Research, Engineering and Development Advisory Committee

DRAFT FINDINGS & RECOMMENDATIONS – SUMMER/FALL 2017

OCTOBER 11, 2017

Subcommittee for Airports

2017 Summer – Fall Meeting Findings and Recommendations

The following findings and recommendations were developed during the Airports Subcommittee's deliberations.

Finding (1): Runway Braking Friction: The Subcommittee was pleased by FAA's reassessment of the Runway Braking Friction project as well as convening a working group of subject matter experts from with a broad range of technical expertise—including aerodynamics, aircraft systems, braking systems, and human factors—to re-scope braking research plans across FAA research programs. While the Subcommittee understands that these reassessment and expert review efforts are not complete, we would like to have a general idea of how the FAA believes needed braking research should proceed.

Recommendation (1): Runway Braking Friction: The Subcommittee encourages the FAA to complete its reassessment of its runway braking friction research projects as soon as possible, with a focus on the objective of providing a reliable, objective method of aircraft runway friction assessment that accurately accounts for the effects of runway contaminants impacts on aircraft performance. Following this reassessment, the Subcommittee would like to receive a revised runway braking friction research plan that addresses issues identified by the aforementioned runway braking friction working group. We also recommend that the runway braking working group report back its recommendations at the next Subcommittee meeting, and possibly to the full REDAC membership, time and resource permitting.

Finding (2): Heated Pavement. The Subcommittee was pleased to learn that use of heated pavements to mitigate frozen contaminants in airfield pavements may be possible at lower costs than originally thought. Given the increased likelihood the economic feasibility of heated pavements, the Subcommittee believes that some consideration should be given to the potential safety and operational issues associated with such pavements, particularly those that use electrical means to heat the pavements.

Recommendation (2): Heated Pavement. The Subcommittee recommends that the FAA consider safety risks associated with electrically heated pavements as well as the potential for electromagnetic interference associated with such systems and any effects the use of

ferromagnetic materials in pavement surface layers may physically have on tires, personnel, or the potential for foreign object debris.

Finding (3): LED Lighting Research. Some Subcommittee members expressed concern during FAA presentations on light emitting diode (LED) lighting systems research that LED runway edge lights do not emit light omni-directionally in the same manner as their incandescent counterparts, potentially making airfields equipped with LED edge lights more difficult for pilots to see at night.

Recommendation (3): LED Lighting Research. The Subcommittee recommends that the FAA expand evaluation of LED runway edge lights to include airfield conspicuity considerations.

Finding (4): Improving Awareness of Other REDAC Research Programs and Opportunities for Cross-Program Collaboration. Based in part on the discussion of research projects that involve other REDAC Subcommittees—including noise research that involves the Environmental & Energy Subcommittee, runway braking and runway incursion mitigation research that involves the Human Factors and Aircraft Safety Subcommittees, and air traffic automation research that involves the NAS Operations Subcommittee—members expressed an interest in increasing its awareness of the research within the purview of the other four Subcommittees.

Recommendation (4): Improving Awareness of Other REDAC Research Programs and Opportunities for Cross-Program Collaboration. The Subcommittee recommends scheduling briefings from either designated members of other Subcommittees or their FAA counterparts on research areas and/or projects that have implications for the Airport Technologies research portfolio during the Airports Subcommittee's meetings and notes that it has already been doing so successfully with the Environmental & Energy Subcommittee for the last 4 to 5 REDAC meeting cycles.

Subcommittee for Aircraft Safety

2017 Summer – Fall Meeting Findings and Recommendations

UAS Findings and Recommendations: The SAS greatly appreciated the initial presentation on the FAA UAS R&D Plan and commends the FAA's efforts. The plan is a comprehensive identification of research required to meet the different UAS implementation phases and the research being performed by FAA, other government agencies, industry and academia. While

we have not yet had the opportunity to review the plan itself, we understand that it identifies gaps in ongoing and planned research and required funding to cover the next 5 years. The FAA is to be commended for undertaking such an ambitious planning activity. We look forward to the opportunity to review the entire plan once it is released.

