



U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

[REDACTED]

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Dr. R. John Hansman, Ph.D.
Chair, Research, Engineering and
Development Advisory Committee
Massachusetts Institute of Technology
[REDACTED]

Dear Dr. Hansman:

Thank you and the Federal Aviation Administration's (FAA) Research, Engineering, and Development Advisory Committee (REDAC) for your April 15, 2022, letter providing recommendations for the Fiscal Year (FY) 2024 Research and Development (R&D) Portfolio. The awareness and knowledge of the dynamic aviation, aerospace, and related industry community subject matter professionals of REDAC promote excellent insight contributing to the successful implementation of various Research and Development (R&D) programs within the FAA. The important guidance generated during the REDAC Winter-Spring 2022 virtual meeting held on April 14, 2022, is much appreciated.

The Committee's assessment of the FAA's R&D portfolio relayed advice and guidance permitting FAA leadership teams to continue to leverage and develop aviation program policies while strengthening collaborations and partnerships from highly regarded influencers within the aviation and aerospace communities. Experts with proficiencies covering the spans of National Airspace System Operations, Aircraft Safety, Human Factors, Airports, and Environment, and Energy contributed to an invaluable review of the FAA's various research program areas.

We have reviewed the nineteen (19) recommendations submitted by the REDAC. The enclosed FAA Response Report reflects our Agency's replies to these recommendations. The FAA Response Report includes our dispositions for the total of 19 recommendations made by the five Subcommittees and authorized by the parent REDAC. The FAA concurs with eighteen (18) of the submitted recommendations. Two (2) of the eighteen (18) are with noted exceptions or clarifying comments. The FAA has identified efforts to address the partial concurrences and provided justifications for those suggestions that are unable to be fully completed at this time. We found one (1) recommendation, already a part of another program's requirement process. Therefore, the FAA Designated Federal Officials and I did not concur with the recommendation to include weather information needs for UAS service provider, Providers of Services for UAM (PSU), and operators as part of the Weather Technology in the Cockpit program.

**FAA Response to Research, Engineering, and Development Advisory Committee (REDAC)
Recommendations for the Fiscal Year (FY) 2024 Research and Development (R&D)
Portfolio**

Subcommittee on NAS Ops

General Observations: Overall Research Architecture and Swim Lanes - The Subcommittee received comprehensive briefings for the major portions of the FAA research portfolio, including components funded through Facilities and Equipment (F&E) and Research, Engineering, and Development (RE&D) lines. The Subcommittee acknowledges the FAA's great work in response to the evolving community needs and FAA's forward-leaning posture to address emerging Air Traffic Services challenges. The Subcommittee would like to receive a briefing on the Enterprise Architecture and the alignment of research activities to operational improvements, particularly those associated with the Info-Centric NAS vision. We are looking to obtain greater strategic insight into the alignment of the individual components and how they all fit within the overall strategic vision and research roadmap for the FAA.

Unmanned Aircraft System (UAS) Integration Research Coordination: The Subcommittee received a comprehensive overview of the UAS NAS Integration Research Plan, including the impressive portfolio of activities in the ASSURE Center of Excellence. The outcomes from this work appear to be highly relevant for strategies beyond small UAS aircraft operations to include the safe integration of large UAS and Advanced Air Mobility (AAM) aircraft into the NAS. The findings and outcomes of UAS research also have the potential to inform aspects of the FAA's future vision for an Info-Centric NAS, as this vision includes technology opportunities that are central to future UAS operations.

It was not clear to the Subcommittee how these UAS NAS Integration activities are connected with, coordinated, or informed other related RE&D efforts (e.g., UTM Implementation, wake research, and topics such as AAM weather needs). The Subcommittee requests informational briefing(s) that would provide higher-level visibility of the overarching RE&D roadmap that would illuminate the potential for value to be translated from UAS NAS Integration to other such projects. We also request a briefing describing the FAA view on the cross-coupling of the UAS NAS Integration outcomes into the vision for xTM and Info-Centric NAS capabilities.

Finding: Interactions between Conventional and Emerging Air Traffic Management Services - The Subcommittee received briefings on Unmanned Traffic Management (UTM), Upper-E Traffic Management, and Advanced Air Mobility. The Subcommittee believes the currently planned research and development activities and concepts are on track to address the near-term requirements of the user community. For example, the initial concept of operations for AAM vehicles using flight corridors may be sufficient for very early introduction of the AAM vehicles into the airspace. The UTM, ETM, and AAM airspace management systems are currently envisioned as standalone systems without a great amount of integration or interaction with the conventional NAS Air Traffic Services. However, increasing diversity, density, complexity, and volume of highly-heterogeneous vehicles and missions will eventually force more integration and interaction of the emergent vehicles and traditional aviation both in

controlled and uncontrolled airspace. Therefore, as more of these emergent vehicles enter operation, the UTM, ETM, and AAM systems will see the need to interact, exchange information, and even integrate with unconventional Air Traffic Services.

Recommendation 1: The NAS Operations Subcommittee recommends that the FAA clearly identify requirements for integration and coordination between emergent and conventional Air Traffic Services and develop and communicate near- and long-term RE&D plans to address these requirements.

FAA Response: The FAA concurs with the Committee's finding and recommendation and is undertaking the following actions to address its recommendation(s) - The FAA concurs that the interaction between the emergent and conventional Air Traffic Services (ATS) is important. What is also very important is that aircraft operate in only one Air Traffic Service at a time so that there is no confusion of roles nor an overload of conventional ATS services. This is already reflected in our concepts and research, which examine both the operations in the service as well as the transition of an operator's flight from one service to another. This includes information and coordination requirements. Other than Unmanned Aircraft Systems (UAS) Traffic Management (UTM), it is assumed that all aircraft need to be capable of operating in the emergent and conventional services.

Finding: **UAS Weather Research Coordination** - The Subcommittee received briefings on BLI A11.k Weather Program, A12.c Weather Technology in the Cockpit (WTIC), and A11.L Unmanned Aircraft Systems (UAS) Research. It is anticipated that UAS vehicles may be more susceptible to weather hazards than typical manned aircraft, and UAS service providers and operators may be less well trained in aviation meteorology than the typical general aviation pilot. Defining standards for providing effective weather information to UAS service providers and operators, and methods for those users to understand the implications of that weather information, will be important to maintain safe and efficient UAS operations. This, in turn, will require some research devoted to UAS weather sensing, translating weather data into operational impact, and weather information distribution.

The A11.k Weather Program includes initiatives specifically addressing UAS weather requirements, such as the use of the airport and off-airport observations to provide local weather information, urban micro-scale weather considerations, and the need to identify appropriate thresholds for alerting UAS operators of weather hazards.

