October 14, 2010

The Honorable J. Randolph Babbitt
Administrator
Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591

Dear Administrator Babbitt:

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

The full committee also made the following general observations:

Complexity of NextGen Research and Development Plans – The REDAC is concerned that there does not appear to be a clear high level Research and Development plan for NextGen that articulates the critical NextGen needs and links them to the R&D portfolio. The REDAC understands the challenge of defining such a plan for a complex system such as NextGen. However, the plans and roadmaps that have been presented to the REDAC do not articulate a high level vision and are so detailed and complex that they are intractable. This makes it difficult to evaluate if the necessary R&D is being accomplished and how R&D results will be used. The REDAC recommends that a high level R&D plan be developed from the existing more detailed plans and enterprise architecture to articulate the R&D vision and identify the critical path of R&D for NextGen.

Concern on Level of Technical Expertise in Key Areas – As noted in prior recommendations the FAA has a unique need for expertise in key areas such as critical software and digital systems and human factors both for certification and acquisition. The REDAC *reiterates its concern* that there has been inadequate progress in developing the core competency and technical workforce in this and other key areas. The REDAC is further concerned that the mechanisms identified to address this issue which accompanied your letter of 16 September, 2010 only discuss the process for developing research needs and do not address any plans for attracting talent to the FAA or increasing the level of technical expertise of existing personnel in key technical areas. The REDAC recommends that a strategy be developed and executed to improve the ability of the FAA to compete in the market for highly desirable talent.

UAS Research - The REDAC applauds progress in defining a clearer path toward certification and routine operation of UAS in the NAS. In light of the significant community pressure on the FAA to accelerate the safe integration of UAS in the NAS, the REDAC questions if the research is sufficient to address the complexity of the operational, technical and policy changes associated with safe integration of UAS and whether the timeline could be accelerated if additional resources were available. The REDAC also notes significant related R&D efforts at other government agencies such as NASA and the Department of Defense, which could leverage FAA efforts and benefit from stronger FAA involvement.

Nav Lean - The REDAC was pleased to learn that the investigation of Lean processes for certification, safety and operational approval is nearing completion and looks forward to the findings of this study.

We hope that these observations are useful to you and the agency. 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

Research, Engineering and Development Advisory Committee
Guidance on the FY 2013 R&D Portfolio

Subcommittee on Airports

Observation: Aircraft Rescue and Fire Fighting (ARFF) research is progressing steadily. A project to estimate the amount of fuel released during an accident involves the modification of 9/11 computer models and previous Boeing test results. Current computer models are designed to focus on the accurate modeling of fundamental aircraft structural features. The Subcommittee notes that the focus on structural features allows for historical data to support the simulation of current aircraft designs, and recent test results have validated that modeling strategy.

Observation: As part of the ARFF research studying new fire fighting agents, methods, and equipment, the Subcommittee is concerned about the influence that manufacturers may have in the research process. Specifically, there is a significant reliance placed on the innovation of manufacturers to develop improved ARFF items. The FAA notes that the manufacturers are generally bounded by two opposing factors: a desire to innovate in response to new federal regulations that require the use of environmentally-friendly materials; and the opposite desire to maintain the status quo, given the disincentive of developing new products when federal procurement laws require competition from multiple sources.

Observation: The Subcommittee is encouraged by the positive results of the alternative runway grooving project conducted within the runway safety and design program. Initial results show that alternative grooves accumulate less rubber than standard grooves, allowing for rubber removal operations at one test airport to be extended 7-9 months. Testing has also shown that more snow can be removed from alternative grooves than from standard grooves using common winter operations equipment. However, the Subcommittee notes that there are currently only two manufacturers of alternative groove cutting blades, and if these blades were patented then operational costs could increase dramatically. The FAA indicated that while the current costs to cut alternative grooves are higher than for standard grooves, future increased usage by airports would allow for costs to decrease to the point where both methods would have equal costs.

Observation: The Subcommittee supports the FAA efforts to work with the Transportation Security Administration (TSA) in order to streamline the airport security research program. The Branch currently provides oversight of the National Safe Skies Alliance (NSSA) program, which is a research effort funded by FAA through the Airport Improvement Program (AIP). NSSA conducts research in five main security areas: perimeter; cargo; access control; checkpoint; and checked baggage. As of August 2010, NSSA has completed 238 projects with 29 currently underway. The FAA is currently negotiating an agreement to have TSA take full control of the airport security program.

Observation: The wildlife mitigation program continues to record favorable progress. There has been significant progress over the past year to improve the wildlife strike database and strike reporting program. The FAA notes that they are working to enhance the web presence of the website by improving the dataflow of reported strikes, reducing the amount of time for reported

strikes to appear on the database, and develop a dashboard for project managers to manipulate database content.

Finding: Research activities in the visual guidance / runway incursion reduction program focus on three main areas: marking materials; lighting technologies; and sign technologies. The project on using LED technology in improved runway approach signs is of particular interest to the Subcommittee. They mentioned that any effort to reduce confusion and improve the human factors associated with these airfield signs would be extremely valuable for aircrew at certain problematic airports.

Recommendation: Research into the evaluation of GPS navigation devices for preventing runway incursions is complete, and the FAA indicates that they are now writing the final project report. Results have indicated that the devices are most effective when used as a situational awareness tool and not for providing directions. The Subcommittee is concerned that the combination of this program and a similar effort by the Air Traffic Organization (development of ADS-B technology) would confuse airports, since the different specifications for tracking assets on the ground are not fully interchangeable. The Subcommittee believes that airports would ultimately like to use a system that can provide all users with a shared data set (as this was the initial promise of the ADS-B system). If the ADS-B systems are able to work as initially designed, then the GPS systems in this project would be redundant. The Subcommittee recommends that the Branch carefully considers the context in which this project is taking place, and produce results that can clearly tell airports the effectiveness of equipment.

