratifying to the Subcommittee to see these operational benefits realized after the considerable investment by both FAA and NASA in the understanding of the impact of wake turbulence on NAS operations.

In its discussions with the FAA, the Subcommittee found that there may be a gap in the ability for aircraft designers and manufacturers to accurately predict, at design, the operational impact of an aircraft's wake. The specific example cited was the experience with the A380 where the flight tests revealed that substantial additional wake turbulence separation was required over that initially anticipated.

Recommendation: The FAA should ask the participants in its user group (Wake Net USA) if they are confident in their ability to predict, at design, the operational impact of an aircraft's wake. If the current set of analytical and numerical modeling tools are not sufficient for a high-confidence prediction, then the FAA should consult with the manufacturers and NASA on the need for more advanced research in this area.

Background: Research Requirements for Aviation Weather Research Program (AWRP) and Weather Technology in the Cockpit (WTIC) The NAS Operations Subcommittee has previously recommended that the FAA present a clear justification for both the AWRP and WTIC programs. Specifically, the Subcommittee recommended that the FAA provide quantitative estimates for the NextGen safety and operational benefits achievable with the research results when applied to operations. The Subcommittee further recommended that if those requirements have not been defined and quantified, the FAA should orient this research portfolio to define the requirements. The FAA responded that its Weather Division has contracted with MITRE to develop the Operational Weather Requirements Analysis Methodology (OWRAM) to establish a repeatable process for deriving operational weather requirements as they relate to the NextGen Segment Implementation Plan (NSIP). The FAA further responded that both the AWRP and WTIC programs would undertake a more rigorous analysis of General Aviation (GA) weather-related accidents to define the weather research requirements related to quantitative safety improvements and agreed to present these requirements in 2014. During its summer 2013 meeting, the Subcommittee received a briefing from MITRE on OWRAM and a briefing from FAA on WTIC.

Findings: The Subcommittee is pleased that the FAA is committed to developing weather research requirements that are firmly based in quantitative operational improvements. The Subcommittee found that the MITRE OWRAM approach presented was reasonable and will be useful in assessing whether or not there are research elements missing in the AWRP. This work also has the potential to do trade studies to look at the cost and potential operational impact of different elements of the AWRP portfolio. The work is still in its early stages and is projected to produce an initial set of weather research requirements in the early spring of 2014.

The Subcommittee found that the FAA has made no significant progress in its justification of the WTIC program, based on GA safety benefits or Part 121 operational benefits, despite repeated requests by the Subcommittee. The WTIC program has defined a relatively modest effort to define GA safety benefits that would yield a research product in 2017. The Subcommittee found this inconsistent with the FAA

commitment to provide an analysis in 2014. The WTIC program referred to pilot simulation studies that they have previously conducted that show that pilot decision making is different with different weather presentations, but there was no demonstration of a safety impact of this difference. The Subcommittee noted that only a fraction of the WTIC program resources are now focused on GA and most of the program is focused on Part 121 operations. However, the Subcommittee found that there was no communication or coordination between the WTIC program and the MITRE OWRAM work. In its deliberations, the Subcommittee discussed the potential that some WTIC applications could provide near term benefit (e.g., uplink of cloud top information in oceanic airspace and the uplink of accurate wind information for use in descent spacing), but found that the FAA cannot prioritize this work with other AWRP programs unless there is effective coordination of the benefits assessment.

Recommendations:

The FAA should expedite its work with MITRE to develop its initial set of weather research requirements early in CY2014. The Subcommittee looks forward to reviewing them during their March 2014 meeting. The OWRAM presentation should include an assessment of the level of effort required to use this methodology for cost/benefit trades for the entire AWRP. The Subcommittee also recommends that the OWRAM effort also assess any potential utility of WTIC research products for use in the NextGen NSIP Alpha and Bravo.

The FAA should immediately take steps to justify its continued investment in the WTIC program. The Subcommittee cannot recommend continuation of this program as it is now constituted. As a near-term action, the FAA should rapidly identify those portions of the WTIC program that can provide quantitative NextGen benefits and focus its efforts exclusively on those. If the FAA believes that WTIC can provide a significant, quantitative safety benefit to GA, then it should present this case to the Subcommittee at its March 2014 meeting. If not, then it should discontinue this portion of the WTIC program.