Finding (1): A significant portion of the FAA's research budget is being directed to the UAS COE. From the FAA's description, it appears that the majority of UAS research is in the form of university grants (i.e. the majority of the research is conducted by the UAS COE). Grants tend to be less driven by specific outputs and thus potentially less directed towards a specific practical aim or objectives of the applied research needs identified in the FAA UAS R&D plan. The subcommittee wonders whether the FAA is receiving full value from such research given the magnitude of the applied research identified in the plan.

Recommendation (1): The FAA should steer grants towards more goal directed research and should consider taking advantage of a contract vehicle to conduct more applied research at the UAS COE aimed at meeting the applied research objectives to identified in the FAA UAS R&D Plan.

Finding (2): The subcommittee noted that peer-reviewed UAS Ground Collision Severity Evaluation research is not being fully leveraged by AFS-800 in granting Part 107 waivers for UAS operations over people. A clear and closed loop connection between the research performers and the consumer of the research results appears to be lacking. The subcommittee senses that research results are not taken into sufficient consideration in UAS safety oversight, rulemaking and other actions required for achieving UAS integration into the NAS.

Recommendation (2): Through all stages of research activities, there should be tighter engagement among research performers and the FAA organization(s) that would leverage research results in safety oversight activities and rulemaking. FAA should consider how to best utilize existing structure to assure the maximum transfer of research learning.

Finding (3): The plan identifies a significant amount of required research and FAA indicated that there will likely be insufficient funds to conduct all of the research identified in the necessary timeframe.

Recommendation (3): The subcommittee recommends that FAA, together with its stakeholders, identify the minimum acceptable research results required to achieve each transition step and revise the plan accordingly. The FAA, together with its stakeholders should prioritize the research.

Finding (4): The advanced research that is ongoing to allow UAS to safely and efficiently integrate into the NAS can, in some cases, provide safety and efficiency benefits in the manned sector. While clearly there is direct applicability to highly automated manned aviation such as with the burgeoning "on-demand mobility" concept vehicles, this research can also inform more traditional forms of manned aviation including airline transportation segments. An example of this might be allowing the crew to take advantage of see and avoid concepts that might keep the aircraft a farther distance from large birds or other airborne conflicts.

Recommendation (4): The UAS research should place added emphasis on communicating research findings which can provide parallel benefits within the unmanned and manned aviation sectors.

Fatigue Mitigation and Research Finding and Recommendation

Finding (5): The committee received a follow-on briefing on the FAA's overall fatigue research program. The committee feels that this report described the existence of a wide-ranging fatigue research program within the FAA, and a strong interest in building follow-up research documenting the effectiveness of the FRMS/FRMP. The report identified an effective plan for moving forward which involved among other things, identifying research initiatives from around the industry, gaps in knowledge, and the establishment of fatigue working group with members from industry, research, and regulators to continue the necessary follow-up work needed to ensure required research is performed. The report stated that this working group will need a sponsor from the regulatory community to provide guidance and tasking for the working group.

Recommendation (5): The FAA establish a Fatigue Working group, identify an FAA working group lead who will best represent fatigue across the agency, execute the FAA plan that was presented as the path forward for identifying and addressing fatigue research issues, and properly implementing the research results. Follow-up studies of the effectiveness, utility, and potentially necessary enhancements of the FRMS/FRMP should be funded and implemented as soon as possible.

Subcommittee for Human Factors

2017 Summer – Fall Meeting Findings and Recommendations

Information Management: After reviewing the 2017 portfolio projects, tasks, and their status and outcomes the subcommittee supports the ongoing flight deck research being conducted and scheduled. However, the subcommittee identified several important gaps in the planned Human Factors research which the subcommittee deems high priority areas of research that should be reprioritized for FY18 and funded in subsequent years.

Finding (1): One gap in the Human Factors NextGen portfolio concerns Information Management. An important example of this is the impact of information overload on pilot workload and its consequences for distraction. Standards are needed to define what information may be pushed to or pulled by the pilot and when. Increasing information management demands for pilots, controllers, dispatchers, and traffic managers in NextGen operations will create human factors risks and vulnerabilities such as high workload, distraction, longer task time, and increase errors.

