U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

February 15, 2013

Dr. R. John Hansman, Ph.D.
Chair, Research, Engineering and
Development Advisory Committee
Massachusetts Institute of Technology
77 Massachusetts Avenue
Cambridge, MA 02139

Dear Dr. Hansman:

Thank you and the Federal Aviation Administration's Research, Engineering and Development Advisory Committee for your October 3, 2012, letter providing guidance on the Fiscal Year 2015 Research and Development (R&D) Portfolio.

Both the senior staff and I have read with interest your recommendations and enclosed are the responses to the general observation and subcommittees' recommendations.

We will continue to incorporate the Committee's recommendations as we build an R&D portfolio that addresses safety, efficiency, and capacity of the air transportation system in an environmentally sound manner.

Sincerely,

Michael P. Huerta
Administrator

Enclosure

FAA Response to REDAC Recommendations on the FY 2015 R&D Portfolio

General Observation

Big Data: The REDAC noted that the FAA is uniquely positioned to take advantage of the national initiative in "big data". While recognizing the current capabilities in ASIAS and NAS monitoring, there appear to be significant opportunities to improve the safety, efficiency and environmental performance of the NAS by applying the current and emerging data mining technologies to the vast set of operational data the agency routinely collects (e.g., ETMS, ASDE-X, PDARS, ASAP, FOQA, etc.).

The REDAC recommends that the agency develop an aggressive "big data" strategy for both monitoring and operational control of the NAS. One particular area identified by several of REDAC subcommittees is the potential use of "big data" to characterize the human element in operational performance both at the individual flight level and the overall system level.

FAA Response: The Federal Aviation Administration (FAA) has made extensive investments in building processes to collect, archive, and analyze the highest quality surveillance data across the National Airspace System (NAS). The Aviation Safety Information Analysis and Sharing (ASIAS) system is one prominent example. ASIAS currently connects 131 data and information sources across the industry and is integrated into the Commercial Aviation Safety Team (CAST) process. There are currently 41 member airlines participating in ASIAS. ASIAS now has access to Flight Operations Quality Assurance (FOQA) programs from 24 operators and Aviation Safety Action Partnership (ASAP) data from flight crews, maintenance, and other employees from 41 operators. ASIAS is also accessing reports in the Air Traffic Safety Action Program (ATSAP), which provides air traffic controllers with a way to report potential safety hazards. Other Air Traffic Organization (ATO) employees will be added to the program in the future.

These investments have already resulted in the ability to routinely track a number of important safety metrics. The FAA monitors these results to identify locations or issues of concern, and to identify trends over time.

The FAA continues to invest in archiving, mining, and analyzing data sets that can contribute to more complete contextual information for the interpretation of human interactions that contribute to an event. One example is air traffic control voice data, which would substantially enhance the ability to understand the pilot or controller role in an event. There are numerous challenges in automating the extraction of useful information from voice data, and additional research will be needed to fully leverage this valuable source.

FAA also routinely monitors ASAP and FOQA data through ASIAS, although each of those data sources have de-identification constraints that prevent data fusion with other contextual data. FAA is investigating processes that would allow data fusion while maintaining confidentiality of

FOQA proprietary data. While these processes are likely to require some new data management approaches, the larger part of the research will be focused on building protocols with the airlines that provide the data to ensure complete protection of the data. There is already some precedent for this with ASAP reports. Several airlines have agreements with the FAA to share ASAP and ATSAP reports of the same event when both reports are available. This program is widely viewed to be of high value by providing both pilot and controller perspectives on the same event.

NAS Operations Subcommittee

(1) Finding: The important work in Operations and Concept Validation Program briefed by John Marksteiner was very near term and had no five-year or longer plan, or roadmap of needed activities. While understandable in light of the budget situation within the FAA, this work, in particular, which the subcommittee has championed every meeting, needs to have a longer-term outlook and the capability to develop it.

Recommendation: FAA should enable and support a longer-term (e.g., five year) activity in developing a coordinated and understandable plan or roadmap for these activities, particularly those supported by the facilities and equipment (F&E) budget line, which would be informed by assessing and monetizing shortfall areas (see related finding and recommendation) to define needed research areas.

FAA Response: The FAA is developing a multi-year research plan for our Operations and Concept Validation research that will be presented to the Office of NextGen (ANG) senior management for approval and prioritization by the end of the calendar year. The plan will address research gaps that have been identified through analyses of multiple sources to include the NAS Enterprise Architecture, the NextGen Segment Implementation Plan 4.0 and 5.0, the NextGen Implementation Plan, and internal reviews of FAA Concept of Operations (ConOps) documents submitted over the past several years. We will also consider the research areas identified in the Subcommittee recommendations. In addition, interviews were conducted with representatives from the NextGen organization and the ATO's Program Management Office. The intent is to have an initial draft of the research plan available in second quarter of Fiscal Year (FY) 2013. This document will be used to support prioritization and down-select of Service Analysis research areas for the Operations and Concept Validation Program.

(2) Finding: Given the breadth of advances associated with the implementation of the NextGen Concept of Operations (ConOps), it is very important to address integration requirements. This applies at both the level of workstation software for the operational staff with different roles and responsibilities, and at a broader systems level where collaboration and coordination need to be carefully addressed in terms of direct and computer-mediated human-human communication, coordination and collaboration and human-automation interactions.