Background: Trade Space Analysis of Mixed Equipage and Benefit Scenarios. Many of the benefits of NextGen depend on a "critical mass" of equipage by flight operators before a procedure is operationally feasible. When distinct benefits are not immediately available for flight operators who equip, a situation can occur where flight operators are perversely incentivized to be the last to equip to improve their individual business case. In August 2012, the REDAC recommended to FAA that research activities for concepts that leverage new aircraft equipage include trade space analyses to address mixed equipage environments. That research should include work to understand questions such as critical mass thresholds, automation mitigations for mixed equipage, performance tradeoffs, etc. An update from the FAA on this recommendation was shared with the NAS Operations Subcommittee in August 2013.

Finding: The Subcommittee is encouraged with the FAA's response, indicating the intent to establish a research plan that addresses these needs. The FAA's plans for operations concept validation (F&E 1A08H) as presented, however, did not list any activities related to mitigation of mixed equipage challenges to achieving NextGen benefits.

Recommendation: FAA should ensure that mixed equipage challenges and trade space analyses are explicitly addressed in research plans associated with NextGen concepts. Because this work may be funded outside of the RE&D funding category, the FAA should identify, within the research plan, other work that may be addressing mixed equipage performance and business case questions for specific concepts, such as trajectory-based operations, and other NextGen concepts that require aircraft equipage to achieve operational benefits.

Finding: JPDO. There is a productive tension between the technology readiness and implementation readiness for NextGen. NASA has the charter for the farther term R&D defining the art of the possible (and advancing the farther-term technology readiness), the FAA for nearer-term R&D leading to

NextGen implementation. These distinct charters create a useful tension between the farther- and nearer-terms, the higher- and lower-risks, and the shorter- and longer-timelines. However, for the nation to benefit we need proactive management of this creative tension. The JPDO is the logical organization, with the Congressional charter, to perform this vital role. The JPDO budget requests for 2014 and beyond appear minimally adequate to fulfill their role.

Recommendation: Given current budget limitations, the FAA should strengthen its bilateral agreements across participating agencies to supplement the NextGen coordination performed by JPDO

Finding: NextGen Implications for Commercial Space Transportation. Little focused investment exists in either the FAA or NASA in this arena. The FAA's presentation to the Subcommittee on its New Air Traffic Management Requirements and Operational Concept Validation included a Space Vehicle Operations Concept Development task deliverable in October 2014. While the Commercial Space Transportation Advisory Committee (COMSTAC) is currently advising the Administrator on matters related to commercial space flight, the REDAC NAS Operations Subcommittee has no insight as to whether NextGen topics such as TBO, DataComm, SWIM, and others are being addressed by the COMSTAC.

Recommendation: The FAA should ensure that NextGen capabilities are specifically addressed in its development of the Space Vehicle Operations Concept Development. The FAA should ensure that both COMSTAC and REDAC are made aware of any NextGen implications for commercial space flight operations in the NAS.

Background: Prioritization of Research across FAA portfolios and lines of business. The NAS Operations Subcommittee has previously recommended that the FAA undertake a broader management framework for its research and development in order to enable the FAA to manage its research portfolio across funding lines to focus on achieving specific operational benefits to the National Airspace System (NAS). The full REDAC made a similar recommendation in its May 14, 2013 letter to the FAA Administrator. The FAA responded that Mr. Dennis Filler, the new Director of the William J. Hughes Technical Center, who is also head of the of FAA R&D will work to develop a more strategic, forward looking process to achieve an integrated agency-wide view of R&D. During its summer 2013 meeting, the Subcommittee received a briefing on this topic from Mr. Filler as well as a briefing on the 2013 National Aviation Research Plan (NARP) from Dr. Cathy Bigelow, the Manager of the FAA's Research and Development Management Division.

Findings: The Subcommittee is pleased that the FAA is committed to developing a more holistic view of its research program. It was clear from the briefing by Mr. Filler that he is committed to this goal, but the Subcommittee finds that the work is still in its conceptual stages.

The Subcommittee is pleased with the FAA's commitment to strengthen the high level goals of the NARP to align more closely with the National Aeronautics Research Plan and NextGen. The Subcommittee finds the three R&D principles (Improve Aviation Safety, Improve Efficiency, and Reduce Environmental Impacts) to be reasonable. However, the Subcommittee noted that the resulting R&D goals covered a very broad area of research topics and that the FAA has simply mapped all the existing RE&D Budget Line Items (BLI) onto the new goals without any indication of prioritization or changes to the research portfolio. Furthermore, there was almost no quantitative aspect to the research goals – many of them contained phrases such as "improved understanding", and "improved knowledge", which provide no reasonable means to track progress toward the goals.