Recommendation (1): The FAA should review its HF portfolio for 2018, 2019 to include information management as a research focus area and ask planned projects as appropriate to address information management issues in their current project tasking. The 2020 research portfolio should include information management as a specific research focus area well above the "Mendoza line".

Consequences if not funded: Modern flight decks and the control stations for controllers, dispatchers, and traffic managers are rich information landscapes that demand user's process and manage information by acquiring, filtering, interpreting, and integrating relevant information, into a coherent understanding. If the information sources are difficult to monitor and verify or if appropriate information is not shared among collaborators in the same format in a timely fashion, several human factors issues may result. Users may over rely and trust automated systems because they don't have the capacity to interpret and verify outputs. Performing information management tasks such as organizing, filtering, and prioritizing information may distract from primary tasks (such as flight path management). Communication may break down and result in both errors and inefficiencies because collaborators don't have

the same information or don't interpret the information similarly because it is in different forms or formats. Primary tasks may take longer because additional information management tasks add task time but not direct value. If this research priority is not addressed, the significant changes in the information environment related to NextGen and beyond will likely increase existing human performance issues and introduce new ones that could reduce safety and efficiency thereby negating the expected benefits of NextGen.

Pilot Training: After reviewing the 2017 portfolio projects, tasks, and their status and outcomes the subcommittee supports the ongoing flight deck research being conducted and scheduled. However, the subcommittee identified several important gaps in the planned Human Factors research which the subcommittee deems high priority areas of research that should be reprioritized for FY18 and funded in subsequent years.

Finding (2): A major gap in the Human Factors portfolio related to Pilot Training. There are a number of important areas related to training for NextGen that include human factors issues that are not being investigated nor are they currently planned. These areas include distance learning, training methods, training effectiveness assessment, instructor/evaluator training, and situations with no checklist.

Recommendation (2): The FAA AVS should review and reprioritize the overall safety portfolio for 2018, 2019 to include research on pilot training issues to improve safety. The 2020 research portfolio should include training as a specific research focus area. For example, concerns about distance learning and training methodologies are already in the requirements but have not been funded and are high priority issues to the subcommittee. Training methods, such as competency based training and other methods need to be assessed and updated to meet current and future needs. What skills and knowledge do pilots need and how do we train instructors to ensure they are developed in pilots? We expect skills and knowledge to transfer, but how do we measure the effectiveness of training? Because we cannot train for everything how do we build resilience into the human component of the system, controllers and pilots, and into the system itself so that the humans are equipped to effectively manage the unexpected?

Consequences if not funded: Distance learning is already being used extensively by operators to replace other proven training methodologies without research being conducted to determine empirically if the distance learning method is effective. Safety and training data suggest that pilot knowledge and skills required for current and NextGen requirements is increasing and current training methodologies used to develop knowledge and skills may not be

as effective to meet NextGen system needs. The FAA currently provides guidance that allows for 100% of some knowledge based training to be done via distance learning using methods which some studies found to be only 10-20% effective. Research is needed to define realistic guidance on what types of distance learning delivery methods are effective for different types of knowledge and skills, how to assess effectiveness of distance learning after training completion, and the proper mix of distance learning with classroom and other methodologies. ICAO is supporting competency-based training and the U.S. has not funded the research to understand competency-based training and other proposed training methodologies. The FAA is participating in the ICAO working group with little or no research to back up their position. The working group work is scheduled to be completed by 2020, so the research needs to be started now.

