May 14, 2013

The Honorable Michael P. Huerta

Administrator

Federal Aviation Administration

800 Independence Avenue, SW

Washington, DC 20591

Dear Administrator Huerta:

Thank you for taking the time to meet with the Research, Engineering and Development Advisory Committee (REDAC) at the spring meeting. Your presence, under difficult circumstances highlights your understanding of the importance of research, engineering and development are to the needs of the agency.

As you indicated in your comments, the FAA will be under financial pressure for the foreseeable future. As a consequence it will be critical to define, articulate and prioritize clear R&D objectives to focus resources and justify investment. The REDAC and its subcommittees are committed to help and we hope you will use us as a resource in this process.

In reflecting on the expected financial stress and your request to also consider the longer strategic view, the REDAC makes a number of recommendations:

1. It is important for the FAA in coordination with other related government agencies (NASA and DOD) to identify and articulate the importance of Aviation Research and Development to the nation. This includes: meeting critical needs for infrastructure and safety while improving environmental performance, supporting national defense, and creating opportunity and economic development.

2. It is be important to develop a holistic agency view of the R&D priorities to integrate and improve coordination of research and development across the agency. The REDAC observes that current research priorities are defined within the FAA lines of business. There does not appear to be an integrated agency wide view of the research and development priorities which will be important if financial pressures dictate a reduction of the R&D effort.

3. If cuts must occur, the REDAC recommends that there should not be an across-the-board cut in all programs. Rather the agency should use the recommended holistic view of R&D priorities to insure that “critical mass” is maintained in the most important programs and that the agency maintains technical capability in essential areas.

4. Under financial pressure, the FAA must continue to develop and maintain the technical workforce which will allow the agency to meet operational requirements; to respond to and to capitalize on emerging technologies.

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

Thank you for the opportunity to engage and contribute to the safety, efficiency and sustainability of aviation in the United States. Please let us know if there is anything further we can do to help.

Sincerely,

R. John Hansman

Chair, FAA Research, Engineering and Development Advisory Committee

Enclosure

Research, Engineering and Development Advisory Committee
Recommendations on the Fiscal Year 2015 Research and Development Portfolio

Subcommittee on Airports

Finding: The Subcommittee is pleased to see that the turn-around time for research reports has been reduced from 9-12 months to 2-3 months as a result of reorganized editorial procedures.

Finding: The Subcommittee reiterated the need for continuing coordination between noise and sleep disturbance projects within the FAA Office of Energy and Environment's research and development program (e.g., PARTNER Projects #24: Noise Exposure Response: Annoyance and #25: Noise Exposure Response: Sleep Disturbance) and the noise study currently underway within the Airport Technologies Program (Airport Sleep and Annoyance/Aircraft Noise (RPD149)).

Recommendation: The Subcommittee recommends that the Subcommittee on Energy and Environment and the Subcommittee on Airports receive regular briefings regarding each subcommittee's noise projects to ensure that redundancy among these projects is minimized.

Finding: Regarding RPD149, The Subcommittee would like to ensure that airport operators are informed about planned noise survey efforts well in advance of administration of these surveys.

Recommendation: The Subcommittee recommends that the RPD149 project team meet with airport noise and environmental specialists at the airports where noise perception surveys will be administered to review the survey contents, research objectives, and survey plan (e.g., communities that will be surveyed and survey sample sizes) in advance of administration of the surveys.

Finding: The Subcommittee appreciates the work to evaluate existing heated pavement installations in Heated Pavements (RPD155), but had concerns about whether advanced materials research should take place before more convincing evidence can be provided regarding the circumstances under which heated pavement systems are cost effective.

Recommendation: The Subcommittee has reviewed the 2013 and 2014 work plans for the RPD155, but would like to continue to receive detailed briefings concerning project progress. We strongly recommend that the FAA describe the circumstances under which heated pavements are likely to be cost beneficial (high-speed exits, critical turn locations, aprons) as well as the rationale behind this assessment. We also recommend that additional efforts be put forward to estimate the life-cycle costs of these systems. The Subcommittee recommends that this work take place before additional work is performed on advanced heated pavement materials.

Finding: FAA has provided improved explanations of the objectives, research plan, and progress associated with RPD147, Aircraft Braking Friction. They have also included "go/no go" decision points in the project schedule as requested by the Subcommittee. However, the Subcommittee continues to have concerns about the project's complexity and challenges associated with producing meaningful research results.

Recommendation: The Subcommittee will continue to closely monitor this project. We recommend that the FAA present results of dry/wet braking tests at our September 2013 meeting to assess project progress. In addition, if data from winter condition tests that will be performed during the Winter 2013-2014 season isn't available for reporting by the Subcommittee's Spring 2014 meeting, the Subcommittee recommends holding a special coordination call with FAA staff to discuss these results in May or June 2014 to assess progress.