Observation: The Subcommittee is concerned about the initial results of the visual guidance project on evaluating runway end / threshold lights. In analyzing varying light spacing and intensities, the Subcommittee believes that pilots could potentially mistake the evenly spaced lights with takeoff hold lights. Such confusion could cause an aborted takeoff, especially in reduced visibility conditions at night. The FAA states that since the lights are located at the end of the runway it shouldn't be a concern to pilots, however, that specific situation would be studied to ensure that no potential safety risk would exist.

Observation: The Subcommittee is very pleased with the brief from Paul Devoti of the FAA's National Planning and Programming Office (APP) on the airport NextGen implementation plan and JPDO airport working group. He states that elements of the NAS Enterprise Architecture (e.g. Airport Roadmap) are currently being revised. A source of the confusion by the Subcommittee members is due to the fact that the Enterprise Architecture is not completely aligned with the other NextGen plans. The Subcommittee is interested in understanding the interface between the Branch's research program and the NextGen requirements. A clearer understanding of this relationship would allow for airports to perhaps facilitate and sponsor related projects and also provide feedback to researchers.

Observation: The Subcommittee questions the extent to which the Branch's research crosses over into the NextGen scope of work. The Subcommittee states that there is a tremendous need for analytical resources in the JPDO working group, and enabling a Branch project manager to perform work identified by the JPDO would be tremendously helpful. The JPDO currently lacks the full complement of analytical resources to perform all of the work that needs to be done. The

FAA explains that any requests would originate from the FAA representative on the JPDO working group, and if there is a research/data analysis need that would benefit the FAA Airports Organization, appropriate arrangements could be considered.

Observation: The Subcommittee believes that is it important to have Paul Devoti return to future meetings and provide updates on NextGen and the Airport Roadmap. Paul's continued presence provides an additional benefit by allowing for the Subcommittee to have a direct connection to the APP Office, which plays an important role in the NextGen /Airport Roadmap process.

Observation: The aircraft braking performance research program is moving forward as planned. The goal of the program is to accurately predict aircraft braking performance from real-time measurements of an aircraft brake's response to braking commands. There are four components to this effort: measure aircraft tire braking forces on ice and snow covered surfaces; use a full-motion aircraft simulator; develop mathematical models of aircraft braking systems during operation on contaminated surfaces; and test and verify with full-scale aircraft testing. The Subcommittee is concerned that the current simulator models for icing and snow on taxiways are inadequate and do not simulate reality. If the FAA could provide the full-scale test data to Flight Standards, then it would be very helpful in improving simulator conditions. The FAA states that it would be worthwhile to do so if the deficiency exists.

Observation: The Subcommittee commended the research team for their excellent work in the airport capacity / pavement program. The FAA states that previous recommendations to conduct research into ASR impacts and the load transfer effectiveness of dowelled and un-dowelled joints have been implemented and research is currently underway. Other projects include the preparations to purchase of a heavy vehicle simulator in FY11, which will support research into high tire pressure testing, asphalt overlays, and green/sustainable pavement products and methods. The goal of the current construction cycle testing is to determine the effect of gear interaction on low-strength subgrade flexible pavement life. Additional efforts to upgrade the test vehicle with new load controllers, servo valves, and an operating system conversion have also been successfully implemented.

Observation: The Subcommittee is interested in the status of the PAVAIR / MicroPaver pavement software relationship. Particularly, as one program is operated commercially, the Subcommittee believes that future coordination efforts may be very difficult once the FAA decides to produce software with improved capabilities. Additionally, the Subcommittee is concerned about the FAA's ability to manage the software database and user access. The FAA notes that that the server will be held on site and provisions are being made to fully support the issues related to the software transition.

Observation: The Subcommittee is pleased with the research project on the methods to quickly and accurately evaluate the condition of airport pavements. Digital imaging equipment is being investigated. Though human factors issues still present a potential hurdle, the technology does provide some improvement over existing methods, such as higher scanning speeds. The proposed product will be a report describing how well each product works and the minimum requirements for airport authorities to operate equipment. The Subcommittee believes that

taking an objective look at the various kinds of common equipment is very useful, and the corresponding report of best practices for equipment use would be very beneficial to the airport community.

Finding: The Technical Center's research into avian radar and wildlife hazard mitigation is progressing steadily. Airports participating in the testing with the Technical Center have been very supportive of the new capabilities that the project offers. Airports have been able to extend their wildlife observations to 24 hours/day coverage.

Recommendation: The Subcommittee is very pleased with the progress of the avian radar assessment project, and noted that the airports that participated in the testing have been highly supportive of the new capabilities the system offers. The Subcommittee notes that those airports were able to benefit by extending wildlife observations to 24 hours a day, identifying movement patterns/trends, educating staff, and taking appropriate action. The Subcommittee recommends that the next step in bird radar research should be to investigate the integration of bird radar into the air traffic control tower environment.

Finding: The Subcommittee was presented with two projects that were deferred by the ACRP: one on through-the-fence security and another on aircraft airport accident data.

Recommendation: The Subcommittee was presented with two research proposals that were deferred to the FAA by the ACRP Oversight Committee. On a project that involved the collection and evaluation of aircraft accident data on airports, the Subcommittee recommends that the FAA integrate the elements of the proposal into the Branch's recently formed project on the same topic. Regarding a project on the investigation of "through the fence" operations that impact airport security, the Subcommittee recommends that no further action is taken, as the subject matter is outside of the scope of the Branch's current research portfolio.

Finding: Research on runway roughness and real-time aircraft braking are important projects.

Recommendation: The Subcommittee believes that the research project on investigating runway roughness is an excellent idea and can produce results that have many potential applications. As the research progresses on the separate project to investigate aircraft braking performance, the Subcommittee recommends that the FAA investigate any potential correlation of that data with the runway roughness studies. The Subcommittee also strongly recommends that the FAA investigate any application of the roughness data to initial pavement construction standards. Airports are currently dealing with problematic construction issues that involve runway smoothness, and the Subcommittee believes that any revised or supplemental standard on that topic would be a tremendous benefit to the industry.