The A12.c WTIC program includes research focused on general aviation operations. Activities include evaluating methods for informing pilots about weather hazards, the effectiveness of preflight weather briefings, and assimilation of non-collocated and varying-modality weather observations to generate weather products in regions not normally covered by airport weather sensing systems.

The UAS research plan described in the A11.L briefing covered a wide range of topics but did not include weather information among the various research efforts being pursued or planned.

Recommendation 2: The NAS Operations Subcommittee recommends that the FAA explicitly identify and integrate UAS weather considerations into its UAS research plan. Relevant efforts underway or planned in the Weather Program and WTIC need to be included within the UAS research roadmap and coordinated with other UAS research efforts. For example, ongoing UAS flight test campaigns offer valuable opportunities to collect or evaluate UAS weather information – this opportunity would be lost if there is no coordination between these research tracks.

FAA Response: The FAA concurs with the Committee’s finding and recommendation and is undertaking the following actions to address its recommendation - The Weather Program works closely with the FAA’s UAS Integration Office, coordinating all UAS/UAM weather research efforts. As part of this coordination, the Weather Program identified and submitted Research Needs for the UAS/AAM Integrated Research Plan (IRP) for the latest cycle (FY22-27). There are 60 explicit and/or implicit weather-related needs identified in the IRP. At the present time, there are two weather-related projects funded within A.11L that Flight Standards and the Weather Program have been heavily engaged with in coordination. Specifically, these projects are multi-year efforts that begin in FY22 to 1) Identify Weather Hazards for UAS and 2) Identify Weather Research and Knowledge Gaps in the Boundary Layer for UAS. These efforts address several of the needs of the IRP. Additionally, the FAA IRP team and the Weather Program are working with NASA to include NASA plans and work to address identified needs in the IRP, starting within the weather area.

Although no funding is being spent on this effort, the WTIC program is also assisting with UAS research efforts. WTIC personnel regularly attend and participate in the UAS Special Weather Action Team (SWAT) team meetings facilitated by the FAA’s Weather Community of Interest group. During these meetings, applicable WTIC research, which translates to UAS and AAM operations, is being presented. The UAS SWAT team has incorporated WTIC inputs, as applicable, in addressing their assigned problem statements. In addition, the WTIC Program has briefed their relevant research to multiple organizations working on UAS/AAM weather issues, such as the United States Helicopter Safety Team, as well as dispatchers and other stakeholders at Infoshare and similar meetings. The coordination between WTIC and various FAA and commercial organizations to address UAS/AAM weather-related issues will continue. This coordination has identified potential research areas to enhance safety relative to adverse weather encounters for General Aviation, so the coordination is beneficial to all parties.

Finding: WTIC Program Scope Relative to UAS Weather Considerations - In the past, the WTIC program scope has been limited to piloted general aviation applications and is only just starting to consider UAS weather information as a potential future area of its portfolio. Inasmuch as UAS operations may still involve a pilot or service provider interacting with weather information to manage the safe and efficient flight of an aircraft, similar weather research considerations may apply to both general aviation and UAS applications.

Recommendation 3: The NAS Operations Subcommittee recommends that the FAA expand the scope of WTIC research to include considerations of UAS service provider (USS) as well as Providers of Services for UAM (PSU) and operator weather information needs. Synergies between general aviation, helicopter operations, and UAS operations (e.g., operations in weather at a low level far from airport weather sensors) need to be exploited so that WTIC research has

application and value to all three communities. Just as WTIC is defining requirements for a minimum weather service for general aviation operations, similar requirements are needed for UAS (and more broadly, UAM) operations.

FAA Response: The FAA appreciates the Committee's finding and recommendation on expanding the scope of WTIC research to include considerations of USS, PSU and operator weather information needs. However, we are not able to pursue this recommendation at this time for the following reasons - All work recommended within this request are already being accomplished via an established requirements process led by the UAS Integration Office. Minimum weather standard determination and development are coordinated within the Weather Program and with other organizations including Flight Standards, who leverage the same processes and information used for minimum weather standard development for general aviation operations. Therefore, there is no need to expand the scope of WTIC research at this time.

Finding: WTIC Program Experimental Design - The WTIC program has initiated and conducted several experiments to explore potential improvements for weather information collection, processing, and dissemination to general aviation pilots. Examples include evaluating the use of video imagery of wind socks to estimate surface winds, or evaluating the use of augmented reality in pilot weather training exercises. Although these research activities are interesting and have potential benefits for general aviation, they do not appear to have been defined using a formal experimental framework including the identification of specific hypotheses and performance requirements with which to judge experimental outcomes. The use of a more formal experimental design framework would strengthen the impact of the experimental results and in turn lead to more effective transition into future operational products or systems.

Recommendation 4: The NAS Operations Subcommittee recommends that the FAA WTIC program enhance its rigor in defining and/or communicating specific research hypotheses when developing experimental projects. These hypotheses need to explicitly state performance metrics and acceptance thresholds by which the outcome of the experiments can be judged.

FAA Response: The FAA concurs with the Committee's finding and recommendation, and with the noted exceptions and clarifications intends to undertake the following actions to address its recommendation - As a clarification, though WTIC Program concurs that research questions and research hypotheses have not been presented to the NAS Ops REDAC, these artifacts are developed for each project. The FAA action plan to address the recommendation is the WTIC Program presentations will list research questions for Anticipated Research and Emerging Focal Areas in future briefings. In addition, at the next REDAC meeting, contractor developed research questions from one ongoing project will be presented as an example. If the REDAC Subcommittee would like to see more examples from a specific project, those will be presented upon request.

Subcommittee on Environment and Energy

General Observations: The Environment and Energy (E&E) Subcommittee of the FAA Research, Engineering, and Development Advisory Committee (REDAC) conducted its fifth virtual meeting on March 22 – 23, 2022, again due to the ongoing challenges that continue to exist because of the COVID-19 pandemic. There was another very good turnout of participants on the calls, but we are hopeful that our next meeting will be in person. With that being said, we anticipate that the next meeting will be a hybrid meeting, allowing individuals who cannot travel the ability to still participate.

