

**STATEMENT OF DENNIS L. FILLER, DIRECTOR, WILLIAM J. HUGHES
TECHNICAL CENTER, FEDERAL AVIATION ADMINISTRATION, BEFORE THE
HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON SPACE: TRANSFORMING AMERICA'S AIR TRAVEL,
JUNE 11, 2015.**

Chairman Babin, Ranking Member Edwards, and Members of the Subcommittee:

Thank you for the opportunity to appear before you today to discuss the Federal Aviation Administration's aviation research and development portfolio. I am Dennis Filler, Director of the William J. Hughes Technical Center. I also serve as the FAA's Director of Research. In that capacity, I am responsible for managing the FAA's aviation research program.

Aviation is a vital resource for the United States. It provides opportunities for business, job creation, economic development, law enforcement, emergency response, personal travel, and leisure. It attracts investment to local communities and opens up new domestic and international markets and supply chains. To maximize the opportunities that the aviation industry provides, the U.S. must not only maintain, but also continue to improve upon, the National Airspace System (NAS).

The FAA works to ensure that the NAS remains responsive to rapidly changing and expanding transportation needs while ensuring the highest level of safety. Collaborative, needs-driven research and development (R&D) is central to this process, because it enables the United States to be a world leader in its ability to move people and goods by air safely, securely, quickly, affordably, efficiently, and in an environmentally sound manner. Today, I would like to provide

you with an overview of our R&D assets, activities, and significant accomplishments in support of our ongoing commitment to modernize the U.S. air transportation system.

The FAA William J. Hughes Technical Center

Since 1958, the FAA William J. Hughes Technical Center has served as the core facility for modernizing the air traffic management system, and for advancing programs to enhance aviation safety, efficiency, environmental responsibility and capacity. The Technical Center is the nation's premier air transportation system laboratory. The Center's highly technical and diverse workforce conducts research and development, test and evaluation, verification and validation, sustainment, and ultimately, de-commissioning of the FAA's full spectrum of aviation systems. They develop scientific solutions to current and future air transportation safety, efficiency, environmental and capacity challenges. Technical Center engineers, scientists, mathematicians, and technical experts utilize a robust, one-of-a-kind, world-class laboratory environment to identify integrated system solutions for the modernization and sustainment of the NAS and for integrating new operational capabilities and technologies.

Successful Technical Center efforts are reflected in aviation advances across the country and indeed, around the world. The Center has assumed a leadership role in promoting international interoperability and global harmonization, through standards and technical guidance to other countries. The Technical Center has contributed to aviation safety in countless ways. Some unique Technical Center laboratories include: air traffic management and simulation facilities, a human factors laboratory, the NextGen Integration and Evaluation Capability, a Cockpit Simulation Facility, a fleet of specially-instrumented in-flight test aircraft, the world's largest full-scale aviation fire test facility, a chemistry laboratory for analyzing the toxicity of materials

involved in a fire, surveillance test laboratories, a full-scale aircraft structural test evaluation and research facility, the National Airport Pavement Test Facility, and a UAS research and development simulation laboratory. The Technical Center also provides strategic direction to the agency's Research, Engineering, and Development (RE&D) portfolio and ensures that it is integrated, well planned, budgeted and executed.

Civil Aerospace Medical Institute

The FAA Civil Aerospace Medical Institute (CAMI), located at the Mike Monroney Aeronautical Center in Oklahoma City, Oklahoma, focuses on the human element in flight—pilots, flight attendants, passengers, air traffic controllers—and the entire human support system that embraces civil aviation. Using laboratory research and advanced simulators, CAMI studies the factors that influence human performance in the aerospace environment and looks for ways to improve performance, efficiency, and overall safety. CAMI also conducts important research to evaluate adverse events that occur in aerospace operations and discover methods to enhance human safety, security, health, and performance.