Finding: The Subcommittee is concerned that the research effort to investigate sustainable/green technology in airport pavement construction, such as warm mix asphalt, is being delayed until 2012.

Recommendation: Although questions about the performance of such methods exist, the Subcommittee recommends that the Branch accelerate the testing of sustainable/green

technologies, using the results from other research programs (ACRP, AAPTP, IPRF, etc.) as a starting point.

Finding: The Subcommittee held an extensive conversation on the content of the Branch Manager's 10-year R&D "look-ahead" plan.

Recommendation: The Subcommittee recommends that future versions of the plan contain thoughts as to not only how the Branch can support the Headquarters program (including elements from the FAA Flight Plan, ARP Business Plan, NextGen plans) but also contain ideas of what could (or needs to) be done outside of the existing programmatic constraints. High-level goals are: reducing runway incursions; reducing excursion fatalities; pavement improvements (reduced costs, increased life, improved maintenance and construction, etc.); airport/environmental sustainability; ramp safety; and safety during construction, etc.

Subcommittee on Environment and Energy

Finding: The subcommittee discussed research drivers, needs and gaps. Members reaffirmed previous priorities (solutions, with a focus on aircraft technology and alternative fuels, science, particularly climate impacts) but also questioned whether FAA's research efforts are addressing evolving issues with general aviation leaded avgas and water quality, both driven by EPA regulatory activity. While these issues are addressed by the Office of Aviation Safety and the Office of Airports, the subcommittee had two specific requests/recommendations.

Recommendation (a): In conjunction with EPA, the general aviation industry, and other interested stakeholders, the FAA should develop an integrated aviation gasoline program to research and test new piston engine technology and fuels with reduced or no lead additives in order to find safe alternatives to leaded aviation gasoline. This program is necessary for FAA to provide the required technical support for anticipated EPA rulemaking activities on lead emissions from piston engine aircraft in light of statutory and regulatory requirements to also consider the impacts of safety, noise, costs, and technology in the development and adoption of standards. The subcommittee asked for a briefing on the status of avgas research at its next meeting.

Recommendation (b): In conjunction with Airport Council International-North America (ACI-NA), the FAA should assess the implications of water quality regulations on airports and identify any research needs. The subcommittee asked for a briefing at its next meeting.

Finding: The subcommittee noted substantial progress in the NextGen Environmental Management System (EMS) work. The concept is extremely complex and development requires input from many stakeholders.

Recommendation: The subcommittee suggested that the Office of Environment and Energy conduct a Focus on NextGen EMS for all relevant stakeholders to educate the community and ensure their views are integrated into the development of NextGen EMS.

Finding: The subcommittee noted that FAA's environmental science efforts are maturing and that FAA needs to develop plans for using these results to inform policy. The committee felt that a "science readiness scale" might facilitate this transition

Recommendation: The subcommittee should form a small task force to develop a "science readiness scale" in conjunction with the FAA

Finding: The subcommittee was pleased with progress made by the Office of Airports and the Office of Environment and Energy identifying funds for noise research. This is a critical issue that must be addressed. While the availability of funds is encouraging, the committee was concerned about the ability of keeping oversight of so many funding strings.

Recommendation: The Office of Environment and Energy should continue to work with the Office of Airports through the budgeting process through the Office of Management and Budget (OMB) to ensure funding is available for noise research, in particular to conduct community noise surveys. The subcommittee also recommends that the Office of Environment and Energy work with funding partners to ensure the noise research program is well integrated and is given sufficient priority.

Finding: The subcommittee was pleased with progress standing up the Continuous Low Energy Emissions and Noise (CLEEN) program. Excellent projects are underway and appear on track to deliver substantial environment and energy efficiency and diversity gains.

Recommendation: The FAA should continue to provide robust funding for CLEEN and explore ways of increasing investment in the future.

Finding: The environment and energy program has experienced substantial growth; however staff growth has been slower. The Office of Environment and Energy has added some well qualified staff but still has many vacancies. The subcommittee understands that hiring well qualified staff in aeronautics is a national issue and requires focused attention.

Recommendation: The Office of Environment and Energy should develop a recruitment plan and make use of subcommittee members to help fill vacancies.

Finding: The subcommittee noted progress developing the NextGen environmental policy and standing up an effort to assess and quantify goal targets. The subcommittee noted that these efforts require refinement and continued attention,

Recommendation: The subcommittee urged the Office of Environment and Energy to continue advancing the computational capabilities to quantify the contribution of various strategies toward environmental goals. This information should inform refinements of the NextGen environmental policies, but should not hold up release of the policy document. The subcommittee asked for updates at the next meeting.

NAS Operations Subcommittee

Finding: Reviewing the FAA's NextGen research portfolio continues to be very difficult, particularly with regard to demonstrable connections between the research elements being briefed and the development of required NextGen attributes while eliminating existing gaps in technology and policy. First, the linkages of the research to a needed NextGen requirement, the basis for that requirement, and the costs, anticipated benefits and priority of the research activity, are rarely evident in the briefings. New concepts for NextGen should be linked to the needs of the key customers and stakeholders outside of the FAA, and explicitly incorporate the interests and capabilities of each; this linkage is also rarely evident in the briefings. Several of the specific findings and recommendations from this briefing stem from the difficulty of finding these linkages.

Recommendation: The Solution Set taxonomy the FAA has adopted may be a useful construct in which to define the NextGen R&D program and to brief its research activities, and NASOPS recommends trying this approach. The R&D program should articulate clearly the intended roles and responsibilities of the customers and stakeholders as a basis for performing needs assessments, defining resulting NextGen system design requirements, and conducting operational demonstrations to achieve system performance metrics. The costs and anticipated benefits of projects or research elements that make up the program should be explained, and their prioritization to develop the system should be defined. NASOPS recommends that the I&I Coordinator should be included in briefings to REDAC, and address the issues of (1) stakeholder/customer involvement across the portfolio, (2) connection of the ongoing research to specific NextGen needs, and (3), the extent to which research concepts will be validated in operational demonstrations to demonstrate system performance improvements. The individuals performing the work should, in the briefings, link the individual research activities that comprise the solution set back to these considerations. This connectivity will assure the REDAC of the strategic alignment needed and ensures the same internally within the FAA.