The Subcommittee focused on reviewing the R&D portfolio for the Office of Environment and Energy that was developed based on the RE&D budget for Fiscal Year (FY) 22 that was enacted on March 15, 2022 (RE&D received \$246.5M). We were advised that the FY 23 budget had a request for \$260.5M for RE&D. During the meeting, the staff from the Office of Environment and Energy (AEE) provided updates on all of the major research projects within the portfolio. Work on programs such as the Aviation Sustainability Center of Excellence (ASCENT), Continuous Lower Energy, Emissions and Noise (CLEEN), Commercial Aviation Alternative Fuels Initiative (CAAFLI), and the Aviation Environmental Design Tool (AEDT) have been progressing. NASA also provided a comprehensive update on its programs. The updates highlighted accomplishments since our last meeting that have been realized both locally and on the international front directly linked to the ongoing research. We are seeing more and more presentations showing the very positive benefit of the different research projects that have been conducted over the years. Again, listing the individual accomplishments and their impacts on many of the different facets of aviation is not realistic during this presentation, but these accomplishments further validate the benefits and the need for sound research when developing regulations and policies, and procedures. The FAA Technical Advisor and Chief Scientist provided a comprehensive briefing to members of the full REDAC cadre during our last meeting.

Despite the ongoing COVID-19 impacts, the Subcommittee continues to be satisfied and very impressed with the job the leadership and staff of AEE have been doing. The presentations outlined a high level of communication between AEE staff and their partners to continue these necessary research efforts, but they also showed the continued challenges associated with COVID-19 restrictions and how they continue to impact some projects. We believe that many of the current restrictions will be lifted this year, and that should allow for greater interaction between scientists.

As was noted before, the current Administration has made a commitment to climate change and issued Executive Order 14008, which outlines its goals. It has a commitment to “reducing the aviation sector’s emissions in a manner consistent with the goal of net-zero emissions for our economy by 2050”. The government announced its intention to advance the development and deployment of sustainable aviation fuels and to maintain a leadership position at the world level with organizations such as the International Civil Aviation Organization (ICAO). The establishment and funding of the new Sustainable Aviation Fuel Grand Challenge aimed at dramatically increasing the production of sustainable aviation fuels are initiatives that demonstrate U.S. Leadership. We are happy to see that the Administration has solidified its commitment by providing additional funding that is already being used on research projects

specifically geared toward accomplishing these goals. We firmly believe that partnerships with other governments, other federal agencies, the Centers of Excellence, and private corporations who are involved in the research portfolios that AEE has in place are key to completing this mission and are the most effective vehicle to conduct and coordinate future research and maximize limited resources.

The Subcommittee believes that AEE is doing a very good job and has once again presented a balanced portfolio. We believe that the priorities that we had previously identified have not changed and that AEE has added research projects that address these priorities as well as those necessary to address the goals outlined by the current Administration. Many of these new projects have been added to the Continuous Lower Energy, Emissions and Noise (CLEEN) and Aviation Sustainability Center of Excellence (ASCENT) portfolios. The Subcommittee members realize that there is still additional research required to address ongoing areas of concern. We are happy to see the recent addition of staff to the group but believe that further evaluation of staffing needs should take place given the additional projects that are required in order to meet the goals outlined by this current Administration. The need to maintain a leadership position at the International Civil Aviation Organization/Committee on Aviation Environmental Protection (ICAO/CAEP) is still vital to the U.S. Aviation interest.

The results that have been accomplished by the projects in CLEEN 1 and CLEEN 2, as well as ASCENT, highlight the value of the Public/Private Partnerships that AEE has made an integral part of its research portfolio. Another advantage of these partnerships is that universities and hundreds of students have benefited from participation in these advanced research projects. The partnerships with the FAA have allowed universities to improve their facilities and capabilities and thus recruit better students to help improve the quality of the research being done in the USA. Many of the graduate students go on to play active roles within the aviation industry. The FAA had directly benefited by adding some of these graduates to their staff. The creation of a whole new industry as a result of the research done in the Sustainable Aviation Fuels (SAF) program has created jobs for individuals in the USA. Guided by the updates and presentations, the Subcommittee has proceeded with the following “Findings and Recommendations.” The recommendations offered are all for inclusion in the REDAC report.

Finding: Sustainable Aviation Fuels (SAFs) - We know that the Sustainable Aviation Fuel (SAF) Program [including efforts in the Commercial Aviation Alternative Fuels Initiative (CAAIFI), CLEEN, and ASCENT] is a critical component of the industry’s global emission reduction strategy. In order to meet the federal goals of increasing the production of SAFs to at least 3 billion gallons per year by 2030; and demonstrate new technologies that can achieve at least a 30% improvement in aircraft fuel efficiency, there will need to be an increase in the research projects within the ASCENT portfolio. We are happy to see that some of these research projects have already been added to the portfolio. The same can be said if we hope to develop fuels that can be blended above 50% in today’s fleet of aircraft. The current research has helped with the creation of a number of companies that have the potential to benefit the rural economies of several states and the U.S. Aviation industry. In February 2022, we have already seen 2.5M gallons of SAF used by the U.S. Aviation Industry. The establishment of the Sustainable Aviation Fuel Grand Challenge will ensure that the U.S. Government and the private sector are working together to address aviation sector emissions. The creation of the SAF MOU between

the DOE, DOT, and USDA will initiate and commit resources to the necessary research, development, and deployment. There are ongoing efforts to ensure that alternative jet fuels are in Carbon Offsetting and Reduction System for International Aviation (CORSIA) through the International Civil Aviation Organization/Committee on Aviation Environmental Protection (ICAO/CAEP).

Recommendation 1: The Subcommittee agrees with the mandate proposed by the current Administration that the work on Sustainable Aviation Fuels (SAF) is a critical component for the reduction of aviation sector emissions and supports the SAF Grand Challenge. Since the maturation of the Sustainable Aviation Fuel program will be a major environmental benefit for the public, will create a new industry within the U.S. that benefits rural America, and will benefit the U.S. aviation industry, we strongly recommend that the FAA AEE continues to allocate funds for the continuation of research on SAFs. We endorse what has been started but strongly recommend that AEE needs to accelerate this program in order to accomplish the goal of being able to supply 100% of the aviation fuel needed in 2050. The FAA must also maintain a leadership role in the development of SAFs to ensure that the rules to be considered at a global level (ICAO) will be beneficial to the U.S. industry.