Leveraging Partnerships

1. Centers of Excellence

In conjunction with the ongoing work at the Technical Center, the FAA has an extensive program to foster research and innovative aviation solutions through the nation's colleges and universities. By doing so, it leverages the nation's significant investment in basic and applied research and helps to build the next generation of aerospace engineers, managers, and operators. The Centers of Excellence (COE) program encourages collaboration between government, academia, and industry to advance aviation technologies and expand FAA research capabilities

through required matching contributions. In 2014, the FAA sponsored six active public-private research centers throughout the U.S. with academic institutions and their industry and other affiliates. These are:

- COE for Alternative Jet Fuels and Environment
- COE for General Aviation Safety, Accessibility and Sustainability
- COE for Commercial Space Transportation
- COE for Research in the Intermodal Transport Environment
- Joint COE for Advanced Materials
- COE for Partnership for Air Transportation Noise and Emission Reduction

Recently, after a rigorous competition, the FAA announced the selection of a team from Mississippi State University as the FAA's Center of Excellence for Unmanned Aircraft Systems (UAS). The COE will focus on research, education and training in areas critical to safe and successful integration of UAS into the nation's airspace. The team brings together 15 of the nation's leading UAS and aviation universities that have a proven commitment to UAS research and development and the necessary resources to provide the matching contribution to the government's investment. We expect that the COE will be able to begin research by September 2015 and be fully operational and engaged in a robust research agenda by January 2016.

2. Industry

The FAA has partnered with three leading U.S. companies—CNN, PrecisionHawk, and BNSF Railroad—in a new project to research the next steps in UAS operations beyond those proposed in the small UAS Notice of Proposed Rulemaking, published in February 2015. This project, known as the Pathfinder Program, will focus on three areas: (1) visual line-of-sight operations for newsgathering in urban areas (CNN); (2) extended visual line-of-sight operations for

surveying crops in rural areas (PrecisionHawk); and (3) beyond visual-line-of sight operations to inspect rail infrastructure in rural/isolated areas (BNSF). The FAA has already been working with CNN through a Cooperative Research and Development agreement and is working on similar partnerships with PrecisionHawk and BNSF. We anticipate that these research trials will yield valuable data that eventually may result in FAA-approved UAS operations.

3. Government

The FAA's partnership with NASA is a valuable part of NextGen development and implementation. NASA, in cooperation with the FAA, develops and matures their technology to a level where it can be transferred to the FAA for further testing and evaluation. The FAA, in turn, generates functional specifications to make the technology portable, sustainable, and deployable in the NAS. These functional specifications are integrated into product system builds and delivery schedules to ensure that training, testing, and full NAS wide systems level performance can be maintained.

NASA/FAA Research Transition Teams have moved several NextGen capabilities from research to reality. For example, we are preparing to deploy a new tool developed by NASA—Terminal Sequencing and Spacing—that will assist air traffic controllers in managing terminal airspace. This technology will allow pilots to fly fuel-efficient, continuous-descent approaches toward an airport, reducing emissions and resulting in greater efficiency and cost savings. FAA is also collaborating with NASA on a 5-year research activity, Airspace Technology Demonstration 2 (ATD-2), which will focus on the scheduling of departures within a metroplex terminal environment to create similar efficiencies for departing aircraft.

Recent Accomplishments

The FAA's research and development (R&D) mission is to conduct, coordinate, and support both domestic and international research and development of aviation-related products and services that will ensure a safe, efficient, and environmentally sound global air transportation system.

Three core principles guide the FAA's R&D activities: (1) Improve Aviation Safety; (2) Improve Efficiency; and (3) Reduce Environmental Impacts. Through our work at the Technical Center and collaboration with our partners in industry, government, and academia, we have made significant accomplishments in each of these core areas.

1. Improve Aviation Safety -- Fire Safety

Aircraft fire safety prevention has always been an FAA priority. For more than 50 years, the FAA has worked with the researchers and engineers at the Technical Center to develop technologies and design procedures to prevent in-flight fires and improve survivability. The Technical Center is widely recognized as a leader in fire protection research and has a unique Full-Scale Fire Test Facility that allows for the conduct of realistic aircraft fire tests under controlled conditions.