Recommendations:

The FAA should vigorously pursue its stated commitment: "to develop a more strategic, forward looking process, so that there will be an integrated agency-wide view of R&D". The FAA should present its progress toward its stated goal at the next Subcommittee meeting in the spring of 2014.

As the FAA formulates its research goals, they should contain quantitative goals and metrics by which the progress of its R&D can be measured. If quantitative research goals have not been established, then the FAA should reorient its research program to establish these goals.

Subcommittee on Airports

Finding: Progress Made on Heated Pavement and Aircraft Braking Friction Studies. The Subcommittee is pleased that FAA has addressed most of the recommendations from the Subcommittee's spring meeting. In particular, we note that substantial progress has been made on both RPD 155 (Heated Pavements) and RPD 147 (Aircraft Braking Friction). The FAA has met project milestones proposed at the Spring Meeting and seems on track to meet milestones proposed for next spring. With respect to RPD 147, initial data from dry and wet pavement testing appears promising, providing some degree of confidence that it will be possible to collect pavement/tire interaction data for snow-contaminated pavements this winter season.

Finding: Research on Trapezoidal Grooves Ready to be Translated into Practice. The Subcommittee notes that FAA Office of Airports has not yet taken action on the Subcommittee's recommendation that FAA Office of Airports make necessary modifications to its advisory guidance—particularly Advisory Circular 150/5320-12C, *Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces*—so that airport operators can utilize trapezoidal grooves to improve runway drainage and friction under wet conditions should they desire.

Recommendation: The Subcommittee reiterates its recommendation that FAA Office of Airports make necessary modifications to its advisory guidance—particularly Advisory Circular 150/5320-12C, *Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces*—so that airport operators can utilize trapezoidal grooves to improve runway drainage and friction under wet conditions should they desire.

Finding: High Strength Concrete Research Should Incorporate Material Properties Considerations. Regarding RPD138, the Subcommittee appreciates the progress the FAA continues to make regarding how use of high strength concrete may affect pavement fatigue life. However, the team also notes that constructability, quality, and practicability considerations can be significant when high strength concrete is used.

Recommendation: The Subcommittee recommends that the RPD138 project team include consideration of constructability, quality, and practicability considerations in its evaluation of high strength concrete pavements, especially when it comes to the development of new or revised design standards for these pavements.

Finding: Greater Situational Awareness Needed Among Research Programs when it comes to Safety Database Development and Management. The Airport Technology Program is currently engaged in the development of an airport safety database as part of RPD141. This database fuses information from the FAA's wildlife strike database as well as accident and incident reports from FAA and NASA databases. Subcommittee members would like to ensure that this database is being developed in coordination with other FAA lines of business, particularly when it comes to the use of these databases to drive new standards and advisory guidance.

Recommendation: The Subcommittee recommends that the development of databases—especially safety databases—be readily available to other research programs, particularly those underway within

the Aviation Safety and NAS Operations portfolios to ensure that other lines of business and research teams are aware of them. We also suggest that there be some means of coordination among the various FAA research programs when it comes to the development and use of these databases.

Finding: Better Definition is Needed Regarding "Safety Mitigation Plans" to be Developed as Part of the Airport Safety Database Project and These Plans Should Be Coordinated with Stakeholders Outside of FAA. As part of their briefings on RPD141, the FAA noted that an upcoming task will be development of "safety mitigation plans". However, it was unclear what the content of these plans would be. Subcommittee members expressed concern that if such plans include airport-specific recommendations—rather than systemic recommendations—they must be coordinated with affected airport operators and other stakeholders.

Recommendation: We recommend that the FAA establish an informal "safety working group" similar to the already established "40-year design life working group", which can be used as a sounding board by the FAA regarding the feasibility, effectiveness, and priorities of identified mitigation strategies. We also recommend that the FAA more clearly define the intent and scope behind the terminology "safety mitigation plans".

Finding: The Subcommittee Should Be More Involved in the Development and Prioritization of New Research Tasks. In recent years, the Subcommittee has not taken a very active role in developing and reviewing new or revised research tasks that are undertaken by the Airport Technologies Research Program.