Finding: The Subcommittee is pleased to see that many of the FAA's aircraft and rescue and firefighting projects are concluding successfully.

Recommendation: As Airport Rescue and Fire Fighting (ARFF) project technical reports—particularly those associated with cargo aircraft—become available, we encourage the FAA to distribute widely to key stakeholders, including airport ARFF representatives and cargo airline representatives.

Finding: The Subcommittee believes that the FAA is making good progress on several research projects that deal with advanced sensor technologies (i.e., foreign object debris (FOD) detection in Airport Design (RPD133), avian radar in Wildlife Hazards Research and Development (RPD150), and low cost surface surveillance in RPD151), but would like to see additional focus on the operational integration of these systems in the field environment. There is also a desire to utilize identified operational needs as the basis for technology specifications, rather than starting from current vendor system capabilities, which may exceed these operational needs.

Recommendation: The Subcommittee recommends explicit consideration of operational integration of the aforementioned airport sensor technologies into the airport environment and the development of operational justifications for the specifications developed under the research program.

Finding: Regarding Pavement Design and Evaluation (RPD145), the Subcommittee believes that the FAA has addressed our recommendations from our Fall 2012 meeting on a conceptual level. These recommendations included (1) definition of the term "40-year design life" and (2) description of project success criteria. This said the Subcommittee would like to see refinement and embellishment of these definitions as the project proceeds. There was also a desire to have opportunities for more robust industry participation of the project by subject matter experts (SME) in both asphalt and Portland cement concrete design.

Recommendation: The Subcommittee recommends forming a SME advisory panel with selected members of the Subcommittee and the Airfield Pavement Working Group that can collaborate with the FAA project team directly in its refinement and execution of the RPD145

work plan, leaving the subcommittee free to focus on the higher level aspects of the pavement research program.

Finding: The Subcommittee believes that research conducted by the FAA demonstrates that trapezoidal transverse pavement grooves improve runway drainage and reduce groove wear in comparison to conventional rectangular transverse grooves.

Recommendation: The Subcommittee encourages the FAA to 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: The Subcommittee would like to emphasize the need for and value of the Airport Pavement Test Vehicle (RPD135), construction of the high temperature pavement test facility. This facility will enable the testing of asphalt concrete (AC) pavements under "real-world" environmental conditions, including innovative AC paving techniques (e.g., warm mix asphalt) and new AC materials (e.g., advanced polymers binders, stone matrix asphalt, recycled asphalt).

Finding: The Subcommittee encourages the National Airport Pavement Test Facility (RPD138) project to continue investigating high strength concrete effects on pavement fatigue life. The current research results indicate that high strength (e.g., flexural strength of approximately 1000 psi) Page Control Chart (PCC) surface layers perform as well or better than medium strength PCC surface layers (e.g., flexural strength of 750 psi) assuming that the PCC layers are of the same thickness. While these results provide evidence that the FAA's flexural strength design limits can be relaxed provided pavement section thicknesses are held constant, they do not address the important relationship between pavement strength and pavement thickness. The Subcommittee believes that the significant benefit of using higher strength materials lies in being able to reduce construction costs through the use of thinner PCC surface layers. Many local areas are able to achieve higher strength concrete with normal construction practices. Making use of this phenomenon is logical and can help reduce construction cost.

Recommendation: The Subcommittee recommends the FAA continue research on the effects of higher strength concrete on concrete pavement fatigue life by investigating the pavement life when reducing pavement thickness proportionally to the increase pavement strength. Until such research is completed, relaxation in maximum flexural strength limits for PCC surface layers should be conditioned on the retention of "conventional" PCC surface layer thicknesses.

Subcommittee on Environment and Energy

Finding: In view of the current budget crisis, including the effects of sequestration, it is crucial that Office of Environment and Energy (AEE) continue to review its portfolio to ensure that available funding is spent most effectively.

Recommendation: With declining resources, it is imperative that AEE prioritize its activities, funding those projects that promise the greatest environmental benefits. In practical terms, this

means that there should **not** be an across-the-board cut in all programs. Rather, AEE should ensure that the most important projects are funded at a level that permits these projects to continue with the least possible disruption.

Finding: Continued Tools Research is necessary to support the implementation of domestic NextGen initiatives and the development of environmental standards through the International Civil Aviation Organization (ICAO) process.

Recommendation: Continued funding of AEE tools development and maintenance is a priority and is required to permit assessment of the environmental and economic impacts of, and trade-offs among, different possible mitigation strategies. These tools enable the analysis of the environmental consequences of aviation operations, as well as the potential impact of NextGen implementation and standards under consideration at ICAO.