Specific examples of the need for workstation integration include the need for integrated workstations for Air Traffic Control (ATC) Tower, Terminal Radar Approach Control (TRACON) and Air Route Traffic Control Center (ARTCC) controllers, supervisors and traffic managers. At the system level, the issue is one broader systems thinking during the design and evaluation of ConOps, procedures and technologies in order to ensure effective integration. Of

particular concern is the need to design to support coordination of the many actors within this distributed work system, including controllers, traffic managers, pilots, dispatchers and ATC coordinators, ramp controllers, airport operators, and Airline Operations Centers (AOCs). It appears that some of this required crosscutting human factors research for NextGen was eliminated after the Human Factors Subcommittee review, as was noted in the succeeding NAS Operations Subcommittee review.

Recommendation: More intense cross-cutting human factors research and development efforts are necessary to ensure that the linkages among different ConOps that have been developed are carefully defined and addressed in order to ensure effective integration. In particular, we reiterate our recommendation that all nodes of collaboration, including AOCs, as appropriate, are explicitly identified as components in all areas of NextGen research and implementation where the flight deck, air traffic control and AOCs already collaborate today or will in NextGen, and should be adequately funded.

FAA Response: We recognize a need to have all nodes of collaboration considered and their importance as components for research and implementation. At this time, we are still working to define our research plan to address this need. Once the funding targets have been defined, we will be able to identify our research requirements. We will brief the Subcommittee on the proposed FY 2015 portfolio at the next meeting in March 2013.

(3) Finding: The Subcommittee was pleased by Dr. Karlin Toner's Joint Planning and Development Office (JPDO) presentation for its overall thought leadership, depth and maturity. We were impressed by the completeness of JPDO's recent engagements of the stakeholder communities, and the explicit acknowledgement of the complexities of the issues and willingness to face the difficulties each presents. In particular, the JPDO briefing describing the flow of NextGen capabilities as a function of needed work was considered excellent by the subcommittee, particularly the understanding that, to reach a 2025 Nation Airspace System (NAS) with changed roles and responsibilities (a long-standing concern of the Subcommittee), work beyond the research currently ongoing is required.

Recommendation: The research requirements to move beyond the NextGen Operations Level 3 to the Level 4 implementation capabilities have been initially identified by JPDO. A gap analysis of on-going research against that required to reach these capabilities should be developed as soon as possible and briefed to the NAS Operations Subcommittee.

FAA Response: We concur. The JPDO is responsible for developing a framework for NextGen planning and development, identifying and prioritizing key multi-agency concerns, and driving consensus in the development of investment choices and decisions. As part of its FY 2012 annual update and data validation process, the JPDO produced the FY 2014 version of the Integrated Work Plan (IWP) and its companion document, Targeted NextGen Capabilities for 2025. The IWP provides the framework for the JPDO to define, depict, and guide the transformation to NextGen. The JPDO developed Targeted NextGen Capabilities for 2025 to better define the original NextGen elements (as defined in 2004) that can be realistically achieved by 2025. This analysis was based on identification of the long term goals of NextGen along with the pace of implementation and provides a future-focused framework for prioritizing

the multi-agency research needed to define the original NextGen elements that can be realistically achieved by 2025. The Targeted NextGen Capabilities for 2025 uses the FAA's NextGen Segment Implementation Plan as the starting point to build out the timeline.

In FY 2013, the JPDO plans to continue its efforts to establish the research and development priorities needed for NextGen implementation. Under the current funding situation, the JPDO will only focus on identifying the research and development priorities and associated gaps in research needed for safe integration of Unmanned Aircraft Systems in NextGen. These priorities represent a strong subset of NextGen elements. The JPDO will brief results as they become available.

(4) Finding: A significant portion of the FAA's research agenda involves the definition and validation of operational concepts that build upon NextGen equipage. The NAS Operations Subcommittee was not briefed on any activities that address issues related to transition and mixed equipage or multiple levels of service based on differing levels of aircraft capability. The NAS consists of, and will continue to consist of, a wide range of aircraft capabilities (e.g., equipage, training, performance envelopes) and missions. Regional jets, for example, are unlikely to be delivered with, or retrofit, certain NextGen functionality due to cost-effectiveness considerations.

Recommendation: FAA research activities (e.g., ConOps development, validation, etc.) involving NextGen equipage need to explore the following:

- Critical mass thresholds for delivery of benefits to equipped users
- Potential automation mitigations to enable controllers to handle mixed capabilities
- Trade space of performance requirements, benefits, costs, aircraft equipage levels, and ground capabilities with respect to overall system performance gains, system benefits, and net benefits to equipped operators
- Performance and equipage levels in different timeframes and operational environments (e.g., 2018 timeframe versus the 2025 timeframe and later)
- Methods to ensure that aircraft with NextGen equipage gain differential benefits over non-equipped aircraft

FAA Response: We recognize the need to understand the requirements for NextGen equipage to achieve the benefits. NextGen equipment in and of itself does not necessarily result in differential benefits. It is actually the suite of capabilities and enabling technologies across the air transportation domains that lead to NextGen benefits. At this time, we are still working to define our research plan to address these needs. Once the funding targets have been defined, we will be able to identify our research requirements. As budgets get finalized we will consider additional research to more fully address the recommendations. We will brief the Subcommittee on the proposed FY 2015 portfolio at the next meeting in March 2013.

(5) Finding: The FAA presented a plan to complete a Trajectory-Based Operation (TBO) concept of operations by November 2012. While there are several activities in place to develop standards and implement TBO capabilities, the direct benefits for operators equipping with a TBO capability have not been quantified, nor have the mechanisms for delivery of benefit been

validated. Current work has not allayed operator concerns that equipped aircraft will not achieve differential benefits.