Recommendation: The Subcommittee recommends that the FAA seek input and advice from the Subcommittee when new research requirements are developed. We believe that Subcommittee member expertise can help to strengthen and/or focus these research requirements and will provide the Subcommittee with improved situational awareness regarding new research the FAA is undertaking.

Finding: FAA Research into Extended Airfield Pavement Life-Cycles Needs to Include Consideration of Paving and Subbase Material Characteristics. Regional paving material and subbase characteristics can have a significant impact on pavement life and should be considered in the FAA's "40-year airfield pavement project" (RPD146).

Recommendation: The Subcommittee recommends that regional paving material and subbase characteristics and their impacts on pavement design life be explicitly addressed in RPD146.

Subcommittee on Environment and Energy

Finding: The Noise Research Roadmap presented to the subcommittee at the August meeting represents an impressive first step in expanding the Agency's knowledge of the current state of aviation noise impacts on the general public. The Subcommittee commends the FAA for this initiative and appreciates the opportunity for input.

Recommendation: The maturation of the Noise Research Roadmap should continue as expeditiously as possible and sufficient funding should be made available to ensure that this program is not unreasonably delayed. Results of the findings made in the course of this research should be used to update and implement Agency policy in the noise area.

Finding: Section 912 of the FAA Modernization and Reform Act of 2012 required an independent assessment of the work of the Office of Environment and Energy. This Report was sent to Congress in July and was supportive of the work that is being done. The only area of minor concern involves the transition of research to implementable policies and products. The independent panel found that ". .

.some additional attention could be paid to the specifics of research transitions and some ideas can be borrowed from best practices at other agencies." The subcommittee agrees with this finding.

Recommendation: The Subcommittee recommends that the Agency review the research transition programs of other agencies to determine whether there are ways to further expedite the transition from research to implementation. A good starting point would be a study of the existing NASA-FAA Research Transition Team concept.

Finding: An area of AEE activity that demands continued prioritization is the ongoing CLEEN/Alternative Fuels program. These activities have shown great promise in accelerating the transition of research into products that can be incorporated into aircraft and engine design and in developing fuels that can be used as a substitute for traditional petroleum-based jet fuels. Congress has recognized the importance of these projects by continually providing funds in excess of those requested in the President's Budget.

Recommendation: The Subcommittee strongly recommends that funding necessary to support the CLEEN/Alternative Fuels programs continue. Indeed, the subcommittee continues to endorse the AEE above-target funding request for the continuation of these programs at the highest possible level.

Finding: United States leadership in the ICAO CAEP process continues to be an important priority.

Recommendation: Sufficient funding should be available to AEE to permit continued U.S. leadership in the ICAO arena. For example, the current ICAO initiative to develop a worldwide CO2 standard is moving forward, with specific deadlines that must be met. It is important that the United States remain engaged in a leadership position to focus the CAEP work on the most important efforts and to ensure that resources are not strained by less productive projects. In addition, it is important that other CAEP members provide resources for the various projects so that the United States does not carry the entire burden.

Finding: The cooperation between the FAA and other domestic agencies in the area of environmental research has been effective and has permitted the leveraging of continually diminishing resources. The Subcommittee was extremely impressed by the presentations of the Departments of Energy and Agriculture in the area of alternative fuels research. These presentations clearly demonstrated that interagency communication and cooperation can go a long way in overcoming resource shortages.

Recommendation: In order to ensure the most efficient use of resources in all areas of environment and energy research, the Subcommittee recommends that existing partnerships between AEE and other agencies in the United States continue. In addition to ongoing work with a variety of agencies in the alternative fuels area, and with NASA on a variety of issues, the Subcommittee recommends that partners be identified to continue research efforts with respect to particulate matter measurements and modeling non-CO_2 atmospheric pollution.

Finding: The briefing given on AEE Goals and Targets revealed that some existing targets, and the metrics used to measure success in reaching these goals, may be unrealistic and should be revisited.

Recommendation: The Subcommittee recommends that the Agency undertake a comprehensive review of its environmental goals, targets and metrics to determine whether existing goals and measurements are realistic or need to be revised. One specific target and metric that the Subcommittee feels needs revision is the fuel efficiency goal and metric.

