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The Honorable Lynne Osmus  
Acting Administrator  
Federal Aviation Administration  
800 Independence Avenue, SW  
Washington, DC 20591

Dear Administrator Osmus:

On behalf of the Research, Engineering and Development Advisory Committee (REDAC), I am enclosing the summary observations and recommendations from the fall meetings of the standing REDAC Subcommittees (Aircraft Safety, NAS Operations, Environment and Energy, Airports, and Human Factors).

As a general observation, the REDAC has been encouraged by the efforts to develop a structured approach for NextGen implementation. The REDAC does have concerns that the NextGen scope is so broad it is difficult to identify the most critical research requirements and determine if the appropriate research is in place to support NextGen. The 2018 focus of current implementation efforts seems appropriate for initial FAA implementation but it will be important to retain a longer national focus for the full NextGen effort.

The REDAC also notes that the existing environmental and safety approval processes are not well structured to deal with the magnitude of system changes expected from NextGen. The challenges of the New York airspace redesign illustrate the difficulty of making even modest changes which clearly improve the environmental performance of the system. Innovative technical and policy approaches to these processes will be necessary for successful modernization.

Finally, the REDAC has a continuing concern regarding the FAA's technical workforce in several emerging technology areas. In particular, the REDAC has repeatedly identified critical software and digital systems as an area where the agency has unique responsibility and exposure to technical risk in both air traffic and flight safety. The progress has been disappointing and will require a significant effort in the hiring and training of core technical staff as well as a research investment to stimulate national competency in these areas.

We hope that these observations are useful to you and the agency. As always, the REDAC stands ready to assist if there is any way we can help in our common objectives of improving the safety, efficiency and capability of the air transportation system.

Sincerely,

R. John Hansman  
Chair, FAA Research, Engineering and Development Advisory Committee

Enclosure

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**Research, Engineering and Development Advisory Committee (REDAC)**  
**Recommendations on the FY 2011 R&D Budget**

## **Subcommittee on Airports**

**Recommendation:** The Subcommittee recommends the FAA expedite completion of the research to identify if more firefighting agent is required at airports. This research is for the new large aircraft (group 6 aircraft) such as the A-380. These aircraft carry much more fuel than the group 5 aircraft such as the B-747.

**Recommendation:** The Subcommittee recommends the FAA continue to focus on wildlife research. This should be maintained at the highest levels to assure further progress in reducing wildlife hazards to aviation around airports.

**Recommendation:** The Subcommittee recommends that staffing be increased by one engineer within the Airport R&D Branch at the William J. Hughes Technical Center. The position will support the increased funding and research projects underway.

**Recommendation:** The Subcommittee recommends the FAA include \$2,300,000 for Phase II of the visual aid test bed, and \$2,400,000 for the high tire pressure testing initiative in the FY 2011 program request.

## **Subcommittee on Environment and Energy**

**Recommendation:** The Subcommittee finds that the FAA Office of Environmental and Energy is significantly underfunded and understaffed, especially in view of the additional responsibilities (global climate change issues and a refocusing on noise research) that continue to be imposed on it. While the Subcommittee recognizes that the FAA is captive to the Congressional appropriations process, action is necessary to ensure that appropriate research activities are initiated and sustained. In particular:

- a. The Subcommittee recommends that the Agency fully fund an additional position in the Operations and Policy Division as soon as possible.
- b. The Subcommittee recommends the Agency should, as quickly as possible, restore the contract support that was recently removed.
- c. The Subcommittee recommends that appropriate funding should be provided to continue the research review of aviation noise metrics and policy.
- d. The Subcommittee recommends that support of, and leadership in, the international processes of the International Civil Aviation Organization (ICAO) be continue. Specifically, funds should be available to support the activities of ICAO's Group on International Aviation and Climate Change (GIACC). GIACC is working to establish international standards on global climate change.

**Recommendation:** The Subcommittee continues to be concerned that environmental issues have not been given appropriate attention in the NextGen effort. In order to ensure proper environmental consideration, it is recommended that an Environmental

Management System (EMS) be established for the NextGen initiative. This EMS would be used to provide information on the environmental impacts of modernization actions and would facilitate the implementation of environmental research efforts.

**Recommendation:** In order to support environmental research efforts, the Subcommittee recommends funding for the Partnership for Air Transportation Noise and Emissions Reduction (PARTNER) program is continue.