Finding: Another area of AEE activity that demands prioritization is the ongoing Continuous Low Energy, Emission and Noise (CLEEN)/Alternative Fuels programs. These activities have demonstrated success in maturing technologies which will facilitate integration into future products and in developing fuels that can be used as a substitute for traditional petroleum-based jet fuels.

Recommendation: The Subcommittee strongly recommends that funding necessary to support the CLEEN/Alternative Fuels programs continue. Indeed, the Subcommittee strongly endorses the AEE above-target funding request for the continuation of these programs at the highest possible level. The first phase of the CLEEN program, a cost-sharing program between industry and government, has resulted in the accelerated development of a number of environmentally beneficial products that are likely to be incorporated in aircraft and engine designs in the relatively near future. This program should continue into its next phase with the level of funding necessary to encourage future success.

Finding: United States leadership in the ICAO Committee on Aviation Environmental Protection (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. In addition, it is important that other CAEP members provide resources so that the United States does not have to carry the entire burden. Perhaps most critically, U.S. resources should not be used for CAEP projects that are not supported by, or of significant priority to, the United States

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 diminishing resources.

Recommendation: In order to ensure the most efficient use of resources in environment and energy research, the Subcommittee recommends that existing partnerships between AEE and other agencies in the United States continue. In addition, the Subcommittee recommends that international partnerships be explored in an attempt to further leverage available funding. For example, the Subcommittee supports and encourages continued collaboration with the Swiss government which has funds available to expand research in the area of Particulate Matter.

Finding: As a new Center of Excellence for research into environmental and alternative fuels issues is established, the FAA has an excellent opportunity to ensure that stakeholders play a meaningful role in the selection of projects selected for inclusion in the research. Experience from the existing PARTNER Center of Excellence suggests that its Advisory Board may have become too large and, in more recent years, has often not been consulted soon enough to weigh in on the merits of particular projects under consideration.

Recommendation: In view of some perceived shortcomings in the existing PARTNER Center of Excellence Advisory Board, the Subcommittee recommends that the FAA review such problems and identify problems that need to be corrected. These "lessons learned" should then be incorporated in the formation of the Advisory Board for the new Center of Excellence.

Finding: The Subcommittee has found that advancements in environmental research, and their implications for aviation, are often not fully communicated to government decision-makers and to stakeholders, including the general public. This lack of communication with the "larger world" has complicated requests for funds to continue the research and deploy the insights gained.

Recommendation: The Subcommittee recommends that the FAA establish a process to ensure that research project successes are effectively communicated to a broader audience. In addition to typical outreach activities such as the publication of Fact Sheets; placing information prominently on the FAA website; and placing articles in trade journals and the mainstream media, the FAA should seek creative methods to ensure the most effective and efficient dissemination of information. For example, publication of the successes in the first phase of the CLEEN program would make the argument for continued funding of the program into a second phase more attractive.

Finding: One of the existing environmental research programs is the Aviation Climate Change Research Initiative (ACCRI). This program concentrates on research involving non-CO2 atmospheric pollutants. Phase 2 of ACCRI is nearing its completion, with a final report expected in the near future. When this report is issued, the subcommittee urges the FAA, consistent with available funding, to determine what future research and policy steps are necessary to address the findings. U.S. research involvement in this area is important to expand understanding beyond the more limited findings from past European initiatives. (Since the report is not yet completed, and the Subcommittee does not know what conclusions will be reached, no formal recommendation on what future steps are necessary can be made at this time).

NAS Operations Subcommittee

Finding: The Subcommittee observed that the Weather Program Planning Team (PPT) Portfolio research requirements, while directly linked to NextGen Segment Implementation Plan (NSIP) Alpha and Bravo, were too broadly stated and open-ended. Examples included: enhanced turbulence forecasts and graphical guidance information, enhanced ceiling and visibility analysis and forecasts, and enhanced aviation specific weather hazard diagnosis and forecast information. While there may be an operational need in NextGen for enhancement to these forecast tools, it was difficult for the subcommittee to ascertain just how much enhancement was needed and what NextGen operational benefits would be achieved with each incremental enhancement. Moreover, the research prioritization process employed by the FAA for the Weather PPT Portfolio appears to be internally focused within the weather research organization. Individual components of the weather research portfolio are prioritized within the A.11k Budget Line Item (BLI) rather than prioritized relative to what is needed to achieve NextGen Operational Improvements. The subcommittee recognizes that this BLI is not controlled by the NextGen Program. However, if the principal justification for this investment of RE&D funds is the NextGen Segment Implementation Plan, then this research should be driven by NextGen operational requirements. If the operational requirements are not sufficiently defined, then the research should focus on defining them. The users of the products of the weather research should be included in this activity.