Finding: The subcommittee was appreciative of the presentations discussing CAASD's work in Collaborative ATM, which included IDRP, Probabilistic TFM, Flow Contingency Management, and High Density Area Departure/Arrival Management. While all of the work presented had demonstrable value, it was clearly limited to an internal ANSP focus. The subcommittee was not presented with any research on advanced collaboration capabilities to enable increased user/operator roles in addressing capacity constraints and limitations.

Recommendation: It is essential that user engagement in true collaboration be emphasized fully in the research. The subcommittee recommends that the FAA research focus, including the work program at CAASD, have a more balanced approach that gives greater weight to the

participation and leverage of the NAS operator's role in collaborative ATM. Specific example emphases might include:

1) Greater emphasis on enabling the operators to provide a first response to the adjustment, clarification, and balancing of demand to meet and alleviate constraints and limitations.

2) Greater emphasis on negotiations of constraints, slots, trajectories and throughput between ANSP and operators to allow fleet-wide optimization, with less focus on reactive and/or unilateral actions by the ANSP.

3) Mapping specific linkages between the NextGen CATM solution set and the research, including that in the CAASD work program

Finding: The briefing on incremental, probabilistic, congestion resolution was well received by the subcommittee. The work provides a very useful framework for conceptualizing next generation traffic flow management during severe weather conditions. The subcommittee is aware that the FAA has agreed to develop CATM capabilities in their response to the RTCA TF5 report, but has not been briefed on the progress or the scope of this effort. The subcommittee did express an interest in moving the concepts forward more rapidly with an aim towards prototyping, high fidelity simulation and, eventually, operational evaluation.

Recommendation: The FAA should:

1) Develop a detailed research and implementation roadmap within the NextGen CATM program and solidify necessary multiyear funding resources. Broaden the research team to include outside expertise in areas such as ensemble weather forecasting, airline operations decision making and terminal and en route capacity impact modeling.

2) Refine and validate methods for probabilistic weather forecasting as applied to this concept. The aviation weather forecasting community is currently experimenting with various ensemble techniques for characterizing forecast uncertainty. The efficacy of these methods relative to this concept of use should be rigorously assessed.

3) Refine and validate methods for "weather impact translation" as applied to capacity forecasting for en route sectors (e.g. dynamic MAP values), individual flows, terminal airspace and airports. This is a big job and will require participation from multiple research organizations as well as the operational community, working in an integrated, cross-research manner, from fundamental research in weather, to means of translation to ATM tactical and strategic decision aids.

4) Articulate and validate the concepts for Traffic Management Initiatives (TMI) that would be used to incrementally adjust demand relative to constrained resources. It is not clear that today's TMIs (e.g. ground delay or ground stops, airspace flow programs, miles or minutes in trail) would support this incremental congestion resolution concept effectively.

Incorporate, as a key element of the concept, the impact of airline operators in modulating demand in response to forecasts of reduced capacity. As with several of the briefings, the subcommittee felt that the work did not adequately consider the essential role of the operator in developing solutions to the capacity-demand imbalance. Operational demonstration with airline operators will be key to entrain users in concept validation.

Finding: As examples of areas in which the user/operator community is supportive of expediting the implementation of FAA research, the subcommittee heard two briefings of specific interest. Although not covered in the weather briefing, operators are currently using their own wind estimates for TOD computations, which could lead to a variety of "optimal" descent profiles. In a different area, the subcommittee was pleased with the presentations of the research on Relative Position Indicator (RPI) and Automation for Monitoring RNP/RNAV Operations (AMRO) tools. These tools will assist Air Traffic Control in utilizing these procedures and delivering the benefits of the RNP/RNAV procedures. Since RNP/RNAV procedures are currently being developed, expediting these automation tools would accelerate benefits in environment and fuel consumption to appropriately equipped users.

Recommendation: FAA, in conjunction with the NWS who generates the core wind data, should work with the user/operator community to ensure that consistent, certified wind information is provided to equipped operators for use in developing descent profiles. FAA and CAASD should expedite the development and implementation of the Relative Position Indicator (RPI) and the Automation for Monitoring RNP/RNAV Operations (AMRO) tools to enable full use of these procedures.

Finding: TCAS has been a significant safety element in the National Airspace System since first deployed in 1993. Its design was carefully coordinated with existing ATM procedures to minimize false alarms while reducing the risk of mid air collisions. As NextGen introduces new procedures, it is appropriate to consider whether TCAS will continue to operate effectively while maintaining an acceptably low false alarm rate. The NASOPS Subcommittee was briefed on a new IRAD CAASD program to explore changes to TCAS surveillance, communications and threat logic to achieve compatibility with proposed NextGen flight procedures while preserving its collision avoidance capability. For example, a 2008 CAASD study concluded that of twelve proposed NextGen procedures in Oceanic/Non-Radar, Enroute and Terminal airspace, six would probably not increase the chances of unwanted TCAS Resolution Advisories, four might increase them and two would likely increase them.

Recommendation: The subcommittee applauds the CAASD NextCAS IRAD effort, but modifying TCAS or creating a new collision avoidance system to achieve compatibility with NextGen would be a particularly complex problem, and that work would need to be based on a clear understanding of changed requirements and be a mainstream activity within CAASD's FAA-funded work program, to be done in concert with existing TCAS experts at FAA, MIT/LL and other organizations.

Finding: The CAASD analysis to determine how many sectors might lend themselves to generic airspace operations did not consider a mix of aircraft that is different from today's mix and did not consider the possible introduction of trajectory based operation (TBO). The Subcommittee

believes that in the timeframe when generic airspace might be implemented there will be a greater diversity of aircraft flying at high altitudes (RJs for example). This mix of aircraft might well change the eligibility of a sector for generic airspace operation. The analysis assumed the current sector layout, but, it is likely that the current sector layout could well change because of TBO.