FAA Response: The FAA concurs with the Committee's finding and recommendation and is undertaking the following actions to address it – The U.S. government and industry are both committed to achieving three billion gallons of SAF use by 2030. This will be critical to enabling the aviation industry to get onto a path to decarbonize by 2050. We in the FAA are working with DOE and USDA, as well as stakeholders from across government, academia, and industry, to develop a roadmap for SAF research, development, and deployment as required under the SAF Grand Challenge Memorandum of Understanding. We look forward to presenting extensive details of the roadmap at the SAF Summit, which will take place on the first day of the CAAFI Biennial General Meeting on June 1, 2022. While this roadmap is being developed, we are also continuing our long-standing efforts in ASCENT, CAAFI, and CLEEN to support SAF development through testing, analysis, and coordination activities. This includes taking a leadership role in leveraging the life cycle greenhouse gas accounting methods of the ICAO Carbon Offsetting and Reduction System for International Aviation (CORSIA), which were developed under the leadership of the FAA AEE, to inform how we can develop means of doing life cycle accounting domestically as required under the SAF Grand Challenge. With the enactment of the FY22 budget, we are standing up projects to support the certification and qualification of 100% SAF for use with today's fleet of aircraft and to continue our long-standing efforts to streamline the process of certifying novel fuels as being safe for use. We are standing up work to quantify how agricultural practices to sequester carbon can cost-effectively reduce life cycle greenhouse gas emissions. We are also working to extend our domestic supply chain efforts to other world regions to aid in the expansion of SAF production globally. Additionally, we are standing up work to understand the potential benefits of using SAF to reduce the impacts of aviation-induced cloudiness on the climate. To reach our goal of net-zero greenhouse gas emissions from the aviation sector by 2050, we will need to be able to use 100% SAF in our existing fleet of aircraft, and this SAF will need to provide a maximum reduction in climate impacts at a minimum economic cost.

Finding: Public-Private Partnerships - The Subcommittee continues to acknowledge and support the fact that the Office of Environment and Energy (AEE) has proven over decades to be very good stewards of taxpayer money. The leadership team at AEE has used their budgeted amounts to conduct and coordinate the research necessary to produce informed, data-driven policies, facilitate technological advances in the aviation industry, and produce models and data that have positioned the U.S. as both a State leader at ICAO/CAEP and on the global aviation stage. The execution of this research portfolio has been accomplished by working collaboratively with private industry, major universities through the ASCENT Center of Excellence, other Federal Departments, and Foreign Governments. Three-quarters of Environment and Energy research funds generate 100% plus cost matching from non-federal partners (CLEEN, CAAFI, and ASCENT). The results that we have seen in the CLEEN 1 and CLEEN 2 projects, as well as those in the ASCENT Center of Excellence, is proof that these partnerships clearly work. These partnerships leverage scarce FAA R&D funds to accomplish significant advances and improvements. In addition, we believe that government funding has been used and executed effectively to lower the risk of new and emerging technologies such that they can be adopted by industry. The research benefits of these partnerships have clearly been proven over time and is very apparent in the current projects. The maturation of new technologies has delivered improved environmental performance and has enabled aviation system growth and associated positive economic impacts. In order to comply with Executive Order 14008 on Tackling the Climate Crisis, there will be an increased reliance on these Public-Private Partnerships.

One of the benefits that have not been highlighted before is that these partnerships have created a new industry and new jobs in aviation. In addition, private industry, universities, and hundreds of students have benefited from the partnership with the FAA.

Recommendation 2: Whereas the Subcommittee continues to endorse Public-Private Partnerships like the CLEEN, CAAFI, and ASCENT programs to leverage resources, we believe that the FAA will not be able to accomplish any of the priorities set forth by the current Administration without allocating robust funding for these programs. The Subcommittee recommends that AEE utilize the additional funding that it has received in FY22 and any additional funding it receives in FY23 and FY24 on new and existing projects that will enhance and accelerate research to best address the current federal mandates. The Subcommittee endorses the establishment of new partnerships with other federal agencies similar to the one that exists with NASA as the key to success.

FAA Response: The FAA concurs with the Committee's finding and recommendation and is undertaking the following actions to address it - The FAA understands the importance of maximizing the impact of taxpayer dollars. By partnering with industry, academia, federal agencies, and foreign governments, we are making our research investments go further by leveraging our collective resources. By having universities in ASCENT work directly with industry partners, it increases the likelihood that the industry will use the research product to reduce noise and emissions. In addition to providing world-class research products that are helping address the environmental challenges being faced by the aviation industry, the ASCENT Center of Excellence is also creating the workforce of the future. Since 2004, the PARTNER and ASCENT Centers of Excellence have supported over 674 students. With the FY22 enacted budget, we have increased the ASCENT portfolio by over a factor of two to be over \$35M per

year. We intend to maintain this funding level with the FY23 President's budget. Of this amount, \$15M is dedicated to SAF research, and another \$10M is advancing technological innovation in the industry. By requiring cost share within CLEEN, we increase the likelihood that the industry partner will use the new technology to reduce noise and emissions. The FY22 enacted budget has doubled the size of the CLEEN Program to \$37.5M, and we intend to further increase that funding level to \$42M with the FY23 Presidents' budget. CLEEN, CAAFI, and ASCENT have all been successful because of their strong engagement with the industry. Each of these programs has had strong partnerships with and support from the industry for over a decade.

Finding: Global Leadership - Despite the fact that the FAA AEE currently maintains a leadership role in the International Civil Aviation Organization/Committee on Aviation Environmental Protection (ICAO/CAEP) and has been the driving force behind the push for data-driven rulemaking, based on the commitments made by the current Administration on Climate Change, the Subcommittee firmly believes that maintaining the U.S. global leadership position at ICAO/CAEP is essential and advantageous to U.S. aviation industry and will allow the U.S. government to defend its positions based on scientific research. Previous work that has been done with ASCENT and the Volpe Center has clearly allowed the FAA to maintain a scientifically supported position at ICAO/CAEP. The close collaboration with NASA at ICAO/CAEP is also clearly supporting global leadership. Anything that jeopardizes ongoing research at AEE will impact the FAA/U.S. global leadership position at ICAO/CAEP. The FAA's ability to attend in-person meetings and represent the U.S position regarding international policy making at the international level is essential.

Recommendation 3: The Subcommittee recommends the continuing strong support of all research efforts/programs that will allow the FAA and the U.S. to maintain their current global leadership position at ICAO/CAEP. It is the belief of the Subcommittee that if the FAA/U.S. does not maintain its leadership position at ICAO/CAEP, it will not be able to influence policy/rulemaking, and this could have a significant negative impact on the U.S. aviation industry.