Research to Reality

Finding (3): Next Gen applications such as, Trajectory-Based Operations and Dynamic RNP aim to enable both greater flexibility and efficiency. For such programs to realize the expected benefits, human factors principles and findings need to be included into the design of flight crew and air traffic displays, procedures, and other details of the complex operations. While significant human factors work has been conducted that relate to these applications and supporting technologies, such as Data Comm, a continual emphasis on the correct application of past research and human factors principles is needed as decisions are made on national and international procedures and guidance. While some of the relevant work had a specific program emphasis in the past (e.g., Data Comm), the total of the work that needs to be applied to ensure realization of expected benefits is broad and cross-cutting. This includes several 'lessons learned' that need to be considered to prevent situations that have resulted in rejection of new technologies by pilots and air traffic controllers. The application of this body of knowledge is the final step in the research process and required for the realization of the benefits of the research.

Recommendation (3): A vehicle or standardized processes is needed within ANG-C1 to enable the continual transfer of the results of both Core and Next Gen human factors research and the correct application of these results and human factors principles into the decision-making bodies of the standards and procedures of Next Gen operations. These include RTCA working groups, ICAO panels and ICAO working groups which develop and refine international standards and guidance materials and work toward global harmonization of such procedures. Such a vehicle would promote and ensure effective continual involvement of human factors in all

aspects of Next Gen operations from concept development through post- implementation. Post-implementation testing would assess effectiveness and identify whether refinements are needed to realize projected benefits.

UAS in the NAS

Finding (4): At the last meeting of the REDAC HF sub-committee, there were several presentations related to the FAA research plans for including UAS in the NAS. While significant progress is being made and some plans are yet in development, the sub-committee was disappointed that research in the areas of communication latency and message clarity between the various components, (ground station, ATC, Visual Observers and UAVs) and the human factors aspects of the communication latency was not seen as significant. Little or no research appears to be planned in this area. Understanding the latency requirements for UAS operating in the NAS is necessary in order to create acceptable standards. While there is some work being done looking at communication latency, the importance of the human aspects of that latency seems to be missing. Without sufficient research in this area, introduction of the UAS in the NAS has a high risk of not having sufficient communication speed and bandwidth to operate safely.

Recommendation (4): Ensure that sufficient research is planned and conducted on the human factors aspects of communication latency in the overall UAS research plan.

Consequences if not funded:

If research related to the human aspects of latency and communication is not conducted, the introduction of UAS into the NAS may result in lower safety margins as well as inefficient infrastructure design.

Subcommittee for Environment and Energy

2017 Summer – Fall Meeting Findings and Recommendations

The Environment and Energy (E&E) Subcommittee of the FAA Research, Engineering and Development Advisory Committee (REDAC) met in Washington, DC on August 1 – 2, 2017.

Following is a summary on the outcome of this meeting. The recommendations offered are all for inclusion in the REDAC report.

Finding (1): Members of the E&E Subcommittee are very aware of the budgetary constraints that exist within the Department of Transportation and the FAA. The Continuous Lower Energy, Emissions, and Noise (CLEEN) program, the Commercial Aviation Alternative Fuels Initiative (CAAFI) and the Aviation Sustainability Control (ASCENT) program are successful industry/FAA cost-share programs that leverage scarce FAA R&D funds that have accomplished significant advances and improvements for the industry.

Recommendations (1): The subcommittee recommends that the FAA continues to prioritize robust funding for the Public Private Partnership programs like CLEEN, CAAFI and ASCENT.

Findings (2): As has been highlighted in the past, there is serious concern over the number of vacancies that exist in the Office of Environment and Energy (AEE) and the increasing requests for answers. There are currently twelve (12) vacancies in AEE. In order for the dedicated employees within AEE to be able to properly manage the current portfolio, which we believe is well balanced, maintain the FAA's global leadership position in the International Civil Aviation Organization (ICAO), address the growth of other areas of commercial transportation and the development of smart policy, there is a need for answers. The answers to the many questions require the ongoing need for research.

Recommendation (2): In order to provide the research that is needed to properly address the increased tasking of the Office of Environment and Energy (AEE), the subcommittee recommends that the FAA commit the resources needed to hire additionally qualified individuals to be able to properly address portfolio needs. We would ask the FAA to not take away limited resources from current work in an effort to handle new work.