Recommendation: To get a more realistic assessment of how many sectors lend themselves to generic airspace operation, the analysis should be repeated, taking into account the fleet mix that might be expected at high altitude and possible changes, such as new sector boundaries, resulting from TBO.

Finding: As briefed, it appeared that CAAD's System-Wide Model is perhaps two generations beyond the NASPAC tool currently in use by the FAA. The subcommittee would like to understand the FAA plans for adopting the System-Wide Model as a NASPAC update, if doing so is, in fact, the case.

Related Finding: In existing modeling and simulation tools (*e.g.,* NASPAC, System-Wide Model, ACES), there is a gap in the ability to account for the effects of dynamically changing 4D trajectories on NAS performance. Such ability is required to assess the impacts of weather avoidance field dynamics, traffic flow dynamics, and airspace dynamics, for example, on NAS capacity and safety. Additionally, the modeling of NAS demand and operations with tools such as FATE, NASPAC, System-Wide Model, ACES, and others focuses on IFR traffic between a limited number of U.S. airports. Specifically, the modeling has limited accounting for the effects of VFR and VFR-Flight-Following operations predominantly by Part 135/91 operations, on total system capacity, workloads, and safety. The ability to model these effects and operations is important to the future implementation of trajectory-based operations of the NAS.

Recommendation: The subcommittee requests the FAA to provide it with a strategic view of the modeling and simulation needs for NextGen, contrasted with the tools currently available. The FAA should begin to develop modeling and simulation capabilities and related requirements for analyzing the effects of dynamically changing 4D trajectories on NAS performance, in accounting for the VFR operations and UAS operations, and in accounting for operations at airports not currently included in NAS modeling tools.

Finding: The subcommittee is encouraged that the FAA has developed an initial Weather-ATM integration plan. To initiate the implementation of integrated weather-ATM capabilities, however, the FAA needs to develop a detailed implementation plan that ensures needed activities are in place to support investment decisions. The subcommittee was pleased to see that FAA and NWS have made substantial progress in defining clear roles and responsibilities, as illustrated in the FAA briefing figure which identifies the four key functions: 1, developing and maintaining the NWS 4D weather cube, 2) determining potential weather constraints on NAS resources, 3) assessing ATM impacts, and 4), developing proposed mitigations. This framework is a positive step forward in defining roles and responsibilities between the NWS and FAA meteorological communities, and ATM stakeholders. The committee notes, however, that weather research in the FAA and NWS should not be firewalled from Wx-ATM integration research, which would be directly counter to the integrated research processes emphasized in the Weather – Air Traffic

Management (ATM) Integration Working Group (WAIWG) Report of the National Airspace System (NAS) Operations Subcommittee of the FAA's Research, Engineering and Development Advisory Committee (REDAC).

Recommendation: The FAA should develop a detailed weather-ATM integration implementation plan, consistent with the JPDO strategy for NextGen weather improvements, that ensures requirements are established, develops needed operational concepts, and establishes a clear business case for weather-ATM integration investments. This detailed plan should address needed activities across FAA lines of business and identify needed external stakeholder actions. Specific suggestions include:

1) Improve coordination between NWS, AJP, AJW and NextGen I&I office in developing foundational NextGen weather capabilities (forecasts, processing, distribution)

2) Improve the process for coordinating weather-ATM concept development and demonstration projects across AJP and AJR. RAPT/IDRP is a successful example. Analogous projects dealing with weather impacts on strategic traffic flow management, time-based metering, en route conflict-probe and high-density arrival management are needed

3) Empower traffic flow management researchers to exploit experimental strategic forecast products like CoSPA for the development and demonstration of advanced concepts, in conjunction with weather researchers

4) Articulate commitments to all of the user community by demonstrations for near and mid-term advances in operational weather capability

Finding: The Subcommittee received an interesting briefing on the development of Metroplex study teams in preparation for NextGen. While the studies are, appropriately, focused on areas recommended by the RTCA, some early work on these complex airspaces has been accomplished by NASA, and the FAA has not utilized that work. Doing so might permit a more aggressive approach to addressing some of the more complex situations than those currently under consideration. Additionally, the committee was struck by the FAA's desire to examine situations in which they would not need to do comply with NEPA requirements to perform an Environmental Assessment (EA) or Environmental Impact Statement (EIS) for new airspace usage because of the time associated with such a requirement. As the committee has noted before, the FAA needs to find a way to streamline compliance with NEPA requirements for new routings, as well as to give credit for offsetting savings. Similarly, in the Metroplex environment, it is clear that separation standards will need to be addressed from the same perspective of developing approaches to tackle complex challenges.

Recommendation: The FAA should not shy away from addressing these long-pole issues in the Metroplex studies, as solving them now will enable much faster implementation of possible NextGen improvements and savings.

Subcommittee on Human Factors

Finding: FAA mechanisms for guiding NextGen developments across organizations within the FAA require significant workforce time and effort, yet are insufficient or inappropriate for the range of activities required to develop NextGen. Of particular concern is, first, safety assessment activities that drive research units to make estimates of failure mechanisms and error rates to calculate quantitative reliability estimates at an inappropriate level of detail early in the design process, rather than guiding developments that promote safety. This is of particular concern for safety-risk-assessments which are demanding detailed estimates of human error rates given fairly notional concepts of operation while not considering safety-enhancing behaviors, as noted in many prior studies, including RTCA Task Force 4. Second, significant effort is required to maintain and compare 'roadmaps,' yet it is unclear from these roadmaps what major goals or capabilities their entries represent, whether redundancies or gaps exist, and what are the critical decision paths and system dependencies. While the roadmaps may provide some valuable functions, they should only be viewed as one of several representations required to drive design; for example, immediate human factors research requires greater specificity of scenarios (including degraded modes) and of roles and responsibilities.

Recommendation (a): The Subcommittee recommends the FAA examine methods of examining safety throughout the development of NextGen, including the human contribution to safety and human error, at an appropriate level of detail and in a manner that guides development to improve safety.