Finding: One of the principal justifications for both the Weather PPT Portfolio and the Weather Technology in the Cockpit programs is that they would provide a safety benefit to general aviation (GA). Both programs cite the 75% average fatality rate in GA weather-related accidents and the fact that GA accounts for 88% of weather-related aviation accidents. However, the subcommittee was presented with no evidence of any systematic study of the causality of these accidents that leads to the conclusion that better forecast tools or cockpit display of weather will substantially reduce the GA weather-related accident rate.

Recommendation: In future Subcommittee reviews of the Weather PPT portfolio and Weather Technology in the Cockpit Programs, the FAA should present a clear justification for the research investment. The FAA should provide quantitative (e.g., monetized) estimates of the NextGen safety and operational benefits achievable with the research results when applied to operations. Where the justification for the research requirement comes from NSIP, the FAA should define specific requirements for weather technology improvement, based upon the safety and operational requirements of NextGen. If these requirements have not been defined and quantified, the FAA should orient the Weather PPT research portfolio to define these requirements. The FAA should also provide specific quantitative estimates of the safety benefit for those research investments targeted for GA safety.

Finding: The NASOPs Subcommittee has previously recommended that the FAA undertake a broader management framework for its research and development. This would enable FAA to manage its research portfolio across funding lines to focus on achieving specific operational benefits to the National Airspace System (NAS). At its summer 2012 meeting, Paul Fontaine agreed to develop a portfolio view of FAA activities related to NAS surface operations. The Subcommittee found this portfolio view to be excellent. The graphical depiction of related efforts highlighted the interplay between requirements sources, funding sources and projects

within the portfolio and could easily be expanded to include more detail on FAA R&D and related research projects from other government agencies (e.g., DoD and NASA).

A true portfolio view and management of research priorities across the portfolio will require the right level of aggregation and oversight by an executive-level governance body such as the Research and Development Executive Board (REB), the NextGen Management Board (NMB), or the Strategic and Budget Planning (SBC). The Subcommittee realizes that asking for this information places workload on already highly loaded managers; however, we believe that there is high value to the FAA being able to see the integrated view to identify research gaps and synergies. The NextGen portfolios are a good start to taking a portfolio perspective; expanding these portfolios beyond projects with NextGen funding is a critical next step.

Recommendation: The FAA should build upon the work that Paul Fontaine presented to the Subcommittee and present a similar portfolio view of FAA research for one or more additional NAS domains during the next subcommittee meeting. This portfolio view should include a first-order, quantified description of the benefits pool(s) that drive the decision for the projects (e.g., safety case, security case, efficiency case, reliability case, etc.). In addition, the portfolio views should include more detail of FAA R&D activities and the research activities of inter-agency and non-governmental organizations. The subcommittee will work with the FAA to define which domain(s) will be presented and how to maintain them as the research activities evolve.

Subcommittee on Aircraft Safety

Finding: For the most part, the FAA's RE&D program and the research components of F&E are 'applied research', that is research involved with addressing practical and identified problems. The anticipated impact of each project in the FAA's research program should be able to be articulated. Research's impact might be to inform an FAA investment decision or help guide a rule-making effort. Research might lead to the development of technical standards or guidelines for industry. Research might develop a technical capability that fills an operational requirement. While most of the projects in the FAA's current research portfolio could be tied to a desired outcome (e.g., reduce the accidents due to weather), the means for the research to effect that outcome is not always clearly articulated. In some instances when the impact can be clearly articulated, it seems that the FAA research investment is late to the need. As an example, the human factors research that would help inform certification of new technology such as angle of attack indicators for general aviation will not be complete until years after the first products begin the certification process. There appears to be an almost three year lag between when a requirement for research is identified before the research can be initiated.

The Subcommittee commends the FAA on the methodical planning process that has been put in place to prioritize its portfolio of projects in a way to meet growing requirements. This process requires that all requirements be clearly articulated in order to receive proper consideration. During a time of a shrinking and unstable federal budget it becomes even more important to be able to clearly justify requirements. In this ongoing environment of budget instability, which the SAS believes will continue into the foreseeable future, the FAA must incorporate within its

planning process a means to respond to near term impacts of changing resources, and address the timeliness of completing longer term research in order to be relevant to industry requirements.

It is important for FAA research managers to have the flexibility to reprioritize research to address practical problems in a timely fashion.