Subcommittee on Human Factors

Finding: ATC/Tech Ops Core. It appears that funding for ATC / TechOps Human Factors will not adequately support critical research beyond 2015. Further, it appears that the interim 2014-2015 activities do not have sufficient funding to effectively provide their intended contributions. This builds on a finding from the Spring 2013 Subcommittee meeting (Finding 4 – no agency response at the time of the subcommittee Fall meeting) noting that plans for the ATC/Tech Ops core research program are important, but that anticipated funding levels would be insufficient to execute the plan. Further, the value represented by the crosscutting nature of the work in this area is difficult to achieve in other research programs or in specific development programs.

At this meeting, the funding levels were confirmed as being roughly halved. This resulted in limiting research primarily to in-house researchers, making impossible the proper execution of most elements of the plan at the depth and rigor required. Research areas depending on procurement funds or outside contractors are particularly hard hit, without apparent consideration of the technical impact. For example, significant risk areas resulting from these funding cuts include:

1. Research for controller fatigue is being eliminated, even as the ATO is trying to startup a Fatigue Risk Management System (FRMS) that should be monitored and updated to reflect how it impacts actual controller fatigue.
2. Research addressing Human Factors in Safety and Operations appear to end in FY2014. This will effectively terminate recent advances in engaging human factors in ATO's annual tackling of their top 5 hazard mitigations, and methods for ATO operational facilities used in the analysis of ATSAP.
3. A previous finding (Spring 2013) noted a need for better integration of Human Factors within the Acquisition Management System (AMS), so as to provide the agency with a capability to incorporate human factors early in the acquisition process and then monitor for potential problems throughout acquisition. It appears that this research area is at risk of termination for lack of funds.
4. Affecting all aspects of ATO/Tech Ops human factors research, the funding reduction will not allow human-in-the-loop testing, which is a necessary component of definitive human factor evaluations.
5. The committee believes there is a need for maintenance, analysis, and future updates to HF research for personnel selection, both in terms of ensuring validity of current selection practices, and for updating personnel selection in response to new developments. This research has been terminated within the research program, without being transitioned to other offices within the agency.
6. Cornerstone success criteria for ATC are reduced Loss of Separation events and Runway Incursion events. The core program includes training R&D to improve controllers' ability to recover from Loss of Separation events, but it is shown only for FY2014; this appears to be insufficient to make substantial improvements in mitigating the effects of, and recovering from, such events through improved controller training.

Recommendation: The funding reduction in this area in 2014 and beyond is insufficient for critical research areas and will have significant impacts on safety and ATO operations. We recommend that the agency restore sufficient funding to address the risk areas identified in the findings; if not, the agency should describe how they will address these risks and their safety and operational implications.

Finding: NextGen ATC/Tech Ops. The Subcommittee was very pleased with the presentation of the NextGen Air traffic Control/TechOps Human Factors Research plan. The set of research activities and outputs represented an important set of cross-cutting HF research needs in support of NextGen. However, it was not clear what relative priority the FAA places on these activities, and thus whether sufficient funding is planned to meet the research objectives.

Recommendation: Continue to pursue the NextGen ATC/Tech Ops research plan as presented. Where funding needs to be prioritized for research in this area relative to other NextGen research areas, and within the plan, describe the prioritization, its impact on the ability to conduct these research activities, and the further impact that any cuts to these cross-cutting research activities may have on NextGen developments.

Action: Further elaborate on details of the individual research activities, and clarify the prioritization of their execution as the plan matures and as the plan is resourced. Present this material at a future meeting.

Finding: Proper Human Factors Input into ConOps. The Subcommittee heard briefings on the expected flightdeck and ATC NextGen research plan. While the proposed work is excellent, these briefings led the Subcommittee to raise the following question:

How can the FAA ensure sufficient human factors input during the development and validation of NextGen CONOPS, including specific coordination to ensure that the findings from recently completed and future human factors research will help both to inform definition and validation of a CONOPS over its lifecycle, and to ensure that the correct human factors research is being done to enable implementation of a CONOPS?

Such human factors input needs to be integrated early in the process of defining and refining a CONOPS in order to ensure that it is viable from a human performance perspective, and to provide guidance in designing the necessary technological enablers for the CONOPS. In addition, as the implementation of the CONOPS proceeds, human factors research needs must be identified proactively in order to ensure that the necessary detailed human factors research has been completed in time to influence design and acquisition decisions. Rather than taking a reactive approach to human factors, such early incorporation of human factors input will help to ensure that the CONOPS and its implementation will be effective once fielded.