Recommendation: The FAA research supporting the validation of a TBO concept of operations should include the following activities:

- Differentiation of mid-term (2018) and post-mid-term (2025+) operations and benefits
- Integrate operations associated traffic flow management and collaborative decision-making with those involving digital communications to the aircraft regarding reroutes (both pre-flight and during flight).
- Address mixed capability operations (see previous recommendation)
- Quantify the marginal benefits of differing performance requirements and capabilities from both a system perspective and the perspective of investing operators

FAA Response: As presented to the Subcommittee, the FAA is developing a Service Level TBO ConOps. This document will be the FAA's description of trajectory operations in the midterm (through 2020). The document will cite the known benefits related to trajectory operations. Once completed, it will be reviewed by external stakeholders. Post mid-term trajectory operations and benefits will be addressed after the midterm document is complete.

The mid-term TBO ConOps mentioned above will address the issue of how the FAA manages mixed equipage from the perspective of large jet aircraft, regional jets, and general aviation aircraft (high and low end) capabilities. Once this document is finalized, it will be used to guide future work addressing mixed capability operations.

The mid-term TBO ConOps will also use currently available information to quantify the marginal benefits of differing performance requirements and capabilities from both a system perspective and the perspective of the operators who invest in equipment. The mid-term TBO ConOps is a Service Level Concept that does not go into great depth concerning benefits. Once this document is finalized it will be used to guide future work on refining benefits.

Subcommittee on Aircraft Safety

(1) Finding: The routine integration of Unmanned Aircraft Systems (UAS) into non segregated civil airspace is clearly a complex challenge, requiring significant research and analysis. The FAA's RE&D budget alone is not likely to be able to fund the necessary research to address this challenge in a timely fashion without close collaboration with other Federal agencies sponsoring similar research. The subcommittee is encouraged by FAA and JPDO efforts to align research among the FAA, DoD, and NASA. The subcommittee is similarly encouraged by efforts internal to the FAA to effectively organize the agency to address the integration challenge. The subcommittee applauds the creation of the new UAS Integration Office, AFS-80, and efforts within the Office of Advanced Concepts & Technology Development, ANG-C, to ensure FAA research and analysis efforts are planned in a coordinated fashion. The subcommittee could not help but note the similarities between the UAS integration challenge and the integration challenge created by commercial space which has an Associate Administrator and a separate line of business devoted to addressing. While the subcommittee notes considerable FAA

organizational improvements with the creation of AFS-80 and changes in ANG-C alignments, the subcommittee is concerned that the matrix nature of the organizational structure without clear lines of authority may not be the most effective.

Recommendation: The FAA Administrator should review whether the FAA is appropriately organized to address the UAS integration challenge and whether sufficient FAA RE&D resources are being devoted to the challenge.

FAA Response: The FAA agrees that routine integration of Unmanned Aircraft Systems (UAS) into non-segregated civil airspace is a complex challenge and understands the Subcommittee's concern about handling the associated research and development workload by the FAA's matrixed organizations. ANG and Aviation Safety (AVS) will continuously monitor the effectiveness of the organization and will determine success based on milestone accomplishment and delivered research products. ANG will report out to AVS monthly on progress and make adjustments as needed.

(2) Finding: The subcommittee received a thorough briefing on the Aviation Safety Information Analysis and Sharing (ASIAS) and finds this program continues to be an exemplary model of how R&D is successfully transitioned into operational use. The FAA in association with the transport community has developed a collaborative process to collect and share data in order to identify potential safety risks. The FAA must continue to build on this success to expand the ASIAS program to other applicable communities such as general aviation (GA) and Rotorcraft.

The subcommittee sees a gap between the Aviation Safety Action Program (ASAP)/Flight Operational Quality Assurance (FOQA) data collected and how it connects to the human element in each situation. The subcommittee understands the challenge with closing this gap but feels that it is a logical next step and that there is great potential value to enhance safety and assist with the development and implementation of future regulation by connecting the human element to ASAP/FOQA data collected as part of this program.

Recommendation: FAA should consider conducting research into connecting the human element with the operational events recorded by ASAP/FOQA data.

FAA Response: The Subcommittee has identified a key challenge in the interpretation of data available to the ASIAS, including both proprietary and nonproprietary data. Many of the ASIAS data sources reflect human interaction only indirectly, such as evidence of changes to flight tracks in surveillance data or changes to flight controls in FOQA data. The FAA is investing in the development of tools to identify and characterize these changes, associate them with pilot and controller input, and assess the risk associated with them.

One of the key challenges in interpreting human interactions from digital data is the lack of complete contextual information. The FAA is investing heavily in building tools and processes to fuse traffic, weather, and airspace and airport configuration information to surveillance data. This will provide a more complete picture of the environment for interpreting events, but it is not complete. The FAA is also investing in archiving and mining ATC voice data to enable a better

understanding of individual events, which will be used as a foundation for abstracting and generalizing at a NAS-wide level.

These efforts to provide a more complete context for the interpretation of surveillance data should significantly enhance the ability to infer human interactions, both from the pilot and controller perspective. There is an additional challenge in applying the same processes to FOQA data due to date and aircraft de-identification constraints. Through ASIAS, FAA is investigating processes that would allow data fusion while maintaining confidentiality of FOQA proprietary data. The FAA is working closely with a limited number of airlines to better understand the concerns and build processes that will address these concerns while allowing full data fusion.

Other ASIAS data sources, including ASAP and ATSAP, can provide much more insight into the pilot or controller interaction with the system. Analysis of individual reports can illuminate issues with human interactions that would otherwise be opaque from analysis of digital data sources. A key challenge in processing these data sources is that they are less structured and less consistent, making it difficult to extract national-level results. FAA is investing in research to build automated processes for identifying and characterizing reports that are relevant to a safety topic of concern. Once these relevant reports can be identified, additional analysis can characterize regional or national effects.