Recommendation: To best deal with the current environment of budget instability, the Subcommittee on Aircraft Safety (SAS) recommends that FAA consider establishing a process for establishing and reassessing research priorities across all Lines of Business. There needs to be a single focal point responsible for the agency's research strategy (including priorities) guided by executive oversight from within the FAA. Advisory committees (such as the REDAC) might be used as a sounding board.

Action: The Subcommittee requests a briefing on the AVS planning process that has been put in place to prioritize its portfolio of projects in a way to meet growing requirements. Examples of how the process has been used to accommodate a pop up and changing priorities will be helpful.

Finding: (Strategic Plan) The subcommittee is very pleased to hear FAA is nearing completion of a 10-year strategic plan for research within the subcommittee's purview. Communication of the strategic direction for FAA research is improving, but many elements seem either overlapping or simply disconnected. Having a 10-year strategic plan is expected to add significant clarity to how numerous FAA research activities are connected and the sum benefit of the anticipated outcomes.

Finding: (Aeromedical Research) The SAS observes that the funding at CAMI is stable as befits a national resource and appreciates the clear linkage to AVS goals in continued operational safety, standards/policy, and certification. The SAS notes the value of knowledge of effects of various drugs on pilot performance, but requests explanation of the specific requirements in Accident Prevention and Investigation.

Action: In Accident Prevention and Investigation, please explain why certain diseases are relevant, why some drugs are more relevant than others, and how particular drugs or diseases (e.g. diabetes) are chosen over others for studying their effects on human performance?

Action: Please provide accurate budget numbers for the Fire and Cabin Safety Aeromedical requirements.

Finding: (Fire Safety Research) The SAS finds that the Fire Research and Safety Program continues to be responsive to clear AVS needs producing timely results with stable funding and portfolio. At the same time the program is flexible to respond proactively to current and emerging needs. Examples were highlighted where the FAA is performing R&D that seeks to understand why fire-related events are happening and thus provide knowledge to be able to prevent them.

Finding: The Weather Program has many facets and addresses a large range of issues from GA weather accidents to improving capacity in the NextGen environment with better environment modeling and forecasting.

Of the $15.1M budget for AVS weather, $3.5M of this budget is driven directly by AVS needs and the remainder by the Air Traffic Organization (ATO) organization. This funding within the REDAC SAS portfolio is unique but seems to be appropriate due to the nature of the products needed in the ATO community.

The Weather Program involves a large number of interagency partners including National Oceanic and Atmospheric Administration (NOAA), National Weather Service (NWS), National Aeronautics and Space Administration (NASA), etc. Despite the diversity of needs and programs, the weather programs result in meaningful and contemporary products. There is no shortage of needs to better understand weather and new research needs appear as technology to better understand weather is created.

Finding: (Advanced Materials Structural) The Subcommittee was pleased with the overall direction in this area. The subcommittee noted there have been many years of research in the area of composite structures and asked what was distinctively different about the current research plan. The FAA noted prior research focused on small aircraft and the future activity was aimed primarily at transport category aircraft. The subcommittee appreciated the clarification but also requested FAA b e conscious of overlapping areas, such as occupant survivability research, or worse yet conflicting goals of areas so closely related. The subcommittee also noted the value of research aiming to validate prior 'ditching' assumptions is not seen as high value in light of other opportunities.

Finding: (Flight Deck/Maintenance/System Integration Human Factors and NextGen Human Factors) As in the last two REDAC SAS meetings, the Subcommittee once again expresses the importance of what has been traditionally known as human factors research in all aspects of aviation safety. The Subcommittee also recognizes the importance of most of the human factors issues that AVS has identified for funding and further research. It is obvious to those in FAA AVS, AFS, and in the aviation industry that human factors research covers a broad spectrum of accident prevention, interventions and supporting information for the development or updating of regulations and guidance. Unfortunately, this significance and importance is not obvious to those who aren't directly involved with the industry on a daily basis. This is evident by the drastic reduction of much of the FY 2014 human factors research funding. The Subcommittee understands the difficult environment that FAA currently is experiencing, however no other area of research received this drastic amount of funding reduction.

The Subcommittee senses that much of this situation might be caused by a lack of emphasis of the following items:

- the importance of the human factors issues to the overall safety of the system
- how those issues fit in with, and are important to the other areas of research being conducted
- specific details on the projected outcome and benefits of the research

Additionally, FAA responses given to the Subcommittee about specific human factors areas tend to be supportive of the issues identified as important by the Subcommittee, then are sometimes given a low priority and receive limited or no funding. The direct result of this is sponsors of the requested research are forced to develop and implement significant regulation, certify systems and components or write guidance material without the information needed to make data driven, results oriented, scientifically-based decisions. Examples of this discussed in the meeting were UAS control stations, Facility Roster Management System (FRMS), and guidance material for loss of control training.