Recommendation*:* Better integrate the development and implementation of NextGen CONOPS with human factors research findings and expertise. This includes not only using human factors expertise to better inform the CONOPS, but also ensuring that the human factors implications of the CONOPS development are linked back out to relevant research and development. Specifically, ensure that the Human Factors Research team is involved in the initial generation of Next Gen CONOPS so that downstream changes and mitigations are minimized.

Finding: Broader set of HF issues around roles, responsibilities. Determining information requirements and their human factors implications is an important focus of planned research for each of the flightdeck and ATC. However, given the significant enhancements expected under NextGen, a broader set human factors issues needs to be addressed, including research dealing with the implications of new roles and responsibilities, as well as the introduction of new procedures and enabling automation, communication and decision support technologies.

A good example of this is the proposed research concerned with the common functions and shared information requirements for ARTCC and TRACON operations that is expected to provide input to support the potential merging of ARTCC and TRACON facilities and functions. While this research is necessary, the full benefits of such a merger look beyond information requirements to also account for the human factors implications of new roles and responsibilities, and corresponding new procedures and supporting technologies. Not only is this broader scope important to provide guidance in the integration and design of decision support technologies, it is of critical importance in guiding the development and validation of the relevant CONOPS.

Recommendation: Map out the broader range of human factors issues that need to be addressed, including not only a focus on information requirements but also the human factors implications of new roles and responsibilities, and their distribution within and between air and ground systems, as well as the introduction of new procedures and enabling automation, communication and decision support technologies.

Action: Ensure an integrated approach to human factors research coordinating efforts examining the flightdeck, ATC and TechOps. This requires careful definition of the research requirements for work

funded as flightdeck research, ATC research or TechOps research. Equally important, it requires careful attention to the definition and execution of the specific research tasks and associated deliverables to ensure that such an integrated perspective isn't lost as the research transitions to implementation. Finally, it requires deliberate coordination across the programs responsible for these three focus areas. Specifically, the subcommittee would like a briefing on this. We believe that developing this briefing will also be useful for presentation by the FAA in other contexts than just our little subcommittee world.

Finding: Requirements Generation and Prioritization within AVS. The Subcommittee very much appreciates that a thorough and structured requirements generation and prioritization process has been put in place by AVS. However, as with any new process there needs to be on-going examination and refinement. Several findings emerged during the discussion of how requirements are generated and evaluated.

- The process can be onerous to requirement writers in a time and resource constrained environment; in some cases, anecdotal evidence suggested that some significant requirements may be lost because the process is perceived as too onerous.
- Part of the perceived difficulty may stem from the fact that, while requirement writers may understand the needs for research and the desired outcomes and deliverables, they may not understand how to actually craft a research plan as called for in the template. The process was not always clear that milestones and project phases should describe the research objectives and requirements, rather than requiring a detailed research plan.
- It also appears that the process may inadequately weight and hence inappropriately prioritize the cross-cutting nature of some projects. There doesn't appear to be a place in the requirements-generation template to give appropriate weight to those requirements that cut across domains and other requirement areas. In addition, the process also does not seem to give much emphasis on multi-year activities.
- While a phased approach to research deliverables, milestones and exit criteria is encouraged in the process, there is no place to adequately identify previous work and accomplishments that the current requirement builds upon. This is particularly important when evaluating multi-year research plans that are intended to build upon each other.

For these reasons, it appears that the requirement process can be further refined to allow for greater efficiencies and enhanced validity of prioritizations.

Recommendation: AVS should undertake a process improvement activity to refine the requirements generation process to address the issues defined above. Specifically: 1) clarify the inputs needed for the milestones and project phase template items, 2) include in the template a means to appropriately weight cross-cutting requirements and ways in which the current requirement builds upon previous work, and 3) consider surveying those who have written requirements concerning their experience of the process and areas where further guidance would be helpful.