The value of non-digital data sources, especially the self-report sources, is considerably enhanced by the fusion of contextual information. While some reports reference contextual information, there are many gaps. FAA is already fusing contextual information for ATSAP, which is not date de-identified. This has proven most valuable for understanding the controller environment, particularly as regards other traffic and weather. When voice data becomes available, it will further enrich the context for interpreting an event.

At this time, de-identification constraints preclude data fusion for ASAP reports, limiting the ability to leverage pilot reports to understand crew interactions. As described above for FOQA, the FAA is researching ways to build processes that will address airline and labor concerns while enabling full fusion of ASAP data. There is already some precedent for this with ASAP reports. Several airlines have agreements with the FAA to share ASAP and ATSAP reports of the same event when both reports are available. This program is widely viewed to be of high value by providing both pilot and controller perspectives on the same event. The FAA is building processes that would allow routine, automated report matching and analysis and will continue to work with airlines to understand how to adequately protect the sensitive data.

(3) Finding: The Subcommittee again expresses the importance of human factors research in all aspects of aviation safety and is pleased to see the coordination both within the FAA and with outside organizations to help establish and set priorities for the focus areas of this activity. It will be important that the human factors research requirements be completed in a timely manner to meet both current and future regulatory needs as well as the needs of the NextGen. In particular there are many research activities ongoing across the aviation community to provide interventions intended to reduce the loss of control category of accidents. The research covers a broad spectrum of interventions to include upset recovery training, enhanced simulator fidelity, and new display systems such as Angle of Attack (AOA) or Synthetic Vision. The FAA will

need to make sure the outputs of their human factors research do not stretch out but are completed in time to effectively support the objectives of these interventions. Additionally, there currently is considerable regulatory activity around fatigue management and Fatigue Risk Management Systems (FRMS). With an implementation date of January 2014, the SAS is concerned that the FAA Flight Standards Service (AFS) might have research needs closer in than FY 2015 to support regulatory development and approval efforts.

Recommendation: The Subcommittee recommends that AFS revisit their research needs to support the implementation of FAR 117 as well as approval and development of FRMS. The high level of industry interest and activity in this issue will likely necessitate funding for research and support in FY 2014 as well as FY 2015.

FAA Response: The FAA agrees there is a need for research supporting implementation of Part 117 and, in accordance with the AVS R&D Prioritization Process, is currently evaluating a research requirement for the FY 2015 Aviation Safety R&D Portfolio. The FAA is also evaluating options that may be available for initiating FRMS research earlier without negatively impacting other prioritized aviation safety research. The FAA will brief the Subcommittee on the FY 2015 portfolio in March 2013 and would be happy to discuss FRMS regulations and associated research needs at that time.

(4) Finding: The Subcommittee is pleased to see the GA envelope protection work being successfully completed with proof of concept flight testing of the FAA developed approach. The stall departure and envelope awareness and protection work for transport aircraft appear to be off to a slow start with contract awards for FY 2012 yet to be completed. The list of proposed FY 2015 research topics appears to cover some important areas in flight controls but the Subcommittee wonders why the AF447 lessons are not being worked urgently today. The FY 2015 proposed tire failure research effort seems so basic the Subcommittee suggests a close collaborative approach with tire and airplane manufacturers would be a good means to make rapid progress.

Recommendation: If lessons from the AF447 incident regarding flight controls design and certification warrant new research, the Subcommittee recommends the research be prioritized and accelerated for near-term completion.

FAA Response: The FAA appreciates the Subcommittee's finding. We believe there are implications from the AF447 accident regarding flight controls design and certification that indicate new flight control research is warranted and we are taking appropriate action. The Bureau d'Enquêtes et d'Analyses (BEA) AF447 Final Report was released in late June 2012 and was examined immediately by the Flight Control/Mechanical Systems Technical Community Representative Group (TCRG). We did not identify any new research requirements relative to the root accident initiating condition (icing on the pilot probes) or the probable cause finding (pilot error). However, the TCRG did identify potential secondary issues from observations of the accident data, indicating the potential need for improved rules relative to flight control after stall warning and to handling qualities in secondary modes to mitigate or prevent crew confusion after receiving the stall warning. Shortly after the release of the BEA final report, research

requirements addressing these issues were prepared and submitted to the AVS R&D Prioritization Process for the FY 2015 R&D portfolio.

As previously briefed to the Subcommittee on Aircraft Safety, the AVS R&D Prioritization Process is deliberative and includes multiple levels of review during the planning cycle. The data driven process uses risk-based decision making to rank the relative merit of all the AVS research requirements, which are then programmed within the constraints of the budgeted resources. AVS is currently developing the FY 2015 Aviation Safety R&D Portfolio. The AF447 related research requirements are being evaluated and, based upon their ranking relative to the other Aviation Safety requirements, may or may not be included in the proposed portfolio.

The AVS R&D Prioritization Process also includes the flexibility to introduce pop-up requirements at any time. Pop-up requirements address newly identified high priority needs that require immediate research action. AVS will continue to evaluate the research related to AF447 and if appropriate consider pop-up research requirements.

Subcommittee on Environment and Energy

(1) Finding: The Office of Environment and Energy announced at the meeting that it would be establishing a new Center of Excellence (CoE) that will include both environmental and energy projects. The existing PARTNER Center of Excellence will continue to exist to enable ongoing projects to be completed, but will then be shut down.

Recommendation: The subcommittee strongly supports the establishment of the new Center of Excellence and urges that the following principles be included in the CoE mandate:

- The FAA must play a leadership role in ensuring that the CoE projects are aligned with FAA research goals. In order to accomplish this objective, the FAA should be encouraged to make an annual presentation to the CoE detailing these FAA goals.
- A process to enable stakeholders to have a meaningful input into CoE research activities must be established.
- A small percentage of CoE projects should be devoted to "entrepreneurial" activities that might appear to be "out-of-the-box" but which might lead to environmental breakthroughs, if successful.