Recommendation: The Subcommittee recommends that, for funding and functional purposes, AFS and AVS explore the possibility of closely aligning human factors research requirements with the other research areas they support, even though those issues fall outside of the traditional human factors portfolio. For instance, research on artificial vision and the complexity of instrument approaches both support increasing airspace capacity, which is a NextGen issue. Additionally, the Subcommittee recommends that more support and priority be given to human factors research that supports significant new or revised regulation.

Action: Also, the Subcommittee suggests that when projected outcomes are developed, they are linked directly with the specific benefit, metric, regulation, or document that they support and given a target completion date. An example of this is the Weather Program briefing, Outcome section, presented on 12 March. This section ties the research requirement to a specific AC and a target completion date.

Finding: (Continued Airworthiness Flight Control Mechanical Systems) The Subcommittee was pleased with the briefing provided, which focused on FY15 and beyond research. The subcommittee asked FAA to verify that planned future work (FY15 and beyond) would be limited to Part 23 aircraft. The FAA confirmed that current efforts, inclusive of transport category aircraft, would shift to Part 23 only by FY15. The subcommittee strongly encouraged FAA to ensure future focus on "developing methods to incorporate derived and sensed angle of attack (AOA) into displays, existing autopilots, and emerging fly-by-wire systems for small aircraft" was coordinated with human factors activity in HF-15-06.

Finding: (Continued Airworthiness Structural Integrity Metallic) The subcommittee greatly appreciates the tour of the Tech Center's facility that directly supports this area of research. The ongoing research into repaired structure, flutter suppression, and exploring new metallic structures is seen as high value by the subcommittee. Likewise, efforts aimed to improve detection of and mitigations for fatigue damage are important for both small and large aircraft.

Finding: The subcommittee finds that the Terminal Area Safety program is appropriately addressing and prioritizing research needs in this area. As they plan for new projects focused on helicopter safety improvements beginning in FY15, the subcommittee notes the importance of close coordination with DoD to leverage prior work performed on synthetic and enhanced vision systems for helicopter applications.

Finding: The FAA aircraft icing research program is well focused and responsive to identified safety needs. Using resources available, the leadership of this activity is effectively using

collaborative partnerships to identify and pursue relevant activities that support the efficiency of current and future icing certification processes.

Finding: (NextGen Alternative Fuels for GA) Over the last year the efforts on finding a viable, lead-free replacement fuel for the piston general aviation fleet has taken a critical turn as a result of environmental and supply side pressures. In the recent FAA Reauthorization Bill the FAA was directed to qualify a replacement fuel through the use of FAA Technical Center resources and to create an FAA Fuels Office (AIR-20). The FAA Administrator has included the determination of an unleaded aviation fuel in the Destination 2025 plan for completion by 2018.

With over 187,000 piston airplanes in the U.S. fleet, the size and scale of the unleaded avgas transition is a significant one. The FAA Technical Center's Aviation Fuel and Engine Test Facility (AFETF) is the only independent lab in the world capable of doing the necessary research to assure the continued safe operation of the this general aviation fleet.

Action: The current plan is level funded at $5.571M per year while the program activity is projected to experience a ramp in effort in the coming years followed by a decline in work. Further, the effort is only partially funded raising questions about whether the program can achieve its goals under the current funding circumstances. The FAA Fuels Office should assure that the funding plan for research aligns with the expected needs for successful completion considering the critical nature of the program. The subcommittee would like an update at the next meeting on the funding levels.

Finding: (Software Digital Systems) In the area of software digital systems, the Subcommittee is pleased with the progress made by FAA in terms of establishing the appropriate internal expertise; organizing the work program; connecting the work program to specific outcomes and impacts within the agency; and in reaching out to potential partners and collaborators. At present, the committee feels that the work being undertaken seems reasonable and that there are no glaring gaps. However, the Subcommittee notes that this is an extremely complex area with rapidly changing research drivers as well as progress being made in various domains that may have relevance for aviation. The subcommittee is apprehensive that the FAA is appropriately resourced to keep-up with the pace of change in this research area and remain a head of the curve.

Finding: The Subcommittee finds that the Continued Airworthiness of Composite Structures requirement continues to develop important information for FAA personnel to evaluate and understand the challenges related to composite structures in use in the field. The SAS also commends the FAA for using the flexibility of the pop-up process to reprioritize some funding to deal with standardization and a risk-based approach in MRO Oversight Support, a very important topic to the industry.