Recommendation (b): Likewise, the Subcommittee recommends the FAA examine the roadmaps for their ability to clearly articulate the critical paths, system dependencies and critical decision points; the standard by which they should be examined is not just whether these effects are captured in theory, but also whether they are clearly documented in a manner sufficient for the range of domains and stakeholders involved in NextGen development. These roadmaps should be able to address the other immediate research needs to achieve NextGen; for example, greater definition is needed for scenarios and role definitions to enable effective research on critical human factors concerns. Where the roadmaps are not a sufficient representation, the FAA should clarify other mechanisms to guide NextGen development. Likewise, the FAA should evaluate the appropriate resources for maintaining these NextGen development mechanisms to ensure that they are used only where there is a clear need without requiring excessive personnel time.

Finding: We agree with the conclusions of the GAO report that much has been done to coordinate FAA and NASA Human Factors NextGen Research, but that these activities could be enhanced through "a cross-agency plan developed [by the FAA] in cooperation with NASA to identify, prioritize, and coordinate NextGen human factors issues." Such a plan should additionally include other entities as appropriate, and should recognize the disparate approaches taken by each entity, such as the orientation of FAA NextGen research towards the Enterprise Architecture and FAA NextGen Concepts of Operation whereas the orientation of NASA NextGen research is towards the JPDO visions of NextGen and Concepts of Operation.

Recommendation: We recommend to the Director of Research and Technology Development that a small high-level 'human factors coordinating committee,' comprised of individuals with appropriate authority for the development of agency NextGen plan development at both the FAA and NASA, meet and come to an agreement on a vision for the 'initial focus areas' as recommended by the GAO report. Within the FAA, this coordinating committee must extend beyond the Human Factors Research and Engineering Group (HFREG) to other research groups that are conducting human factors research or whose activities require human factors research. For this activity to have the greatest utility, this committee should also include other NextGen stakeholders, such as the Department of Defense, the Department of Homeland Security, and the JPDO, as well as Federally Funded Research and Development Centers supporting research such as MITRE/CAASD.

Finding: The Subcommittee was heartened to hear that two senior leadership positions – the head of the Human Factors Research and Engineering Group and the Integration Lead for Human Factors in NextGen – have been either filled or are actively been solicited. However, the committee was concerned to see that these positions have been effectively downgraded from their original conception; in particular, the head of the HFREG was created as a Senior Executive Service (SES)-rank job. This suggests a de-emphasis of human factors and a diminished visibility and priority to ensure that human performance considerations are factored agency-wide into programmatic decisions across the system life cycle. Likewise, it remains unclear what resources and authority the Integration Lead will have, and, thus, whether it will be situated to identify and resolve particularly cross-cutting human factors concerns that may require, for example, changes in technology, operational procedures, and concepts of operation on both air and ground sides. Finally, the HFREG remains short-staffed with research program management staff.

Recommendation: We recommend that the FAA senior leadership responsible for defining these positions and for allocating SES and research program management staff positions review the positions currently being hired and clarify their roles, ensure that the HFREG has sufficient research program management staff, without establishing excessive supervisory chain and management overhead, clarify the mechanisms by which the Human Factors Integration Lead can identify human factors issues in NextGen and guide effective cross-cutting resolutions, and ensure that the position has the appropriate resources and staff to do so.

Finding: The Subcommittee was pleased to see the extent to which the high-level plan to validate NextGen Con Ops accounts for human factors concerns, to the degree that they were covered in the high level briefing provided. The committee also appreciates the mechanisms at both the researcher and management level to coordinate human factors research where possible between this effort and the HFREG.

Recommendation: The subcommittee recommends to the Manager for ATS Concept Development and Validation Group to continue coordination between this effort and the HFREG. The subcommittee requests some deep-dives into the human factors component of validating NextGen con ops. This should include the strategy for identifying relevant human factors issues and examining them in tests of fidelity relevant to the concept maturity level, from early-on methods such as cognitive walk through to detailed human-in-the-loop simulations,

through the data analysis and conclusions based on these research activities. The Subcommittee also notes the need to carefully consider off-nominal and degraded operations and recommends further development (or elaboration) of the strategy for addressing this.

Finding: The Human Factors Subcommittee has not been briefed on the Weather Technology in the Cockpit (WTIC) program and understands that it is in the process of replanning in response to earlier recommendations made by other sub-committees. However, the presentation and repeated questions did not present a clear, consistent vision for this project, and identified several proposed objectives of this research where government research does not appear to be justified. It is unclear what the research will provide beyond developments already taking place in industry, and how specifically it will support NextGen and/or AVS activities. Human factors efforts appeared to be vague and disparate, without clear, technically sound approaches; the presentation and use of weather information in the flightdeck should be better coordinated with, or actually conducted by, specialists in this area associated with the FAA Human Factors Research and Engineering Group (HFREG).

Recommendation: As in earlier recommendations, the Human Factors sub-committee strongly recommends to the Director of Research and Technology Development that the vision, intended deliverables and anticipated customers of the WTIC program be clearly articulated. The role of government research in this area needs to be carefully examined, as should whether an isolated project in weather in the cockpit is more appropriate than broader inclusion of weather concerns in other NextGen programs and by the HFREG. An expert review of the project is warranted. Following that, the project should be resourced and staffed appropriately to its goals and intended impact relative to other NextGen research areas.

Finding: The Subcommittee applauds the FAA for attempting to develop a Human Systems Integration (HSI) Roadmap that encompasses all human system integration aspects of NextGen and is developed in accordance with Operational Improvements (OIs) as they are represented in the NAS Enterprise Architecture (EA). While the Subcommittee recognizes the limitations of roadmaps as an agency mechanism for guiding NextGen development, the committee applauds their use by the HFREG. The Subcommittee also respects the careful consideration given to balancing the workload of maintaining the HSI roadmap with the benefits it provides for within-agency coordination. However, the Subcommittee also recognizes the limits of the roadmaps and the need for human factors research to also use other representations of NextGen as input to their research activities, such as scenarios (including degraded modes) and storyboards.