FAA Response: **The FAA concurs with the Committee's recommendation and is undertaking the following actions to address it** - The FAA appreciates the support of the Subcommittee for our ICAO CAEP activities and the importance of continued U.S. leadership therein. We have made considerable investments over the years to support the work of ICAO CAEP, and that continues today, as FAA leadership is critical to securing U.S. objectives at ICAO. ICAO relies on FAA-funded research and analyses to inform its environmental work. Research efforts led by FAA AEE will be central to the deliberations that will be taking place leading up to and through the ICAO Assembly on a long-term aspirational goal for international aviation CO₂ emissions. Much of this analytical work was done by ASCENT COE universities and the Volpe Center, under the direction of FAA, in close collaboration with NASA and industry. Our efforts have also been critical to how SAF is credited under CORSIA, and we expect our SAF research to take on additional importance within ICAO. We have stood up two new ASCENT projects to support CAEP standard-setting efforts. These projects will help us understand the opportunities to reduce aircraft noise and carbon dioxide emissions through the standard-setting process, as well as explore metric systems that could be used to control full-flight nitrogen oxide emissions. These new projects will enable us to provide intellectual

leadership to the international community as we seek means to reduce noise and emissions from aircraft. We are also continuing to fund research to support the development of noise standards that would enable the introduction of drones, advanced air mobility vehicles, and supersonic aircraft.

Finding: Noise Research - Aviation noise is and will continue to be one of the biggest environmental impacts related to the aviation industry, and it requires ongoing research in order to address the concerns of the citizens. Despite the fact that we have learned a lot based on the results of many of the projects in the “Noise Portfolio,” the Subcommittee’s position on noise has not changed in that there is much research that is still necessary to address the ongoing topic of aviation noise. Whether there are new technologies or new procedures that can be implemented to help reduce the impacts of noise as the aviation industry rebuilds needs to be evaluated. Historically, advances in aircraft technology have been the major factor in reducing aviation’s environmental impacts. The Subcommittee recognizes that there is about a seven (7) year lag between flight testing of technology and its appearance in the fleet. Therefore if we want to consider any new technology being introduced into the fleet in early 2030, we need to invest in the research now. The use of government resources during the initial research stages helps mitigate technology risk and incentivizes private companies to invest and develop cleaner, quieter technology. AEE has seen a number of research projects that have contributed to more fuel-efficient and quieter aircraft. They have also developed new operational procedures that have reduced the noise impacts in communities in and around airports. There are a number of new research projects that have been added to address issues related to new entrants into the aviation system. Many of these new entrants will be active participants in our airspace in the not-too-distant future. There also have been significant upgrades made to the Aviation Environmental Design Tool (AEDT). AEE has established an AEDT User Review Group for ideas and feedback in order to ensure that the tool is beneficial to the actual users. FAA has also launched an initiative to partner with airports to gather more noise data resulting from noise complaints. Finally, AEE is working with the industry to accelerate the development of technologies that reduce noise through the Continuous Lower Energy, Emissions and Noise (CLEEN) Program.

Recommendation 4: The Subcommittee once again recommends the continued prioritization of noise research and the prioritization of the projects that will support informed decision-making as it relates to the introduction of new entrants to the national air space.

FAA Response: The FAA concurs with the Committee’s finding and recommendation and is undertaking the following actions to address it - The FAA is committed to developing meaningful and equitable solutions to address the complex and nuanced issue of aviation noise. We are continuing to execute the research program that was captured on January 13, 2021, in the Federal Register notice (Overview of FAA Aviation Noise Policy and Research Efforts). This includes research not only on the fleet of existing fixed-wing aircraft and helicopters but also on unmanned aircraft, advanced air mobility, and supersonic aircraft. We also have a number of research projects within ASCENT to improve the noise modeling of AEDT in areas well outside of the DNL 65 contour that is laying the foundation for AEDT version 4. Further, we are expanding our noise research effort on a number of fronts. We are working on expanding the research efforts of the team at U. Pennsylvania to examine how broadband sounds could help to

mitigate sleep disruption due to aircraft noise. Further, we are looking to continue and expand the long-standing work of Boston University to understand the potential health impacts of aviation noise exposure. Finally, with the expansion of the work of the CLEEN Program, we will be able to support additional work to accelerate the development of technologies to reduce noise.

Finding: Staffing - Given the mandates and financial support from the current Administration for climate change and increased Sustainable Aviation Fuels (SAF) production, AEE has added a number of new projects to the portfolio. The Subcommittee has concerns that they are not sufficient to subject matter staff to handle and manage the increased workload. AEE needs to carefully examine its staffing to ensure that it has sufficient staff to support the expansion of public-private partnerships and planned future projects.

Recommendation 5: The Subcommittee strongly recommends that the FAA and AEE carefully examine the workload on its current staff and ensure that it has sufficient staff to support the additional projects that have been added to the portfolio.

FAA Response: The FAA concurs with the Committee's finding and recommendation and is undertaking the following actions to address it – With the increased funding for the Environment and Energy portfolio, the FAA will need to bring on additional RE&D personnel to oversee the work. Over the past few years, we have had 16 personnel supported by the RE&D funds within the Environment and Energy R&D portfolio (these are on top of operations-funded personnel who also work within the Office of Environment and Energy). In line with the recommendation, the FAA is expanding the number of personnel supported by RE&D funds, with three new personnel being added in the spring of 2022 and one to two more personnel being potentially added over the remainder of 2022. These individuals will focus on research efforts related to sustainable aviation fuels and technology development.

Subcommittee on Aircraft Safety

Finding: Artificial Intelligence and Machine Learning Technologies - The industry is researching the introduction of Artificial Intelligence (AI) and Machine Learning (ML) technologies into many different aircraft systems and has a need for regulatory guidance from the FAA on the use of these technologies in a safety-critical context. The REDAC Subcommittee on Aircraft Safety (SAS) finds that the Digital System Safety (A11Ds) FY22-27 Research Plan only funds two AI/ML research activities for the first time in FY24, and two AI/ML research activities are unfunded in any fiscal year. The REDAC SAS agrees that research results are needed by FY25 (or sooner), as shown in the Digital System Safety (A11Ds) FY22-27 Research Plan. The REDAC SAS finds that the four AI/ML research activities do not clearly define a Roadmap for when the industry can anticipate incremental releases of AI/ML regulatory guidance. The roadmap should show how the benefits of AI/ML can be realized for safety-critical applications and the evidence needed to ensure that the intended function is performed.

Recommendation 1: The REDAC SAS recommends that the FAA prepare and publish a phased roadmap for AI/ML research and development required to formulate AI/ML regulatory guidance. The AI/ML roadmap should inform the industry on the sequence in which the FAA plans to

release regulatory guidance on methods and procedures to (1) certify systems of various Design Assurance Levels (criticality), (2) certify AI/ML-based on various types and sources of AI/ML training and testing data, and (3) procedures for updating AI/ML models in previously certified systems based on updated training and testing data sets. The REDAC SAS recommends that the FAA consider the *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap, Appendix A: UAS Integration Research & Development Plan* as a template for following in developing an AI/ML Research & Development Plan.