Finding: The Subcommittee finds that research programs around Continued Airworthiness-Engine NDE and Propulsions and Fuel Systems are effectively addressing the research needs in these areas. These efforts have produced tangible results in the form of regulation and guidance material that is regularly used in industry, with more on the way in the near future. Particularly

noteworthy is leveraging the relationship with industry and evolving the research effort to where industry responsibility and contributions continue to increase.

Finding: (Aircraft Catastrophic Failure Prevention) This research activity is focused on enabling the use of analytical methods to show regulatory compliance of engine containment designs against rotor burst or fan blade failures. Although a narrow focus, the research goals align with the much broader trend by industry to make use of analytical tools wherever possible.

Observation: The analytical tools being developed to support certification are important to industry and could be a pacing item for the certification cost and efficiency of new engine designs currently being developed. The FAA should continue to support this activity as intended and also provide an implementation plan as to when these tools will be available for use by industry.

Finding: (Continued Airworthiness; Rotorcraft Systems) The subcommittee found the briefing on rotorcraft systems to be very thorough and areas of future research well placed. When asked, the FAA adequately explained the lack of FY14 funding for the Advanced Control Systems research but the subcommittee voiced interest as to whether a funding change could be made at a later date. Further, the subcommittee looked favorably on the progress of HUMS activity and the proactive research aimed at better understanding the risk of bird strikes.

Action: Report on FY14 funding picture at next SAS meeting in August.

Subcommittee on Human Factors

Finding: Human centric design is key to achieving safe, effective, and efficient systems and a human factors research program must be scaled commensurately. Over the past few years, many strides have been made in creating a human factors program of sufficient scale to address the needs for human centric design in the areas of flight deck and air traffic control (ATC). In looking at FY2012 – FY2015, the Subcommittee is concerned that these strides will be erased with a down-scaling of the human factors research program. Human factors research needs to be supported at a level commensurate with the overall mission of the Agency to ensure human centric design can be implemented in the flight deck and ATC systems. As the FAA evaluates the appropriate sizing of programs, consideration must be given to the fact that human factors research has a large role in safety and efficiency and any down-sizing of broader research portfolios should recognize that equally-proportional down-sizing of key human factors research components may adversely impact the ability of the Agency to conduct its mission.

Recommendation: Ensure that the scale of the human factors research programs is commensurate with meeting the mission of the Agency through an adequate understanding of the risks associated with any down-sizing. These risks need to be understood in terms of integrating human factors research in system design and acquisitions as well as needed regulatory and guidance material. Critical human factors staffing and key capabilities should be maintained during prioritization of flight deck and ATC research programs.

Finding: Overall, the projects defined for 2015 in the Flightdeck/ Maintenance/ Systems Integration Human Factors portfolio adequately address the requirements that are set-out by Aviation Safety (AVS) and the Subcommittee agrees with the portfolio.

Recommendation A: Office of Aviation Safety (AVS) should ensure that the 2015 plan as defined gets executed. Prior to execution of each research requirement, survey the field of research and modify the detailed plans as appropriate.

Recommendation B: Several important projects, i.e., UAS HF Considerations, Avionics and New Technologies: Certification and Operational Approval Criteria, and Advanced Vision Systems are significant areas and the 2015 plan needs to ensure that key resources are available.

Finding: One of the primary goals of the REDAC is to review and provide guidance on the FY+2 portfolio. The winter meeting is presented with the research requirements as coalesced by the AVS process. This data is not sufficient to adequately assess the overall portfolio for the Flightdeck/ Maintenance/ Systems Integration Human Factors program. Additional information regarding rankings would allow the REDAC Subcommittee to perform its task.

Recommendation: At the winter/spring meeting, the REDAC Subcommittee requests visibility into the rankings of the AVS requirements for the FY+2 year as of the date of the meeting, even if the rankings are preliminary.

Finding: The Subcommittee reviewed the Air Traffic / Technical Operations Human Factors Strategic Research Plan and found it to be an excellent document to guide the core research efforts in this area, particularly in cross-cutting research areas that may not be addressed by isolated technology programs. This strategic plan clearly identifies the most important areas for continued research and development investment and the Subcommittee agrees with the importance of these areas. In looking at the 2015 portfolio there appear to be significant gaps between areas of important research defined by the plan and the projects that are currently in the portfolio. While there are many criteria to consider in prioritizing research projects, the Subcommittee sees that the current strategic plan represents important areas of need and hence should represent a significant input to research funding criteria. Where gaps exist between the strategy and plans, the Subcommittee is concerned that important areas of research will not be addressed. Several specific gaps in the 2015 plan were identified by the Subcommittee and are noted in the following findings and recommendations.