Recommendation: The Subcommittee recommends to the Director of Research and Technology Development a coordinated approach across FAA R & D efforts where the HFREG and, as appropriate, the new HF NextGen Integration Lead and other programs examining human factors concerns use the insights of the road map to create other representations that serve other important purposes. This would include fleshing out the job requirements of all important personnel sufficiently to identify key research needs, to ‘storyboard’ their future positions sufficiently to provide a common vision within HF research and to highlight concerns with assumptions about human roles in a sensible way to the community, and to identify programmatic and technical risks, redundancies, and gaps that require near-term action. To the maximum extent possible this effort should build on any NextGen descriptions developed

elsewhere within the FAA, both for efficiency and to foster coordination with, and transition of human factors results to, other NextGen research and development efforts.

Subcommittee on Aircraft Safety

General Observations

- The SAS believes that the Aircraft Safety R&D portfolio content is substantially correct, but remains concerned that several research programs lack a sufficient level of technical expertise to assure success.

- The SAS found no programs that should be eliminated.

- The extent to which FAA leverages the work and expertise of other government agencies, industry and academia continues to be an effective way to conduct relevant research.

- Specific Findings and Recommendations on individual areas of research reviewed and discussed by the subcommittee follow.

Finding: Aeromedical Research program (CAMI) is conducting research on the subject of human fatigue both from the human factors and aero-medical perspectives. The expertise at CAMI and the output from their research is an essential technical resource available to the FAA in support of recent and future rulemaking activities on pilot fatigue. The SAS understands that the Human Factors expertise at CAMI has been well integrated into this rule making activity. However there may be a gap in the coordination and integration with aero-medical expertise at CAMI with regard to their input to new rulemaking activities on fatigue. While this may be a unique case, it was not clear to the SAS that a sufficient process is in place to ensure that the in house FAA science community is integrated into the rulemaking process, in particular for future rulemaking to address human fatigue.

Recommendation: The Subcommittee receive a review on how FAA integrates its' in house technical expertise into the rule making process to ensure new rules are based upon and influenced by publicly available scientific findings.

Finding: AFS recently issued the first significant revision to pilot flight and duty time regulations in over 30 years. This regulation is science based and will require carriers to manage risk using SMS principles. It also permits compliance using a Fatigue Risk Management System (FRMS) for all or part of a carrier's operation. There are gaps in some of the scientific knowledge that must be filled in order to improve the effectiveness of the regulation. CAMI is currently providing oversight on industry funded research and data collection. CAMI, in conjunction with FAA, industry and labor has the expertise to either conduct this scientific research or provide oversight to fill the necessary scientific gaps. It is clear to the SAS that this new regulation will require research and data collection and that, to date there has been none requested by FAA to support this regulation for FY 10 and beyond.

Recommendation: AFS and CAMI meet with AVS as soon as possible to sponsor needed research to support the new pilot flight and duty time regulation

Finding: The Weather Research Program continues to deliver useful products. The subcommittee is impressed with the quality and relevance of the work and found the program to be tightly integrated with the research efforts of NCAR, NOAA (various laboratories) and MIT/LL. The program is also connected to the real world through partnerships with UAL, Delta and SWA.The Subcommittee supports the weather research program's focus on improving general aviation safety through enhancing forecast accuracy. However, the subcommittee notes the importance of balancing enhanced weather forecast information with developing tools and resources for improved pilot decision making to address the root-causes of GA weather accidents.

The Subcommittee noted the absence of a volcanic ash research effort. Following the meeting the Subcommittee received a copy of the FAA letter responding to a previous Subcommittee recommendation on this subject. The letter states in part ("…….With respect to ash plume detection and reporting to flight planners and flight crews for hazard avoidance, FAA has suspended research into those and other aspects of volcanic ash hazards pending a full review of the need for further research.").

Recommendation: Due to the significant disruption caused by the recent Icelandic volcanic eruption and the resulting activities led by ICAO to establish international guidance for operations in the vicinity of volcanic ash, the Subcommittee recommends that FAA identify and aggressively pursue any research needed to support these international discussions. This research may include the prediction or modeling of the movement and intensity of volcanic ash following an eruption, the provision of tactical information to flight planners and crews so they can effectively avoid hazardous areas with minimum impact on flight schedules, and identification of ash tolerance levels for aircraft, engines, and passengers.

Finding: The Subcommittee received an excellent briefing on the emerging details of a UAS Research Plan intended to support the milestones of the current FAA notional roadmap for UAS NAS integration and noted significant progress has been made in defining a clearer path towards certification and routine operation of UAS in the NAS. In light of the significant community pressure on the FAA to accelerate the safe integration of UAS into the NAS, the SAS questions whether the envisioned timeline would be acceptable. The SAS questions whether the resources currently devoted to research, engineering, and development is sufficient to address the complexity of the operational, technical, and policy challenges associated with the safe integration of UAS and whether the timeline could be accelerated if additional resources were available.

Recommendation: The Subcommittee recommends the following:

- The FAA should review UAS research requirements and the research plan in an attempt to match the integration timeline to the integration needs of the community.
- The FAA should reassess staffing and funding requirements for research, engineering, and development

Background: The Subcommittee noted in March 2009 that Software/Digital/ Systems R&D be given additional emphasis, increased staffing and funding. In August 2009 the Subcommittee noted the lack of a comprehensive and integrated Software/Digital Systems Project Plan and also noted that little progress had been made in acquiring the specialized expertise required to support this critical research program. In March 2010 the Subcommittee was pleased to note the development of an SDS comprehensive research plan which would provide a solid context against which research initiatives could be assessed.

Finding: Although the Subcommittee was pleased to see that the SDS Research projects were organized to address four significant research requirements, time did not allow for a comprehensive assessment to be accomplished. The SAS again noted that the level of specialized expertise to support this critical program is not yet in place.

Recommendation: The Subcommittee would like to do a "Deep Dive" review of the FAA integrated SDS R&D portfolio and recommends that this be accomplished in a one day workshop. The Subcommittee recommends that the one day workshop be convened prior to the next SAS meeting.