FAA Response: The FAA concurs with the Committee’s recommendation and is undertaking the following actions to address this recommendation – The FAA agrees that there is a need to develop regulatory guidance on the use of AI/ML in aviation applications. For this reason, the FAA and NASA have been working collaboratively to develop an Autonomy V&V Vision 2045, with an associated roadmap, which will be reported when available.

Recommendation 2: The REDAC SAS recommends that the FAA place a priority on continuing to make points of contact/ government authorized representatives available to participate in AI/ML standards developing organizations activities, such as SAE G-34 /EUROCAE WG-114, Artificial Intelligence in Aviation, to facilitate a more rapid exchange of information on AI/ML technologies and related-certification issues between the FAA, industry, and academia. It is further recommended the FAA continue its strong collaboration with the DARPA Assured Autonomy and Air Force Agility Prime programs.

FAA Response: The FAA concurs with the Committee’s recommendation and is undertaking the following actions to address this recommendation – There has been continued involvement in the SAE G-34 activities, and as of this writing, AIR plans to continue to provide participation in the working group activities. Also, as of this writing, the FAA plans to continue the successful collaboration with DARPA Assured Autonomy and Air Force Agility Prime programs.

Recommendation 3: The REDAC SAS recommends that the FAA include in its research how run-time assurance methodologies can be certified and used in conjunction with AI/ML assurance to ensure safety.

FAA Response: The FAA concurs with the Committee’s recommendation and is undertaking the following actions to address this recommendation – The FAA has been working on the run-time assurance concepts, and it has been evolving over time. The preliminary research work was published (see URL: <https://ntrs.nasa.gov/citations/20200003114>) on the concepts, and detailed implementation methodologies are under consideration in one of the ongoing research with Boeing. Collaboration with NASA is continuing where research on the topic is ongoing. The current research outputs will be presented at the REDAC Subcommittee on Aircraft Safety Summer/Fall 2022 Meeting with the rest of the fiscal year 2022 safety R&D portfolio accomplishments.

Finding: FAA Aeromedical Research - The REDAC SAS notes that the FAA is conducting valuable aeromedical research into genes and genetic markers as they relate to fatigue states and

postmortem analysis. Industry and the DoD are conducting research into the safety and operational value of sensors (wearables and others) and technology to predict and monitor pilot fatigue, workload, incapacitation, and other indications of human performance. The industry is also researching the use of sensors in the cockpit to assess pilot fatigue, drowsiness, and sleep conditions. The REDAC SAS believes that, when mature, these technological advances have the potential to dramatically enhance safety in aspects of civil aviation. FAA research into pilot state monitoring and interrelated changes to cockpit automation technologies that may affect aircraft automation and control should inform the development of appropriate flight standards.

Recommendation 4: The REDAC SAS recommends that FAA Aeromedical, Human Factors, and Flight Standards regulators and researchers develop a joint RE&D plan together with industry and additional relevant U.S. Government agencies to address the introduction of pilot state monitoring technologies related to decision-making algorithms and automation technologies into the cockpit. The plan should include the development of flight standards and airworthiness criteria for these AI-based and other safety-enhancing systems, which will interact with pilots' physiology and psychology during the flight in new and potentially intrusive ways. The research should determine the potential benefits, as well as possible hazards of pilot state monitoring and related cockpit automation technologies and potential effects on current regulatory requirements for flight and duty times, crew operations, and crew complement.

FAA Response: The FAA concurs with the Committee's finding and recommendation and is undertaking the following actions to address its recommendation(s) - The FAA recognizes the technological advancements in human state monitoring and potential applications in aviation to improve operational safety. AAM, AIR, and AFS will co-sponsor an operational capability in the FY23-28 Human Factors Budget Line Item (BLI) Plan addressing pilot physiological state monitoring technologies and mitigations. Data-driven guidance based on the research findings will be added to existing regulatory and guidance material as appropriate and will support aeromedical certification special issuances and operational suitability evaluations. This operational capability and associated research questions will be presented at the REDAC Subcommittee on Aircraft Safety Winter/Spring 2023 Meeting with the rest of the FY25 R&D Portfolio and FY23-28 BLI plans.

Finding: Future Complex Innovative Technology Design - The 2022-2027 RE&D Portfolio for Digital System Safety (A11Ds) identifies the challenges of balancing the complexity of innovative technologies with the ability of traditional software development processes to validate the safety designs and implementation of those technologies. However, there is not a clear roadmap that identifies whether the focus of future research is on the development of new software processes or if it is focused on the evaluation of architectural performance and results.

It is also not clear what is defined by non-prescriptive based evidence. While the SAS agrees that further research is required to develop alternative means of software assurance for the lower end of the safety continuum, there may be platforms where this may or may not be acceptable based on the risk criteria of the operations. Identifying specific use cases would be beneficial to ensure the usability or applicability of any alternative means of assurance so that applicants design their software to meet the appropriate levels of compliance.

The SAS further finds that the identified research output of developing a new mechanism to map risks and development approaches is unclear in the context of currently issued FAA software assurance guidelines for durability and reliability means of compliance and airworthiness for categories 1 and 2. This current FAA guidance, coupled with ongoing software standards development activities, which are scheduled to be completed in 2023, makes it uncertain as to the timing of this research activity that is not programmed until FY2024. More recognized and supportive software performance standards currently in development will be enhanced by FAA research into new and novel methodologies.

Recommendation 5: The REDAC SAS recommends that the FAA more clearly defines the focus and applications of this research output in terms of software development, hardware evaluations of performance, validation and verification of complex systems, and platform applicability.

FAA Response: The FAA concurs with the Committee’s recommendation and is undertaking the following actions to address this recommendation – The research on alternate means of compliance is ongoing. The Overarching Properties research is a non-prescriptive assurance, technology-independent, and domain-independent assurance case-based approach. Research on the use of Overarching Properties is being conducted with NASA’s collaboration. Additional case studies are being proposed to evaluate the effectiveness of assurance case-based certification. While the case studies are evaluated, further work should consider the development of a framework so that these alternate means can be applied uniformly and consistently. There currently is ongoing work relating to the estimation of worst-case execution time using AI to better predict when deadlines would be missed. Essentially the AI system is predicting outliers that are difficult to detect using traditional measurement techniques.

Recommendation 6: The REDAC SAS recommends that this research activity be conducted before FY2024 so that the results can influence current FAA certification guidance and industry software development standards work that is already in progress.