Recommendation: Ensure that the Air Traffic / Technical Operations Human Factors Strategic Research Plan is used as a significant input to the prioritization of research efforts in the human factors ATC Core program. Where parts of the strategic plans are not being implemented, define the impact and create a plan for how it will be addressed in future years. Provide this information as a briefing at the next meeting.

Finding: All Air Traffic / Technical Operations human factors research that supports personnel selection has been eliminated. Testing as part of personnel selection based on prior human factors research has been demonstrated to significantly reduce the cost of training in the past. As the demographics of incoming personnel change, and as new systems are implemented, such

data-driven methods for effective personnel selection will require further research. Thus, this research needs to continue and expand for placement purposes and to support NextGen implementation. The elimination of this area also puts the agency at potential risk in terms of its ability to successfully defend against future lawsuits that target hiring and selection processes. Finally, ongoing human factors research into personnel selection preserves the specialized skills and knowledge to further improve the Agency's efficiency in this area.

Recommendation: Ensure the Human Factors research that supports Personnel Selection is retained to enable the agency to realize the efficiency, cost savings, and scientific defensibility associated, and to mitigate the potential loss of competency in this area that could result from elimination of this work.

Finding: The Air Traffic / Technical Operations Strategic Plan Objective 5 focuses on maintaining a high level of human performance and safety. It cites a strategy with specific actions to reduce the probability of human error within the ATC system, including:

- Human performance baseline development to assess effectiveness of mitigations to identified challenges or error type
- Development of methods to prevent skill degradation brought on by increased dependence on automation
- Development of ATC best practices

There is a gap between meeting those goals and the portfolio presented, prompting the concern that the loss of focus in these areas would be detrimental to the Agency's mission going forward. This risk needs to be carefully evaluated in determining the final portfolio.

Recommendation: For research relating to the Air Traffic / Technical Operations Human Factors Strategic Plan for Safety, the ATO and the NextGen Organization should complete an assessment to ensure sustainment of plans and activities in this area that are commensurate with the continued pursuit of NAS modernization, for which the research items listed in Objective 5 of the strategic plan are particularly relevant.

Finding: There is a significant gap in designing new tools and systems for the operation of the NAS in terms of maintainability from a human factors perspective. This includes design at the level of individual devices and at the level of collections of devices or subsystems that need to be maintained by the same individual or team of individuals.

Designs need to be developed such that, from a human systems engineering perspective, it is easy to detect, diagnose, and repair faults and to train Technical Operations staff to perform such activities. For some subsystems, this includes the development of a user-centered design for an integrated workstation that allows Technical Operations personnel to monitor the health of several tools or subsystems remotely and, where feasible, diagnose the nature of a system failure and in some cases (such as a software failure) even repair the fault remotely.

Recommendation: Conduct the human factors research necessary to guide the development of such an integrated maintenance workstation, as well as guide the design of individual tools and

subsystems to ensure easy maintainability. Insert specific tasks and reviews into the Acquisition Management System (AMS) lifecycle to ensure that this research is used to provide human factors guidance in the implementation of operational systems.

Finding: Advances in airport surface management, trajectory-based operations, dynamic airspace design, traffic flow management and flight operations control will enable both greater flexibility and more precise control of flight operations. To be effective, however, this requires an integrated system design that supports much greater synchronization across the surface, terminal, en route, and systems operations domains. To effectively support interactions among the relevant operators, cross-domain human factors research is needed.

Recommendation: Conduct human systems integration research focused on the integrated management of airport surface and airspace constraints that considers airport surface, terminal and en route (gate to gate) operations as an integrated, distributed work system. Translate these findings into human factors guidelines and into requirements for the acquisition of the tools and subsystems necessary to support effective individual work, as well as to enable effective teamwork across these domains.

Finding: Although planning tools such as the Human-System Integration Roadmap help to identify interactions among different development programs at key Decision Points, as does the development of specific human factors guidelines, there remains a need to ensure closer integration of FAA human factors research and human factors design decisions for different development and acquisition programs. This applies to the design of new roles, responsibilities, and procedures, as well as the development of supporting tools and technologies. It is especially important in cases where a single operator, such as an air traffic controller, will have to work with tools that are being developed by different programs or where the work supported by these tools has to be coordinated across a distributed team of operators.

Recommendation A: To ensure better coordination among the human factors professionals involved in human factors research and/or the design and acquisition of specific new tools, the AMS lifecycle should include specified points in the design and requirement generation process where the human factors professionals conducting research, design, and requirement definition across related subsystems exchange information. This is needed to ensure compatibility with established human factors guidelines and to maintain consistency across the designs for these related subsystems from a human factors perspective.

Recommendation B: Include a focus on scenarios including off nominal, emergency, and system degradation events, as those are often the most demanding situations confronting operational staff in these cross-program information exchanges.