Finding: AVS Core. Examining the ranks assigned by AVS to the Human Factors research requirements, we find that there appears to be significant variation year to year: for example, proposed applications of human factors developments to address Jet Upset, notably including training, are ranked the highest of the requirements proposed by the Human Factors TCRG in one year, and then second-lowest in the next. Further, we note that these rankings are made three years out based on the best estimates available at that time. While these rankings three years in advance serve a valuable planning function, new knowledge and considerations may arise after the rankings are originally are made. We understand that AVS also considers 'pop-up' research needs on a shorter time-cycle, but note these pop-up research needs appear to be handled with a distinctly different process rather than explicitly integrated into the formal planning process that has been established; further, this process appears, from the written description of the 2013 Aviation Safety R & D Prioritization Process, to be limited to year of execution.

Recommendation: Rather than viewing the rankings as fixed three years in advance, and then waiting until the year of execution for further evaluation, we recommend that the rankings be revisited in advance of the year of execution to take into account:

1. New knowledge about the problem and potential solutions that may increase or decrease the importance and likely impact of the research requirement.
2. New considerations in the broader aviation community may make specific research requirements more-or-less pressing.
3. Emerging problems and potential solutions.

Finding: UAS. The Subcommittee was not briefing on the AVS research requirement for UAS Human Factors due to concerns about release of contracting-sensitive information, particularly where committee members may have inherent conflicts of interest. However, this research area is vital to achieve the mandated ability to include civilian, commercial applications of UAS within the NAS, and it merits a review even if the review process must be modified to account for conflict of interest concerns.

Recommendation: Continue with the planning and implementation of the research requirement and specification, recognizing the pressing need of this problem, and opening up these research plans for proper review as soon as possible. This should involve experts without conflict of interest now, rather than waiting until the research plans are finalized beyond the ability of a review to provide constructive comments and feedback.

Action: Distribute to the committee the research requirement immediately upon its public availability and/or address concerns with conflict of interest so as to enable a review of the proposed requirement.

Action: ATC/Tech Ops Core - UAS Ground Movement, Contingency Ops, and Incident Reporting. The Subcommittee found three areas of the program description that were confusing or needed more explanation. It is unclear whether these reflect potential areas for project improvement or simply are areas that need to be presented more clearly.

First, the described research requirements of "ensure Next Gen systems support UAS integration" and "Generate HF Operational and Functional requirements for NextGen systems to support imminent UAS NAS integration" make it sound as though the focus of the effort is to support modification of the NAS and NextGen to accommodate UAS's; the Subcommittee believes the requirements should include, and perhaps focus on, the opposite, that is, UAS requirements for operating in the NAS rather than NAS requirements for accommodating UAS's.

Second, the outcome titled "provide HF for ground control systems" is too broad and sounds very similar to an objective of the Flight Deck HF program on UAS's. The Subcommittee believes this objective should focus on identification and mitigation of HF issues related to communication between the UAS ground control station and air traffic control. This would make it clear why the outcome is part of the ATC HF project and not the Flight Deck project, and it would explicitly show how the two programs are coordinated.

Finally, the outputs or deliverables of this project, namely reports, are viewed as inadequate in terms of identification of how they will be used by stakeholders. The Subcommittee believes that the outputs should be in a form that makes clear how they will be used. For example, will the deliverables provide guidance to FAA certification and operational approval personnel, are they meant to help develop standards and design guidelines, or are they intended for some other purpose? Simply producing reports without identifying their intended impact and user may result in the objectives and requirements of the project not being achieved.

Action: Loss of Control (LOC)– Inflight Research Program. The Subcommittee suggests that the learning objectives and training techniques for LOC training be more explicitly defined and delineated.

For example, LOC awareness/avoidance and detection/recognition may primarily require additional knowledge and knowledge refresh, while recovery likely requires both knowledge and manual skill/practice. Knowledge components could be taught in the classroom and with existing simulator capabilities while skill development and practice of skills may require new simulator capabilities. It is suggested that training guidance and recommendations be separated into different categories that might be implemented in these different ways. For example, the training protocol for LOC avoidance knowledge elements that can be taught in the classroom can be defined separately from the training protocol for recovery skills that must be practiced under realistic operational simulation conditions. Further, some elements of LOC training might be incorporated into CRM or other specialized training modules – for example, startle, surprise and distraction aspects of LOC might best be covered in CRM in conjunction with aircraft state awareness, automation awareness, proper monitoring practices, and so on. Similarly, CRM skills should be integrated into both academic and skill development for LOC training. While the learning objectives should be defined and addressed separately, the research should also identify how the LOC and CRM training components should be integrated for maximum benefit.