FAA Response: FAA concurs with the Committee’s recommendation and, with the noted exceptions and clarifications, intends to undertake the following actions to address its recommendation – This is highly specialized work. Work is already progressing in several standards organizations in which FAA already participates. If the conditions are right for accelerating timelines, the FAA will adjust the five-year plan and Operational Capability to reflect an early start. However, research results cannot be guaranteed, and neither can expected implementation products. Research needs will be balanced against the maturity of deployment and the needs of the industry and authorities.

Subcommittee on Human Factors

Finding: Office of Aviation Safety Human Factors Research Roadmap - The Subcommittee for Human Factors received a briefing on the initiation of the Office of Aviation Safety (AVS) Human Factors Research Roadmap. The Subcommittee was pleased with the presented construct

and description and applauded the FAA's efforts. The proposed roadmap consolidates the core and NextGen flight deck Human Factors research portfolios and expects to catalog and track the breadth of Human Factors research within AVS. This effort to date is promising and provides value to the Agency.

By providing a holistic view of Human Factor issues and progress toward solutions, AVS can more efficiently make decisions regarding Human Factors research investments. The AVS Human Factors Research Roadmap will reduce the probability of duplicate efforts and allow for important linkages to operational capabilities and policy to be salient within AVS. It will become an important document that can be used by AVS and human factors personnel within AVS.

Having the roadmap signed at the proper level within the FAA would provide the level of visibility and support needed. In our opinion, the AVS Human Factors Research Roadmap is a key document that the senior executives within the FAA's Aviation Safety organization, including AVS-1, should endorse and support since the roadmap was developed by AVS and has the support of AVS Human Factors personnel.

It should be noted the AVS Human Factors Roadmap only addresses the Human Factors research initiatives that support AVS. It does not address Human Factors research that supports the FAA's Air Traffic Organization (ATO). At some point in the future, it may be helpful to have a Human Factors roadmap that addresses research that supports both AVS and ATO. However, the REDAC recognizes this is a significant level of effort and coordination that is required to sign and share this document and recognizes generating an expanded document is not feasible at this time.

Recommendation 1: The Subcommittee recommends that the AVS Human Factors Roadmap development be continued and sent to AVS-1 for signature. The FAA is also encouraged to develop a similar Air Traffic Organization Human Factors research roadmap so that the Subcommittee is able to understand the full range of planned Human Factors research across both the FAA's Aviation Safety and Air Traffic organizations, to enable effective strategic planning.

Consequences: Without the AVS Human Factors Research Roadmap, it will continue to be difficult to obtain information about the individual projects, or understand interdependencies and synergies between projects, because the projects are currently spread across multiple BLIs. The FAA and REDAC will be challenged to provide strategic guidance and to plan to keep moving forward. It will also be more difficult for advisors and industry partners to provide meaningful feedback across the entire AVS human factors research portfolio. Without similar efforts within the FAA's Air Traffic Organization to develop an ATO Human Factors research roadmap, it will continue to be difficult to develop a big picture view and a plan for prioritizing and promoting important Human Factors research efforts.

FAA Response: The FAA concurs with the Committee's findings and recommendation and is undertaking the following actions to address its recommendation(s) - The FAA Office of Aviation Safety (AVS) will continue to develop the draft HF research roadmap with the intention of publishing it for public access. The publication will require the management's signature. At

the next HF Subcommittee meeting (Summer/Fall 2022), AVS will provide updates on the document maturity and management support, including an update on the document within the FAA coordination process. Additionally, the Air Traffic Organization (ATO) and the NextGen Human Factors Division (ANG-C1) will provide an overview of the FAA Enterprise Architecture Human-Systems Integration Roadmap.

Finding: Use of Immersive Technologies for Workforce Training - Several FAA research projects are investigating the issue of required cognitive and psychomotor skills and their degradation. These projects are identifying which skills are required, the maintenance of skills, which skills have the potential for degradation, and the impact on operational efficiency and safety. However, the research did not completely investigate how to develop and maintain proficiency or how to return the worker to proficiency once the skills have degraded. Immersive technologies such as Virtual Reality (VR) and Augmented Reality (AR) have rapidly advanced in recent years and might be useful for developing or maintaining certain skills currently exercised in other training devices. It is not clear if the FAA has the information needed to provide effective guidance and approval for advanced training technologies.

This research could also provide the FAA input to develop guidance for authorizing the use of new technologies such as VR and AR towards accreditation in training programs. This would enable operators to use immersive training technologies where and when appropriate to efficiently train the workforce to develop and maintain specific critical skills and to assess if personnel can apply these skills in operational use, especially after long gaps in exercising those skills. Advanced technologies such as VR/AR can be useful for different domains of aviation such as flight operations, technical operations, ground operations, cabin environment, dispatch, etc. Some precedence exists for VR applications: for example, the European Union Aviation Safety Agency (EASA) granted the first certificate for a VR-based Flight Simulation Training Device in April 2021. This device is intended for rotorcraft pilots to practice risky maneuvers in a virtual environment. (See <https://www.easa.europa.eu/newsroom-and-events/press-releases/easa-approves-first-virtual-reality-vr-based-flight-simulation>)

Recommendation 2: The Human Factors Subcommittee recommends that the FAA conduct research to explore immersive technologies for training such as VR and AR for developing proficiency, maintaining proficiency, enhancing training, and bringing workers' skills back to standard proficiency levels after periods of skill degradation.

Consequences: Without leveraging new technologies to develop and maintain skills, the industry may experience inefficiencies with current traditional methods. Without proper research to understand the effectiveness of immersive training technologies, the FAA might have to delay approval of such devices until adequate guidance is available, especially for new entrants into the NAS.

FAA Response: The FAA concurs with the Committee's findings and recommendation and is undertaking the following actions to address its recommendation(s). The FAA has begun to explore opportunities for the use of immersive technologies for training. As an example, current research for the Office of Aviation Safety is expected to provide recommendations in 2022 to examine modern training practices by air carriers and help identify which pilot skills, knowledge, or tasks are appropriate to these methods. At the next HF Subcommittee meeting

(Summer/Fall 2022), FAA will provide a summary of this research and other research across the Agency related to training with immersive technologies, as well as assessments on the research applicability towards developing/maintaining operator proficiency, including after periods of skill degradation.

Finding: Human Factors Research for Unmanned Aircraft Systems Beyond Visual Line of Sight -The HF Subcommittee received a briefing on the recently released Unmanned Aircraft Systems Beyond Visual Line of Sight Aviation Rulemaking Committee Final Report. In the report, recommendations were made in five areas: establishment of acceptable levels of risk for UAS operations; modifications to the right of way rules; recommendations for operator qualification; recommendations for qualification of UA and UAS; and recommendations for a regulatory scheme for non-mandatory use of third-party services.