### **Subcommittee on Human Factors**

**Finding 1:** As a whole, the NextGen research work plans proposed by both Air Traffic Control/Technical Operations (NextGen Controller Efficiency) and Flight Deck (NextGen Self Separation and NextGen Air Ground Integration) domains were well crafted and reflect a good allocation of budget. The Subcommittee was pleased to see the efforts within NextGen Self Separation and NextGen Air Ground Integration focused on flight deck automation and human-automation function allocation. However, after reviewing the material provided (NARP, NextGen Implementation Plan), we were unable to judge the extent to which human factors was adequately addressed beyond the efforts of The FAA Human Factors Office (AJP-61) across NextGen elements. Numerous reviews by GAO, National Research Council and so forth have highlighted the lack of a NextGen strategy for ensuring that concerns with human performance, human-system integration and effective use of automation are being systematically and thoroughly addressed at all stages of design and implementation.

**Recommendation:** The FAA, perhaps through the NextGen Integration and Implementation Office, should ensure that all organizations responsible for design and implementation of NextGen contribute to and act upon the following:

**(a):** A thorough review should be made and reported in a single document (e.g., “*Human Factors Requirements of NextGen*”) of the key issues with human performance, human-systems integration and effective use of automation inherent to NextGen Operational Improvements (OIs) and enablers. Particular attention should be devoted to highlighting potential solutions and mitigations to likely issues.

**(b):** This document should be finalized in a multi-disciplinary workshop. The workshop organized outside of AJP-61 should include key decision makers in NextGen design and implementation. It should include the Chief Scientist for Architecture, the NextGen Development and the Director of the NextGen Integration and Implementation Office. This workshop should also address a strategy for pervasively, comprehensively, and systematically accounting for issues with human performance, human-systems integration, and effective use of automation, and building in solutions and mitigations to identified concerns early in design. The document should have concurrence with the Chief Scientist for Architecture and NextGen Development and by the Director of the NextGen Integration and Implementation Office at the conclusion of the workshop and made available for public dissemination.

(c): The Subcommittee recommends that the agency should require all organizations in the FAA to periodically report how they are addressing the human factors requirements as documented in the areas of NextGen design and implementation for which they are responsible.

**Finding 2:** Many programs within and outside NextGen call out issues that have direct human factors implications but may not fall within the purview of AJP-61. Examples are weather products, safety, System-Wide Information Management (SWIM), and the repeated articulation of “supporting situational awareness” across many NextGen elements. We are concerned that critical human factors issues within these elements may not be addressed.

**Recommendation:** The Subcommittee recommends that the FAA develop a consistent process that addresses critical human factors issues within the seven NextGen Solution Sets. One approach would be to hire a human factors professional within the solution sets comprising the developmental areas of NextGen. AJP-61 could help coordinate and facilitate these developmental human factors activities.

**Finding 3:** The Subcommittee views the new NextGen positions allotted to AJP-61 and one more position as important steps to addressing the resource shortfall. However, filling the remaining positions is an immediate need for managing programs and contracts. Challenges external to the FAA include a shortage of both qualified applied researchers who understand the flight-deck, ATO domains, human factors engineering, and qualified human-in-the-loop simulation facilities. Compounding this problem is the lack of rapid and effective mechanisms for letting contracts to bring external researchers into the program.

**Recommendation:** The Subcommittee recommends that the FAA begin now to prepare human factors researchers for the NextGen tasks. This should include bringing in top talent in human factors and providing rapid but comprehensive exposure to the flight-deck and ATO domains. The FAA should explore ways to engage researchers in countries with similar ATO traditions (e.g., Canada, Europe, and Australia). Qualifying simulation facilities needs to be explored and the specialized programming skills required for this work obtained. The NextGen program is of long enough duration that a concerted effort to train the necessary researchers is still feasible, if it starts immediately. Other funding mechanisms need to be explored to allow qualified researchers to participate effectively, e.g., contracts, inter-agency agreements, broad agreements with umbrella groups (e.g., National Institute of Aerospace) and temporary assignments of researchers to FAA for specific time periods.

We also recommend that efforts be made to increase the pool of qualified applicants for future positions. This may be addressed by supporting the education of aviation human factors specialists at universities through contracts and grants. Within the FAA, short courses may be offered in aviation human factors for acquisition and regulatory personnel.

**Finding 4:** The Human Factors office (AJP-61) has had rapid turnover in leadership with a series of temporary appointments. This may provide human factors with less influence on NextGen policies and decisions than would be the case if there was long-term continuity in the office.