FAA Response: The FAA appreciates the Subcommittee's continued support of our plans to establish a Center of Excellence (COE) for Alternative Jet Fuels and Environment. To ensure that the current PARTNER and new COE are aware of the Agency's goals, the FAA will give a research overview briefing, as well as briefings on individual research areas, at COE Advisory Board meetings. To gain input on COE research, the FAA will engage stakeholders with a condensed project planning process. The FAA has and will continue to use a small percentage of the COE funds on entrepreneurial, out of the box projects as they could indeed lead to environmental breakthroughs. The current PARTNER COE Project 43, which examines how changes in aircraft mission specifications affect system performance, is one example of this.

(2) Finding: A continuing theme of the subcommittee is the absolute need for the FAA to engage in cooperative research with various other government departments. These cooperative efforts would be important in any budget scenario, but are particularly important in the current fiscal environment. The subcommittee also commends the continuing internal cooperation within the FAA to ensure that environmental considerations are taken into account in all Agency decision-making activities.

Recommendation: The subcommittee is encouraged by the continuing cooperation among government agencies and among the various lines of business within the FAA and strongly recommends that these efforts continue. In order to continue to assess these efforts, it is recommended that NASA and the Department of Defense continue to brief the subcommittee on their environmentally related programs and that this type of briefing be expanded to include other governmental departments and agencies (Department of Agriculture, Environmental Protection Agency, etc.).

FAA Response: The FAA appreciates the recognition of the Subcommittee of our continued cooperation within the Agency and with other Government agencies. The FAA will continue these cooperative efforts and will look for additional opportunities to expand these as is appropriate. Based on the recommendation, the National Aeronautics and Space Administration (NASA) and the U.S. Department of Defense (DoD) will continue to be invited to give presentations at our Subcommittee meetings and an invitation will be extended to U. S. Department of Agriculture (USDA), U.S. Department of Energy (DOE), and Environmental Protection Agency (EPA) so that they can present at one of our coming Subcommittee meetings.

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

Recommendation: The Agency should continue to develop and refine environmental tools that will enable the assessment of the environmental consequences of NextGen implementation as well as assist in the establishment of environmental standards at ICAO. This effort is particularly important now, when several tools are on the verge of being fully operational.

FAA Response: The FAA agrees with the Subcommittee recommendation. Continued development of the Aviation Environmental Design Tool (AEDT) is one of our top priorities and we anticipate a 2014 release of the AEDT2b tool that will sunset Integrated Noise Model (INM) and Emissions and Dispersion Modeling System. AEDT is indeed used for both International Civil Aviation Organization (ICAO) activities as well as domestic aviation environmental regulatory analysis. In addition, the Aviation Environmental Portfolio Management Tool continues to provide us the ability to perform cost-benefit analyses to inform domestic and international environmental policy decision-making.

(4) Finding: United States leadership in the international community continues to be an important environmental priority, especially as the ICAO debates the setting of a worldwide aircraft CO_2 emissions standard. At the same time, the subcommittee is concerned that the

demands on the Office of Environment and Energy in the ICAO context are burdensome, with the United States playing a disproportionate role in the international research effort. A possible result of such an overemphasis on the ICAO research requirements may limit needed research projects in the domestic NextGen context.

Recommendation: The subcommittee strongly recommends that support for ICAO activities continue. However, the Agency should exercise discipline over the ICAO work projects by requesting a clear problem statement for each request that has been appropriately vetted and encourage other countries to play a greater role in the environmental research area.

FAA Response: The FAA appreciates that, while the Subcommittee wants the Agency to continue its leadership role in ICAO, it is also concerned that the Agency's efforts on international aviation does not lead to neglecting domestic environmental research needs. The FAA will carefully balance its portfolio and work with other stakeholders at ICAO to ensure tasks have clear problem statements and are supported by multiple stakeholders.

(5) Finding: The Noise Roadmap designed to update the Agency's position on the effects of aircraft noise is moving forward with the development of a community survey to track public concerns. The validity of the results of any survey such as the one underway in the area of aircraft noise depends on the robustness of the questions asked. The subcommittee is concerned that all aspects of the noise issue may not be addressed in the current survey planning process.

Recommendation: The FAA should consider empanelling an expert review board to assess the survey questions before the survey is actually conducted to ensure that all aspects of aircraft noise issues are considered.

FAA Response: The FAA agrees that an expert panel review of the survey instrument would prove useful as it should help to improve the quality of this important research effort. The FAA will seek both U.S. and international experts to perform this review.

Subcommittee on Airports

(1) Finding: Regarding Research Project Description (RPD) 155, Heated Airfield Pavements, the Subcommittee felt that additional information was needed regarding the business case justification for heated pavement installations, which would include defining the conditions under which these pavements can be used beneficially. Because the concept of use, benefits and life-cycle costs associated with heated pavements are not fully understood, the Subcommittee also felt that the project schedule should incorporate explicit decision points together with "go/no go" criteria to manage the risks associated with the research project.

Recommendation: The Subcommittee recommends that the FAA complete its review and assessment of existing heated pavement installations (e.g., Oslo, Helsinki, Stockholm) and the prototype heated pavement sections at Binghamton Airport. The assessment of existing heated pavements should include a review of what drove the business case for the heated pavement installation and what proven benefits these existing systems can provide. The Subcommittee also suggests that the project schedule include explicit decision points together with "go/no go"

criteria to its project schedule so research funds can be conserved in the event this research does not prove fruitful.