Finding: The descriptions and discussions under the four areas – Performance Based Navigation (PBN), Aircraft Performance in Terminal Area Operations, Simulation Model for Advanced Maneuvers, and Laser Safety – were relatively general. The briefing on PBN indicated that a primary focus of this research is to understand issues associated with operations in a mixed equipage environment. It was unclear exactly what information was needed from this research to allow it to move forward with the implementation of PBN in terminal airspace. What may be valid and focused needs were difficult to ascertain from the generalized briefings.

Recommendation: The Subcommittee would find it helpful if at the next review, the research efforts could be described specifically in a way that reflects actual needs of system implementers or regulation developers.

Finding: A stated objective of the Aircraft Performance in Terminal Area Operations research is to determine "what can be done to prevent unsafe landings and runway excursions." The Subcommittee noted that work to date has been focused on analysis of operational landings and modeling aircraft performance. The Subcommittee also noted that most of the focus of this research dealt with runway excursions due to contaminants (ice, snow, etc). Since many runway excursions result from unstable approaches (high, fast, long, etc) on dry as well as contaminated surfaces, the Subcommittee believes that the research needs to cover all causes, not just slippery runways. While program funding runs out in FY 10, deliverables that would result in solutions for reducing runway excursions are not at hand.

Recommendation: The Subcommittee recommends this project be refocused and funded to identify solutions to improve the safety of landing operations and reduce runway excursions from **all** causes.

Observation: The Subcommittee again finds the Fire Research and Safety Program to be relevant, well managed and directly responsive to current and emerging aircraft safety

requirements. It is an example of what FAA can expect from a world class technical staff, working in modestly funded world class facilities, producing world class and life saving results. This program clearly is a model for other research projects. It is important that this program continue to be adequately staffed and funded.

Observation: The Subcommittee notes that FAA continues to work with the US Army Research Laboratories to take full advantage of the Army's knowledge and HUMS fleet data to support the FAA effort of providing better guidance in maintenance credit determinations within the current AC. The SAS further notes the progress FAA has made in leading a collaborative effort to expand the Army effort to include OEMs, vendors and civil helicopter operators through HAS.

Observation: The Subcommittee continues to be concerned about the lack of a sufficient internal core capability and the lack of "bench strength" to support continued success in this safety critical area. The SAS finds the FAA responsive to past recommendations notes the continued good work being performed under the Aircraft Icing Program and looks forward to the research results being translated into regulatory guidance.

Observation: The Subcommittee notes the progress that FAA has made in the research program designed to ensure the structural integrity and durability in critical rotating engine parts in turbine engines throughout their service life and looks forward to the research results being translated into Advisory Circulars in 2014.

Observation: The Subcommittee continues to find that the research conducted by FAA in cooperation with industry, under the Transport Structural Integrity Metallic R&D Program, to be relevant and a good example of self funding through industry cost sharing and engineering support.

Observation: The Subcommittee noted the relevant and important research being done under the Continued Airworthiness Transport Program and further noted the research program as a good example of what can be accomplished with limited resources by leveraging the capabilities of research partners.

Observation: The Subcommittee continues to believe that the Small Airplane Directorate has a very tough task ahead to insure Continued Operational Safety (COS) for the >150,000 general aviation aircraft in the US. It is critical that FAA be able to collect the aging aircraft structural cracking data to support an adequate data based, reliable approach to COS for this fleet. The SAS looks forward to FAA's response as to whether these required data are best acquired through either a voluntary or mandatory reporting requirement.

Finding: The Subcommittee again emphasizes the need to support funding for FAA research facilities which serve not only FAA but are also resources for the world. It is important to ensure adequate funding and support not only for the modernization and operation of existing facilities but funding must also be provided to ensure that laboratories with required capabilities to support future research are available when needed. The subcommittee recognizes the difficulties in providing needed significant funding out of a limited Aircraft Safety R&D budget. The massive building program that transformed NAFEC into the FAA Technical Center in the mid 1970s is

an example of what can be accomplished when all elements of the FAA pull together and think "out of the box". The Pavement Test Facility is another example on a lesser scale of what can be accomplished with good planning and a commitment.

Recommendation: The Subcommittee recommends that FAA undertake a R&D Facilities Needs Review to answer the following questions:

- What facilities need to be upgraded?
- What facilities need to be replaced?
- What facilities are no longer required?
- What capabilities are required to address future requirements and when will they be required?
- Where should they be located?
- Costs and schedules
- Capital Investment funding Options
- Operation and maintenance options, private versus public

Finding: The Subcommittee remains concerned that several research programs lack a sufficient level of technical expertise to ensure success. Within the Aircraft Safety Program, the Software/Digital Systems Program, the Icing Program and Unmanned Aircraft Systems are examples of where there are needs for increased core competency.

Recommendation: The Subcommittee recommends that developing an R&D core competency and high quality R&D technical workforce continue to be a high FAA priority.

Observation: The Subcommittee commends the FAA on the development of a Research Project Performance Reporting Template designed to track the status of work planned for the coming month, problems or issues, plans for the next reporting period and status of planned financial obligations. The subcommittee suggests that, following implementation, the frequency of reporting be evaluated based on experience.

Finding: The Subcommittee believes it would be helpful for FAA and the industry to draw a clear distinction between two areas of R,E&D activity under its purview. Both are vitally important. The first areas are those in which FAA or its partners do the lead work in developing new knowledge – such as in icing, fire safety research, wake vortex issues, fatigue measurements, - and many others.

The other areas, equally important, are work efforts in which the basic work may have been done, or is being done in industry, but where FAA's efforts are needed to synthesize research of others to inform FAA of needed regulatory and processes, and where, this FAA expertise is essential. Some of this work may point to specific needed efforts of research.

Recommendation: The SAS believes it would be worthwhile for FAA to draw a clear distinction between the two areas of work so that both can be better understood and supported by the responsible and interested parties.