FAA has been actively engaged in research and testing to develop technologies and procedures to improve the safe transportation of lithium batteries. Numerous tests conducted at the Technical Center's Fire Test Facility, including a very-realistic full-scale test in the cargo compartment of a Boeing 727, show that lithium metal (non-rechargeable) batteries pose a different risk than lithium-ion batteries, which are the more common re-chargeable type. The 727 tests and separate testing of cargo compartment fire resistant containers and fire containment covers revealed that current fire suppression technologies are ineffective against lithium metal

battery fires. The fire resistant container testing also revealed that lithium-ion batteries in thermal runaway generate significant smoke and vent flammable gases that create an explosion hazard.

The Technical Center's research directly supports and advances the position of the U.S. delegation on the ICAO Dangerous Goods Panel, which develops international standards for the safe transportation of all hazardous materials. As a result of this work, the FAA was able to bring necessary attention to the safety risks presented by bulk shipments of lithium batteries to achieve a global ban on their transportation as cargo aboard passenger aircraft. The FAA is continuing to conduct research and testing to address and mitigate the safety risks associated with bulk shipments of lithium batteries on all-cargo aircraft.

2. Improve Aviation Safety – UAS Research and Development

The FAA is committed to the safe integration of UAS into the nation's airspace. Our UAS R&D Portfolio includes the UAS Center of Excellence, interagency UAS partnerships, UAS modelling and simulations at the Technical Center, UAS flight demonstrations, and all of the aviation safety research defined by the FAA's UAS Integration Office and funded by the FAA's UAS RE&D budget line item.

The FAA works in close partnership with NASA on UAS R&D in order to leverage the expertise, capabilities and research results of the two agencies. Since the inception of NASA's UAS in the NAS research program, FAA has been a key partner collaborating on UAS simulations and flight tests as well as providing operational expertise and support from our air traffic controllers. In October 2014, FAA and NASA established another in a series of Research Transition Teams to explore NASA's UAS Traffic Management (UTM) concept for enabling

safe UAS operations in low-altitude airspace to address evolving UAS civilian applications, from goods delivery and infrastructure surveillance, to search and rescue, and agricultural monitoring. NASA's near-term goal is the development and demonstration of the UTM to safely enable low-altitude airspace and UAS operations within five years. For the longer-term (10 to 15 years in the future), the goal is to safely enable the anticipated dramatic increase in density of all low-altitude airspace operations.

3. Improve Efficiency – NextGen Wake RECAT

The Technical Center is the primary aviation facility responsible for conducting research, engineering, development, testing, and NAS integration activities required to support NextGen. ADS-B, ERAM and DataComm were all developed, tested and began their nation-wide deployment at the Technical Center through its engineering, testing, evaluation, and deployment platforms.

The FAA has prioritized the use of Multiple Runway Operations as part of its commitment to modernize the NAS. Through research with our government and industry partners, we have engaged in a process to re-categorize required minimum wake turbulence separation standards based on the performance characteristics of aircraft (wake RECAT). This re-categorization updates and decreases separation standards, which increases efficiency and reduces flight delays. The FAA had been using five wake turbulence separation categories formulated 20 years ago, based primarily on aircraft weight. Now, based on a closer analysis of much more nuanced data there are six.

Phase I of wake RECAT was first implemented at Memphis International Airport in 2012. The adjustment to the wake separation standards increased the throughput rate (number of departures

and arrivals) and improved airport efficiency. In 2014, FAA continued the implementation of Phase I at Cincinnati/Northern Kentucky Airport and Hartsfield-Jackson Atlanta International Airport. To date, wake RECAT has provided real benefits to air carriers. FedEx can take advantage of a 13 percent increase in departure capacity at Memphis. At Atlanta's Hartsfield-Jackson airport, Delta Airlines and FAA have found a one and one-half minute reduction in departure queue delays and Delta projects to save \$14-19 million dollars in operating costs over a one-year period.

The work on wake RECAT continues today. A separation matrix for Phase II of the project has been developed for 107 aircraft types, which covers approximately 99 percent of the aircraft flown in the NAS. Additionally, an optimization tool was developed to allow each TRACON to create wake separation aircraft categories from the matrix that will provide the greatest increase in runway throughput for the airports it services. Implementation of Phase II will begin following the approval of safety documentation and updates to the FAA order that defines separation standards in the NAS.