FAA Response: The FAA will complete an assessment of airfield heated pavement installations at airports known to have such installations, as well as the prototype heated pavement installation at the Greater Binghamton Airport. The assessment will include the business decisions used to justify the heated pavement installation, the proven benefits for such a system, as well as the life-cycle costs for the installation. The project schedule will include explicit decision points with "go/no go" criteria so that research funds can be conserved in the event that proposed heated pavement research initiatives do not lead to beneficial outcomes.

(2) Finding: Regarding RPD147, Aircraft Braking Friction, the Subcommittee believes that the research plan is very challenging and has significant risks that may impact its successful completion. To help manage the risks associated with the project, the subcommittee believes that the project schedule should incorporate explicit decision points together with "go/no go" criteria to manage the risks associated with the research project.

Recommendation: The Subcommittee recommends that the FAA add decision points together with "go/no go" criteria to its project schedule its project schedule so research funds can be conserved in the event this research does not prove fruitful.

FAA Response: The FAA will modify the Risk Analysis Report for the Aircraft Braking Friction Project, incorporating more explicit decision points into the Project Schedule along with "go/no go" criteria. The modified Risk Analysis Report, which will be forwarded to the Subcommittee in advance of the March 2013 meeting, will identify specific goals and objectives for the research effort associated with each decision point and "go/no go" criteria. The "go/no go" criteria will consist of metrics to assess how effectively these goals and objectives were accomplished and to determine the level of risk associated with continuation of the research work.

(3) Finding: Regarding RPD145, 40-Year Pavement Life, the Subcommittee found that additional information was needed regarding the definition of what a 40-year pavement is as well as what would constitute a successful project outcome. To help manage the risks associated with the project, the subcommittee believes that the project schedule should incorporate explicit decision points together with "go/no go" criteria to manage the risks associated with the research project.

Recommendation: The Subcommittee recommends that the FAA provides the Subcommittee with a working definition of 40-year life and a list of expected pavement maintenance activities associated with 40-year pavement life-cycle at or before the next Subcommittee meeting. The Subcommittee also recommends that the FAA continues to solicit advice from the FAA Pavement Working Group, which meets twice a year, on this project. Finally, as with RPDs 155 and 147, the Subcommittee recommends that the FAA add decision points together with "go/no go" criteria to its project schedule so research funds can be conserved in the event this research does not prove fruitful.

FAA Response: The FAA is in agreement with the recommendation and will have a working definition of pavement life and a list of maintenance activities by the next Subcommittee meeting on March 19-20, 2013. The FAA will also continue to solicit advice from the participants at our yearly Working Group Meeting, as well as add "go/no go" criteria to the 40-year pavement life project schedule.

Subcommittee on Human Factors

(1) Finding: The subcommittee was briefed on the FY 2015 research plans for the Air Traffic Control (ATC)/ Technical Operations Human Factors Program and the NextGen Human Factors ATC/Technical Operations Program. The subcommittee was encouraged by the research plans themselves, and by the degree that the plans were generated in consultation with the sponsoring organizations within the FAA. Thus consultation serves both to call out to relevant organizations where human factors research is warranted, and to smooth the path for transition of the research into implementation. Further, the subcommittee was delighted by recent efforts to broaden the scope of the research methods and thus the impact that human factors research can have, through novel studies such as the use of Air Traffic Safety Action Program (ATSAP) to identify operational issues. Such demonstrations highlight where human factors researchers can work closely with the operational community in examining concerns such as air traffic procedure design, in addition to the more-established role of human factors in system acquisition.

Recommendation: Continue as presented to the subcommittee with the FY 2015 research plans for "Air Traffic Control/ Technical Operations Human Factors Program" and "NextGen Human Factors ATC/ Technical Operations." In support of this research, continue with the close collaborations with the research sponsors, and continue with efforts to expand the application of human factors research into supporting the operational organizations within ATO, such as assisting with air traffic procedure design.

FAA Response: The Human Factors Division intends to execute the 2015 program as it was presented to the Subcommittee and endorsed by the finding in their report. Research requirements meetings were held the week of October 15, 2012, to discuss the program and project priorities. The addition of the new areas of research regarding operational safety and procedure design are being met with enthusiasm and endorsement from the sponsor community. At the request of the ATO Vice President of Safety and Technical Training, a meeting is scheduled to discuss his priorities to address the FAA Top 5 operational safety topics as well as personnel selection and training priorities.

(2) Finding: The only significant gap noted by the subcommittee in the FY 2015 research plans for "Air Traffic Control/ Technical Operations Human Factors Program" and "NextGen Human Factors ATC/Tech Ops" is the lack of sponsorship of research into the human factors of the operation of Unmanned Aerial Systems (UAS) within current and NextGen air traffic operations. Human factors concerns in common air traffic operations, such as the resolution of a conflict between the UAS and a manned aircraft, can span the air traffic controller, the operator of the UAS, and the pilots of other aircraft. The subcommittee understands that a reasonable body of

research is planned into the technical and operational concerns with UAS, which is not balanced by the highly-likely human factors concerns that will commensurately arise.

Recommendation: The Human Factors Research Division (ANG-C1) should coordinate with the ATO offices responsible for incorporating UAS into air traffic operations to develop research plans that examine the likely human factors concerns with the handling of UAS within current and NextGen air traffic operations, and should work to define and sponsor human factors research that is balanced with, and scheduled to provide research results timely relative to planned research into UAS vehicle systems and operation. Such research should also be closely coordinated with the flight deck human factors UAS research being sponsored by AVS through the UAS and Human Factors TCRGs, and with the UAS concept of operation development.