**Recommendation:** The Subcommittee recommends that permanent leadership be appointed as rapidly as possible. This person should have sufficient authority to ensure effective, coordinated human factors activities across the organizational lines spanned by human factors.

**Finding 5:** The Subcommittee is encouraged by the identification of human factors lessons learned in acquisition such as those expressed in the AJA Report *Cross Post-Implementation Review Analysis Lessons Learned*, dated December 30, 2008. However, in order for the FAA to take full advantage of the opportunities identified, a follow-on activity is needed to address each of these lessons as an appropriate change to acquisition policy, standards, guidance, or processes.

**Recommendation:** The Subcommittee recommends a process be developed that establishes how to transition human factors lessons learned into substantive follow-on activities. This will improve both system implementation and acquisition policy, standards, guidance, and processes.

### **NAS Operations Subcommittee**

**Finding 1:** The majority of the research presented was oriented at developing a "mid-term" capability in 2018 for the NAS or by implementing incremental changes to the existing system to increase controller productivity. The general construct for the research is therefore one of evolution from the current system, rather than a transformation of the system. The Subcommittee understands that it is important for the FAA to provide as many benefits to the NAS users in the near term as possible; the evolutionary focus is consistent with that requirement. However, the Subcommittee is very concerned that this emphasis will not provide the technologies, policies, and procedures required for the transformation to the long-term vision of the NAS, because it is a push from current operations rather than a pull from the future. To have research oriented to both 2018 and the long term may require more resources than those needed for either vision alone.

**Recommendation (a):** The Subcommittee recommends that the FAA conduct an assessment of the extent to which the planned "mid-term" improvements to the NAS for 2018 are consistent with the requirements for the transformed long term NAS. Research conducted for the 2018 goal should be scalable to the transformations most needed for the long-term vision.

**Recommendation (b):** If the research supporting the 2018 capability does not scale to the longer-term vision, the FAA should undertake to identify additional research resources that may be required for the longer-term vision and clarify the approach for obtaining them.

**Finding 2:** The Subcommittee heard a briefing on the Avionics roadmap, which provides a good start to providing an understanding of the requirements for the air-side contribution to the NextGen infrastructure, but much work remains to be done. Performance metrics must be established and systems requirements must be defined. This is particularly true for the aircraft contribution to the 2018 architecture, because no research was described which addresses what the airspace users have to do to enable NextGen. Additionally, none of the research we have seen has addressed the aircraft avionics reliability impact on the 2018 or the long-term ConOps.

**Recommendation:** The Subcommittee recommends that the FAA accelerate developing airborne avionics and ground-based automation requirements that permit achievement of the stated 2018 goals so that users will know what they need to do. Consideration of reliability requirements should be part of this development. The roadmaps should include necessary stakeholder decisions, actions, and implied costs.

**Finding 3:** The Subcommittee was given a briefing of the “Air Traffic Control/Technical Operations Core” and the “NextGen Controller Efficiency” human factors research programs. The Subcommittee has mixed opinions concerning this work and the level of funding it is receiving. On the one hand, these two programs each are requesting “plus-ups” near \$6M for FY11, which are substantial increases when overall ConOps, and technical issues such as human-automation or air-ground roles-responsibilities, have not yet been determined. On the other hand, it is clear that controller roles will in some sense be switching from tactical control to “management” of traffic, even for the mid-term implementation, and it should be relatively straightforward to develop hypotheses regarding the change in required skill sets and start developing selection and training programs for new hires.

**Recommendation:** The Subcommittee recommends that the FAA task REDAC to put together a joint NASOPS-Human Factors Working Group to provide an external assessment of the best way to accelerate appropriate ATM human factors research in support of the 2018 mid-term capability. A key aspect should be the definition of accelerated activities required to develop new controller selection and training criteria.

**Finding 4:** In the presentations given to the Subcommittee, there is frequently a lack of connection of the research to desired increments in NextGen capability, a lack of any sense of the magnitude of the problem being addressed, a lack of any real technical detail of the work being performed, a lack of any measure of the extent to which performing the research and implementing the results will provide an efficiency or capacity increase for NextGen, and a lack of an overall sense of relative priority among research elements.

The resulting lack of clarity makes the research (1) very difficult to place in context, and (2) very difficult to ascertain in value.

**Recommendation:** The Subcommittee recommends that the FAA should conduct (or complete, if it is underway) a gap analysis which clearly identifies projected benefits, in quantitative terms, to capacity, efficiency, and/or safety of proposed implementations in the solution sets, the priorities among them, and the research required to provide them, and develop research portfolios which have clear milestone completion requirements, exit criteria, defined funding lines, and clear lines of authority.