Finding (3): During the subcommittee meeting, the FAA presented information that indicates that there has been a dramatic increase in the level of interest in supersonic aircraft under the current Administration. There is also potential growth in unmanned aerial systems and commercial space vehicles. There is a significant amount of research that needs to be done in order to understand the environmental impacts of these new entrants. Research is the key to establishing sound policy. The FAA/AEE should ensure that its research plans will address the noise, emissions and possible health impacts of these new entrants such that the FAA can make informed decisions in carrying out their responsibilities under various statutes.

Recommendation (3): Based on increased interest in supersonic aircraft, the growth of unmanned aerial systems and the growth of commercial space vehicles, the subcommittee encourages the FAA to advance our understanding on the environmental impacts of these entrants.

Finding (4): The subcommittee is very pleased with the work done by AEE on developing a non-volatile particulate matter (PM) emissions standard and in the development of the Carbon Offsetting and Reduction System for International Aviation (CORSIA). In regards to the CORSIA, it is important that proper credit be given for the use of alternative fuels. The subcommittee is also pleased with the efforts of the FAA along with NASA to conduct and align research activities to inform the development of noise and emission standards for supersonic aircraft. The subcommittee believes that United States leadership in the ICAO CAEP process continues to be an important priority.

Recommendation (4): The subcommittee highly recommends that the FAA continue their commitment for all of the necessary programs to support continued U.S. leadership in ICAO CAEP. This includes the non-volatile PM emissions standard, CORSIA, alternative fuels and supersonic aircraft.

Subcommittee for NAS Operations

2017 Summer – Fall Meeting Findings and Recommendations

Commercial Space

Findings (1): The projected dates for NAS improvements to integrate Commercial Space in the NAS are based on the current commercial space research plan. The subcommittee believes that these implementation dates need to be moved to the left (i.e. come earlier) to deal with the significant growth in commercial space operations that the subcommittee anticipates.

1) There are a large number of R&D projects across the four pillars. The subcommittee believes that, with the available budget, many of these will not have enough funding to achieve meaningful results.
2) Some of the projects in the commercial space R&D portfolio don't appear to support commercial space operations integration into the NAS.

Recommendation (1): The subcommittee recommends that the Commercial Space R&D be prioritized and limited to those activities that directly support early integration of commercial space into the NAS. The most critical items (those necessary to ensure that as the number of space launches increases there will be as little impact on ATC as possible) must have sufficient investment. Lower-priority activities, such as those in pillar 4, should be stopped completely. The R&D plan should be revised to reflect this recommended prioritization, as these activities appear to be most appropriately the responsibility and obligations of the private sector.

Pathfinder Programs

General Observation

The subcommittee received briefings on the FAA's three Pathfinder Programs, namely CNN's Visual Line of Sight operations over people, PrecisionHawk's Extended Visual Line of Sight operations, and BNSF's Beyond Visual Line of Sight operations.

Findings (2): The Pathfinder Programs represent an excellent opportunity to both provide near-term access for specific UAS operations in the NAS while also identifying and providing data for key research issues that warrant further exploration. Although the subcommittee appreciates the complexity of integrating these UAS activities into the NAS, the pace of progress is significantly slower than required to satisfy the accelerating demand for airspace access. The processes used to approve airspace access in the current Pathfinder Programs will not scale up to meet the expected significant expansion in the scope of UAS operations that is needed. At the same time, there does not appear to be an established process for extracting research issues and linking them to other R&D efforts within the FAA so that they can be resolved. As a result, the Pathfinder Program risks falling behind the demand for access and failing to inform the FAA's UAS research roadmap.

Recommendation (2): The FAA should define a formal process for identifying and prioritizing research and development issues arising out of the Pathfinder Program and then conveying that information in a way that can be integrated into the UAS R&D plan. Each Pathfinder focus area should produce an ordered list of associated research questions that, if resolved, would validate the assumptions and constraints placed on operations and inform future UAS operational concepts. In turn, the FAA's UAS research roadmap should facilitate ingesting inputs from the Pathfinder Program and ensuring they are resolved through its ongoing research programs. The REDAC looks forward to reviewing these research issues and priorities at its Spring 2018 meeting.