FAA Response: The FAA agrees with the Subcommittee's recommendation to closely coordinate ATC and flight deck UAS research in accordance with the FAA's UAS Concept of Operations. The FAA's UAS Integration Office (AFS-80) focuses on both AVS and ATO aspects of UAS integration in the NAS. In fact, AFS-80 will incorporate the results of the NextGen UAS ATC communication flight demonstration (Demo 4) and the ATC outcomes of the Mitre CAASD FY13 UAS Work Plan into the FAA's UAS integration efforts. The Human Factors Division will continue to collaborate with the ATO (Safety, Terminal, and En Route) and the UAS Integration Office to ensure the appropriate level of coordination required to assess potential specific human factors ATC research requirements to support UAS integration in the NAS.

(3) Finding: The subcommittee was briefed by the Air Traffic Control/ Technical Operations Human Factors Program within the FAA Human Factors Division (ANG-C1) about a strategic plan for air traffic human factors research that is under development. This plan is intended to specify long-range objectives and areas of emphasis that build upon traditional research areas and, most notably, outline new initiatives. This program intends to work closely with appropriate organizations throughout the FAA, including potential sponsors within the ATO and elsewhere within the FAA, to demonstrate where human factors research can apply new methods to address new and emerging problems.

Three specific new initiatives were presented to the subcommittee and the subcommittee recognized the value of each of them. The first is to expand human factors research contributions to (and work more collaboratively with) ATO operations. Of note, such research can address human factors concerns in the safety evaluation of current and proposed air traffic procedures (with RNAV arrival and departure procedures as a potential first area), conduct analyses of operational problem areas (for example, a recent analysis was conducted problems within 'hand-offs'), and provide longitudinal studies to monitor operations of interest following their implementation and/or modification. While these initial steps have focused on safety evaluation, the subcommittee believes this expansion can also be fruitful if it also extends to more direct collaboration with the ATO operations community. The subcommittee finds this initiative to be a valuable application of human factors research, particularly with the increased complexity of new air traffic operations and the need to identify human factors concerns throughout their design and implementation.

The second initiative addresses automation, and intends to support the air traffic operations organizations by providing an actionable philosophy to guide the development of automation at a high-level, as well as specific criteria in its design as can be applied by the software and program management community. Automation is a critical element in many of the plans for NextGen and modernization. There are core human factors related to automation, and these need to be clearly understood to support a core strategy. This is an important problem and the subcommittee is delighted to see the Program tackling the need to tie together prior research results and identify a coherent automation strategy for air traffic. The subcommittee also discussed with the program where more specificity will need to be provided in the Program's strategic plan as it moves forward.

The final initiative addressees change management, with a unique and vital focus on preparing the workforce for the introduction of significant changes to their systems and to their tasks. The workforce of interest includes not only the controllers, but also the other personnel in the facility whose tasks and functions may change significantly. The subcommittee finds this initiative to be critical not only in implementing change, but also in understanding the allowable rate of change within the work force.

Recommendation: The Air Traffic Control/ Technical Operations Human Factors Program within ANG-C1 should continue with the strategic plan development as presented to the subcommittee. The three new initiatives as presented should be further scoped and detailed. These initiatives should also explicitly identify where these initiatives touch on cross-cutting human factors concerns and thus can learn from, and coordinate with, other human factors research (completed in the past and on-going) within the FAA, NASA, and other stakeholders in the aviation community. A specific area noted by the subcommittee is with parallel examinations of automation between the proposed flightdeck research requirements and the 'automation' new initiative identified here for air traffic research; a briefing should be provided to the subcommittee at the next meeting as to how and where cross-cutting research in automation exists and will be coordinated.

FAA Response: A strategic plan for the Air Traffic Control/Technical Operations Human Factors Program has been drafted and is currently being reviewed. The plan will be distributed to the Subcommittee prior to the next meeting. The plan addresses the Subcommittee's request to further scope and detail the three initiatives noted above (ATO operations, automation, and change management). To successfully implement this plan, we will coordinate closely with the ATO Offices of Safety, Terminal, and En Route to ensure that we continue to address ATO high priority areas and will have access to the facilities and other resources needed. We will also coordinate with the AVS Human Factors TCRG lead to address the Subcommittee's recommendation to address potential cross-cutting areas, such as the interaction between flight deck automation and ATC automation. In response to the recommendation, a briefing will be presented to the Subcommittee on the cross-cutting research in automation and our coordination efforts at the next Subcommittee meeting

(4) Finding: The Subcommittee received a briefing by the chair of the Technical Community Research Group (TCRG) for Human Factors on the FY 2015 Requirements Reviews on Flightdeck / Maintenance/ Systems Integration Human Factors and on NextGen Flight Deck

Human Factors. Overall, we find the FY 2015 requirements as presented to us to represent key areas of importance to the aviation community at large and to NextGen. Each of the requirements as presented describes has obvious safety implications that are either already emerging in the community or very likely to emerge in the near future; failure to address these concerns could delay critical NextGen developments and/or limit the ability to implement key safety improvements in many elements of the current system, including general aviation and rotorcraft.

Recommendation: The Office of Aviation Safety (AVS) should continue with planning the FY 2015 research requirements as presented to the subcommittee, recognizing that they represent key areas of importance to the aviation community at large and to NextGen as captured through a systematic requirements generation process.

FAA Response: The FAA appreciates the Subcommittee's positive feedback regarding the proposed FY 2015 human factors research program. The proposed requirements will be evaluated in accordance with the AVS R&D Prioritization Process and the proposed human factors research portfolio will be presented to the Subcommittee at the February meeting.