**Finding 5:** Public-private partnerships hold substantial, and largely untapped, potential for many of the activities underway for engaging the private and state sectors in NextGen technology maturation and the related required innovations. Such partnerships are particularly effective when they emphasize pre-competitive, industry-wide design guidelines, industry standards for systems and architectures, and means of compliance for certification of new technologies. Additionally, industry methods for managing R&D may provide various accelerations to the FAA approach. Even with the slowly rebuilding NASA/FAA partnership, current FAA NextGen implementation strategies make scarce, insufficient use of partnerships.

**Recommendation:** The Subcommittee recommends that the FAA should consider developing a public-private partnership for the execution of NextGen. The FAA should use past models for lessons learned, and build the partnership around pre-competitive focus, shared governance, cost sharing, and appropriate IP protections. An approach would be to engage the National Council for Public Private Partnerships (NCPPP) as a forum to facilitate the design exercise, and engage the roles of small and large businesses (OEMs and suppliers), the states and municipalities, the operators, academia, and the Federal sector.

**Finding 6:** The described FAA approach to assessing the environmental impacts of operational changes focuses on deleterious effects but does not allow credit for offsetting reductions in environmental impact. This imbalance was particularly evident in the discussion of the Required Navigation Performance (RNP) approaches that remove noise impacts over much of a possible approach or departure area by concentrating all flight tracks in narrow corridors.

**Recommendation:** The Subcommittee recommends that the FAA should task REDAC to develop a NAS Operation/Environment & Energy Working Group to propose new assessment approaches for environmental impact.

### **Subcommittee on Aircraft Safety**

**Finding 1:** The Subcommittee has considered the roles played by several activities and laboratories – especially the Tech Center Fire laboratory, the Fuels laboratory and,

importantly, CAMI. FAA has made major contributions to knowledge in these areas. The laboratories and their work are world renowned and add important luster to FAA. There is a need to document the various capabilities and the justification for the care and feeding of these facilities, so as to permit an FAA-wide examination of the need for, modernization of, and the funding of existing facilities. This examination should ensure that adequate ATC/Cockpit/pilot/controller simulation and modeling capabilities are available to support studies related to NextGen, self-separation, human factors, reduction of spacing between parallel runways, RNP, etc.

**Recommendation:** The Subcommittee recommends that, even in difficult budget periods, the work and funding of these laboratories be addressed from not only a program perspective, but from an Agency and national perspective as well. The full motion flight simulators at CAMI supporting research in Terminal Area Safety is a case in point.

**Finding 2:** Several research topics presented plans that were stated to be in support of the Next Gen initiative. Detailed NextGen research needs appear to be elusive and still need to be clearly defined in most areas. It was mentioned that the I&I office is working diligently on this requirements definition process.

**Recommendation:** As stated in the last several Subcommittee meeting reports, the Subcommittee recommends that this must be accelerated to assure research is done in a manner consistent with NextGen deployment timing. In the interim the FAA research sponsors must use their best judgment to anticipate the NextGen research needs until such requirements become better defined. In addition as requirements evolve, the sponsors must be aware of research that has already been done. For example, much work has been done to evaluate closely spaced parallel runway limitations for today's infrastructure. Much of this work may be applicable to support Next Gen objectives for assessing self-separation capabilities on closely spaced parallel runways.

**Finding 3:** Consistent with the Strategic Guidance provided, the Subcommittee expects to see detailed plans with measurable milestones & deliverables for the FY11 research activity. It is noted that excellent results need several key ingredients – complete planning, diligent execution & skilled people.

**Recommendation:** The Subcommittee recommends that the FY11 plans be defined, be clear & explicit to the point of being trackable on a monthly basis – not just the budget expenditure but the actual results vs. the plan. This timely understanding of execution issues enables midcourse corrections to be considered & implemented early for maximum benefit. Additional focus on execution excellence will yield more & better research per dollar spent. Earned Value Measurement techniques are available to help here and can be very simple to implement in their most basic form.

**Finding 4:** The Subcommittee understands that FAA now uses Project Level Agreements as a management tool to make judgments about appropriate NextGen research levels – as opposed to the former use of Program Plans. Program Plans have been valuable as a mechanism to gather user and stakeholder support and input. Weather

Plan and Human Factor Plan are good examples. (The Weather research program, for example, continues to deliver high quality capability improvements. This consistent delivery may be due, in part to a consistently high level of research funding for which multi-year detailed plans are created & executed). This approach could be duplicated for strategically critical programs in other areas. These efforts have helped FAA to achieve support, consistency, and effective monitoring on the research initiatives.