The Committee recognizes that there are unique challenges within the FAA's existing regulatory framework posed by these types of operations. In that regard, the REDAC would like to better understand how Human Factors considerations for human operators are being addressed in the recommendations on determining the acceptable level of risk, operator capability to safely handle more than one vehicle at a time, operator qualifications, the design of ground control stations and supporting automation, and coordination across operators using third-party services. This request is in part driven by a recognition that, in the case of UAS, (1) control stations are not part of the aircraft, and (2) current proposals assume that ATC will not be responsible for managing such aircraft.

The Subcommittee sees a need for standards and guidelines for UAS control stations to ensure the safety of operations. However, most of the development is being driven by industry. Guidance from standards organizations, such as ASTM and RTCA, may not be incorporating Human Factors considerations sufficiently. Although FAA has provided overviews of UAS Human Factors research at prior meetings, the UAS Beyond Visual Line of Sight (BVLOS) ARC Report has illuminated several potential UAS research gaps.

The Subcommittee recognizes that Human Factors considerations normally identified and addressed in aircraft certification are being moved from the traditional aircraft certification process into the operational approval process, which is new to the FAA. What standards or guidance will the FAA use for operational approval, including control stations? Research is needed to inform the development of standards and policies for operational approval.

Recommendation 3: For UAS BVLOS aircraft and operations, the FAA should leverage past Human Factors research on manned and unmanned aircraft, including controls and displays, system behavior, and alerting. The Subcommittee recommends that the FAA define specific new research to establish Human Factors guidance and inform the operational approval of UAS control stations for BVLOS operations.

Consequences: Lack of UAS information controls/displays standardization may lead to confusion, increased training, and other factors which may affect safety.

FAA Response: The FAA concurs with the Committee’s findings and recommendation and is undertaking the following actions to address its recommendation(s) - The FAA will continue to coordinate cross-agency research through the UAS Integration Office (AUS) and is in the process of reviewing the BVLOS ARC report. A significant portion of prior manned and unmanned aircraft HF research products are available to inform UAS approvals in general. Initial BVLOS operations may require new guidance and associated research to support operational approval (vs. design approval) of control stations. Therefore, FAA HF specialists will discuss BVLOS HF research needs with the Office of Aviation Safety (AVS) Flight Standards organization, including the Aircraft Evaluation Division, which is responsible for operational approvals of UAS control stations. At the next HF Subcommittee meeting (Summer/Fall 2022), FAA will provide an update on research plans to support BVLOS UAS operational approvals.

Subcommittee on Airports

General Observations: The Airports Subcommittee remains supportive of the Program’s ongoing work and future research directions, which continue to emphasize foundational research to support (1) advisory circulars and design guidance promulgated by the FAA Office of Airports; (2) airport capital improvements currently eligible or prospectively eligible for federal grant funding under the Airport Improvement Program; and (3) U.S leadership in areas of airport safety, planning, and airport infrastructure, airfield pavements in particular.

The briefings from the complementary research programs— Airport Cooperative Research Program (ACRP), Airport Asphalt Pavement Technology Program (AAPT), and Airport Concrete Pavement Technology Program (ACPT)—provided useful information about the scope of these three projects research efforts. The Subcommittee appreciated the efforts from both pavement research programs to identify emerging paving and pavement testing technologies and develop research proposals to meet them. The Subcommittee plans to invite representatives from the three programs to provide updates at our future meetings to assess progress, avert potential research duplication, and evaluate areas for collaboration among the programs. We appreciate FAA’s continuing focus on time-critical research projects. These include evaluation of alternative aircraft firefighting agents, assessment of uncrewed aircraft system (UAS) applications at airports, and development of initial vertiport design criteria.

With respect to firefighting research, the Subcommittee previously expressed its concern and disappointment that the FAA’s evaluations of PFAS-free firefighting agents had not identified agents capable of meeting current FAA and Department of Defense (DoD) performance standards.¹ Since the Fall 2021 meeting, the FAA and DoD have made additional progress in their respective firefighting agent research programs. Most notably, the DoD has developed a draft specification for what it has termed “fluorine-free foam” (F3) that the FAA plans to utilize in its firefighting agent requirements and guidance. Representatives from the ad hoc firefighting expert group that the Subcommittee recommended forming two years ago have assisted in the initial review of this specification. The Subcommittee looks forward to broader industry review

¹ Current DoD performance specifications necessitate use of firefighting foams that contain per- and polyfluoroalkyl substances (PFAS), a class of chemical compounds that is bio-accumulative, persistent, and have been linked to adverse health impacts in humans and animals.

of the proposed specification and subsequent guidance from the FAA regarding how airport operators can transition from current aqueous film-forming foams (AFFF) that contain PFAS to F3 consistent with our prior recommendations.

The Subcommittee is also pleased to see several research efforts come to fruition in the form of revised software tools and/or industry guidance. Notable among these is the finalization of the latest version of FAARFIELD pavement design software and the publication of vertiport design standards in the form of draft FAA Engineering Brief 105.

Finding: Construction Cost Inflation - Construction cost inflation is affecting planned pavement testing facility improvements, notably the new pavement materials laboratory, which the Subcommittee has supported in our past findings and recommendations. Additionally, costs of pavement materials have increased sharply in recent months as petroleum costs and construction demand have increased.

Recommendation 1: The Subcommittee recommends that FAA Program staff assess the impacts of construction and materials cost inflation on ongoing facility construction and pavement research schedules and brief the Subcommittee on these impacts at our Fall 2022 meeting. It is noted that the exorbitant increase in construction costs is extremely important as it impedes the FAA's capacity to efficiently conduct and apply research that is vital to the successful outcomes of various Airport programs areas.

FAA Response: The FAA concurs with the Committee's findings and recommendations and is taking the following actions to address it - The Airport Technology Research Branch will track construction and materials cost inflation over the next few months (Spring-Summer 2022 and beyond), assess construction scheduling impacts, and will coordinate with the FAA Office of Airports on the construction planning and budgeting of the pavement research laboratory. Updates will be provided at the Fall 2022 meeting of the Airports Subcommittee.

We will continue to address all of the Committee's recommendations and incorporate those elements as applicable to maintain our R&D portfolio that consistently enhances the safety, efficiency, and capacity of the air transportation system in an environmentally responsible manner.

Sincerely,

A handwritten signature in black ink, appearing to read "Billy Nolen", with a stylized, flowing script.

Billy Nolen
Acting Administrator

Enclosure