(5) Finding: The subcommittee recognizes that this annual review cycle is part of a systematic process looking out several years to enable informed certification and operational approval, based upon research results of appropriate depth and breadth that are available as they are required. Thus, we appreciate the benefits of this cycle with its substantial look-ahead; we also recognize the flip-side of this approach, which is the potential for some important issues to be 'missed' by the process, either by the TCRG or the subsequent AVS selection process, or because of issues that emerge on a faster-time scale than the multi-year cycle represented here. The Human Factors subcommittee thus views its role as also helping to monitor for any issues that have been missed or that may be emerging; from this perspective, the subcommittee identified the following three issues:

Issue 1: Within the funding profile presented from present day to FY 2015 and beyond, and within the proposed research requirements for FY 2015, the subcommittee was encouraged to see the emphasis on new systems such as Class 1 and Class 2 Electronic Flight Bags (EFB). These systems represent a larger class of concerns arising with new ways to certify (and provide operational approval for the use of) emerging technologies involving personal/consumer electronics in the cockpit, mixed levels of criticality, and management of information stemming from multiple sources and presented across multiple displays. Given the rapid rate of change in the enabling technologies, these concerns may not be isolated to EFB systems. Thus it will be necessary to monitor for where these concerns may also arise in other systems and the degree that research examining EFB systems can -- and cannot -- provide the required insight.

Issue 2: Likewise, given on-going plans within the aviation community for fatigue risk management systems (FRMS), the subcommittee was encouraged to see the requirement "Fatigue Mitigation in Flight Operations." The proposed timeline for this requirement is scaled to the latest deadlines required of operators for the implementation of FRMS. Where operators may choose to implement FRMS earlier, the proposed database for tracking carriers' application of FRMS may also need to be moved earlier.

Issue 3: Similarly, the subcommittee was encouraged to see the requirement "NextGen: DataComm Human Factors R&D." Many related concerns are already emerging in the community, even with current day systems, which this research requirement may both learn from and provide some insights into. These concerns include questions about digital Notices to Airmen (NOTAMs) and proper methods for amending Pre-Departure Clearances (PDCs) such that all relevant parties remain synchronized.

Recommendation: In addition, we recognize that Aviation Safety (AVS) has a process to reconsider research planning, selection and execution in light of emerging issues. Specific considerations that the subcommittee recommends considering at this time are:

- Concerns arising with human factors research sufficient to guide certification (and operational approval for the use of) emerging technologies involving personal/consumer electronics in the cockpit, mixed levels of criticality, and management of information stemming from multiple sources and presented across multiple displays, particularly where these concerns may extend beyond the planned research focused more specifically towards EFB systems.
- Where operators may choose to implement FRMS earlier, the proposed database for tracking carriers' application of FRMS may also need to be moved earlier.
- Related to on-going research within "NextGen: DataComm Human Factors R&D," concerns are already emerging in the community, including questions about digital NOTAMs and proper methods for amending Pre-Departure Clearances (PDCs) such that all relevant parties remain synchronized.

FAA Response: The FAA appreciates the Subcommittee's input on topics to be considered in our research prioritization process.

Relative to emerging flight deck technologies, the FAA shares the Subcommittee's concerns about potential human factors issues associated with use of personal/consumer electronics in the cockpit, mixed levels of criticality for flight deck systems, and management of information stemming from multiple sources and presented across multiple flight deck displays. We are addressing these topics through a range of regulatory policy and guidance development activities. These regulatory activities are supported by research that the FAA has sponsored for several years. We have submitted research requirements in this area in the FY 2013, FY 2014, and FY 2015 portfolios and will continue to evaluate research requirements needed in this area to address regulatory questions that continue to emerge and identify new challenges that will need to be addressed.

Relative to Fatigue Risk Management Systems (FRMS), the FAA agrees there is a need for research supporting implementation of Part 117 and, in accordance with the AVS R&D Prioritization Process, is currently evaluating a FRMS research requirement for potential inclusion in the FY 2015 AVS R&D Portfolio. The FAA is also evaluating options that may be available for initiating FRMS research earlier without negatively impacting other priority aviation safety research. If desired by the Subcommittee, the FAA will review and discuss FRMS regulations and associated research needs at the next meeting of the Subcommittee.

Relative to data communications (DataComm), the FAA has identified DataComm as a subject requiring human factors research, has identified multiple specific research questions, and is pursuing research to address these questions. In its regulatory program, the FAA is supporting implementation of digital Notices to Airmen and predeparture clearances through standards development activities, and, at present, has not identified specific research questions for these functions.

(6) Finding: Of particular note, with the FY 2015 Flightdeck/Maintenance/Systems Integration Human Factors proposed Core Human Factor TCRG research requirements, the proposed Requirement "NextGen: Human Factors Considerations of Complex Systems" is a forward-looking initiative that can provide a broad look at an important phenomenon spanning almost all NextGen systems and operations. The subcommittee agrees that systems are rapidly becoming much more complex in day-to-day operations for human operators, and both Flight Deck and Air Traffic Control will encounter these issues in the near future. The subcommittee finds the proposed FY2015 research requirement in complexity to be a good start into this area, and further believes that broader perspectives on complexity will be required in future years, including examining not only of specific types of flightdeck systems but also complexity of operations and of integrated air-ground systems.

Recommendation: The Human Factors Subcommittee recognizes the value of the proposed FY 2015 research requirement in complexity and recommends that its planning continue in close consultation with its AVS sponsor. In addition, this effort should be considered a starting point for planning in future years to recognize the operational and technical factors creating system complexity, and to motivate novel, inter-disciplinary research approaches to what is fundamentally a cross-cutting concern.

FAA Response: At this time, the AVS sponsor has withdrawn the draft research requirement for "NextGen: Human Factors Considerations of Complex Systems," for further review of the project outcome and research objectives. Should the requirement be resubmitted at a later date, it will be evaluated in accordance with the AVS R&D Prioritization Process.