**Recommendation:** The Subcommittee recommends that the Project Level Agreement mechanism be used actively to document the core research efforts and to capture industry and stakeholder input.

**Finding 5:** The Subcommittee also recognizes that Weather requirements cut across both safety and capacity mission objectives of the FAA. Consequently there are inherent institutional complexities for managing and sponsoring the Weather research.

**Recommendation:** The Subcommittee recommends that FAA ensure it has enough qualified people to manage the broad and complex Weather related programs that support multiple mission needs.

**Finding 6:** There is more funding proposed for Unmanned Air System (UAS) activities than for software /digital systems work. We have been informed that all the internal requests for research have been fully funded, but this situation may be evidence of the previously identified difficulty of FAA acquiring talented software/digital system experts. Next Gen based research requirements for Software Digital Systems are largely missing & must be defined. The continued lack of requirements is actually quite surprising since all of Next Gen is dependent on advanced avionics.

**Recommendation:** In light of the growing and crucial importance of software/digital systems, the Subcommittee recommends that this work be given additional emphasis and funding, as well as renewed efforts to hire software and digital systems experts.

**Finding 7:** Unmanned Air System (UAS) research requirements are fuzzy at best and lack a coherent plan that provides a clear path to certification & operation of UAS in the NAS. It appears the possible solution set is overly constrained by multiple conflicting operational requirements to the point where it may well be a null set making research either irrelevant or misdirected.

**Recommendation:** The Subcommittee recommends that significant system level thinking be applied to the development of the optimal operational construct and to the definition of the research (if any) needed to permit guidance material & regulations to be developed. The Subcommittee recommends that a Program Plan be developed with milestones, metrics and funding requirements.

**Finding 8:** The Subcommittee notes that based on what was presented, the FAA planned activities for icing research are relevant, appear to be on track, and are well integrated with other organizations doing icing research such as NASA.

**Finding 9:** The Small Airplane Directorate has a very tough task ahead to assure Continued Operational Safety (COS) for the >150,000 general aviation aircraft in the US. The issue of aging aircraft (one that has been worked tirelessly for many years on large commercial aircraft with great success) has barely had an impact in the General Aviation (GA) fleet. There remains significant work to do here. The approach proposed to develop guidance material for GA airplane structural fatigue assessment is good but insufficient. The efforts of the Directorate to educate pilots, mechanics & owners are commendable & are very slowly increasing awareness of the issue, but this too is insufficient. There needs to be a large scale, mandatory reporting system implemented to permit the FAA to gather the aging aircraft structural cracking data it needs to support an adequate, data based, reliable approach to COS for this fleet. This is unpopular & difficult. Absent a program such as this, the GA fleet will expose the structural fatigue issues, event by event, death by death. It will happen, what will be the human cost before the FAA is called to react to the systemic issue of aging GA aircraft?

**Recommendation:** The Subcommittee recommends that FAA develop a more efficient and timely reporting system for the general aviation fleet as a means of gathering factual data on the aging GA fleet to proactively prevent in-flight catastrophic structural failures by enabling timely, appropriately focused, data based, high priority GA R&D activities leading to improved structural assessment guidance material and potentially Airworthiness Directives. This is directly aligned with the FAA mandate to assure Continued Operational Safety as well as complimentary to the ongoing Small Airplane Directorate Part 23 Certification Process Study.

**Finding 10:** The Subcommittee was asked to review a Volcanic Ash Risk Assessment paper that was provided at the meeting. Although the risk assessment was very limited and there have been no accidents to date due to Volcanic Ash encounters, the Subcommittee recognizes there is legitimate concern within the transport pilot community about the potential hazards of volcanic ash. The subcommittee concludes that these concerns probably warrant further research.

**Recommendation:** The Subcommittee recommends that research be limited to a very focused approach on how to detect and avoid a volcanic ash encounter. The Subcommittee does not believe the research related to the development of onboard technologies to detect or harden an aircraft against volcanic ash is warranted. The Subcommittee recommends that the research be limited to the development of procedures for getting tactical information to flight crews so they can effectively avoid the hazardous areas. Finally the Subcommittee believes that even this limited scope for research is relatively low in the broad research portfolio.