4. Reduce Environmental Impacts – Aircraft Technology

The FAA's environmental vision is to provide environmental protection that allows sustained aviation growth. Although there are a range of environmental issues associated with aviation, noise, air quality, climate, energy, and water quality are considered to be the environmental aspects with the greatest potential to constrain aviation capacity, efficiency and flexibility.

Aircraft technology advances have been the primary factor in reducing aviation's environmental footprint and will continue to be key in the future. Realizing the potential of technology, the FAA is invested in accelerating development and commercialization of new technologies that

reduce fuel burn, noise and emissions through the Continuous Lower Energy, Emissions, and Noise Program, or “CLEEN.”

CLEEN is a public-private partnership in which the FAA leverages Federal investment by partnering with industry. The FAA has awarded contracts worth \$125 million to 5 companies and these companies agreed to contribute at least equal amounts -- for a total of more than \$250 million. CLEEN is designed to promote and invigorate efforts to develop technology that can be incorporated into today’s aircraft fleet and begin making a difference in the near-term. Based on the successes of the first phase of CLEEN, we are moving forward with a second phase of CLEEN that will run from 2015 through 2020.

5. Reduce Environmental Impacts -- Airport Asphalt

The FAA has operated a state-of-the-art, full-scale pavement test facility dedicated solely to airport pavement research since 1999, teaming with Boeing on the construction and operation of the building, test track, and test vehicle (National Airport Pavement Test Facility - NAPTF). This year, the Technical Center completed construction and took possession of the new National Airport Pavement and Materials Research Center (NAPMRC), which has expanded research capabilities, including a custom-designed heavy-vehicle simulator (airfield version) or HVS-A.

A key objective of the test facility and the HVS-A is to research environmentally friendly technologies like warm-mix, stone-matrix, recycled asphalt shingles, and recycled asphalt pavements. Current FAA advisory circulars lack guidance on such asphalt pavements because of the limited knowledge about how high tire pressure and heavy gear loads affect airport pavement performance. This is the primary reason for the limited use of “green”, or more environmentally friendly, pavement materials. Research at the test facility is aimed at increasing the use of

greener materials, more durable airport pavements and locally available materials modified with admixtures that enhance pavement durability, workability, and strength. This will help save money by lowering the costs of initial construction, maintenance and repairs.

The original pavement test facility features a rail-based test vehicle inside a fully enclosed building. It does a great job examining the impact of wheel loads on lower layers of pavement. But it cannot heat the pavement effectively because it moves over rails. By contrast, the HVS-A is mobile, can be operated with a remote control, and includes an automated heating system with 12 heating panels inside the structure. The machine gives engineers the ability to replicate and analyze the damage that heavy commercial jets can do to the top asphalt layer of pavement when it gets hot, particularly during the slow-moving trek between the gate and runway. The older rail-based test vehicle also uses full landing gear configurations to gauge the impact of wheel-load interactions at lower depths, but within the HVS-A, one wheel is sufficient for testing due to insignificant wheel load interactions in the pavement surface layers.

The HVS-A gives the Technical Center the ability to test asphalt materials at very high tire pressures and temperatures. This is important because even at airports as far north as John F. Kennedy International Airport in New York, pavement temperatures can reach 140-150 degrees Fahrenheit. The new generation aircraft, such as the Boeing 787 and Airbus 350, have tire pressures in the range of 220 to 250 pounds per square inch. The remote control will be used to move the HVS-A between the existing outdoor pavement test strips and two more strips inside a new fabric building, which will allow for testing in a more controlled environment and for continuous research. The test facility and HVS-A also make it possible to test materials and

ideas other than pavement, such as marking paint technologies and rumble strips for preventing runway incursions.

Conclusion

The aviation industry is marked by constant evolution and there will always be a need for research and evolving technology in response to changes in aviation needs. While we respect our past and its legacy, our vision is firmly fixed on the future and how we can best be prepared to meet its challenges and maximize our nation's ability to respond to aviation-based opportunities while performing at our present global standard of excellence. We are committed to ensuring that the United States continues to lead the world in the development and implementation of aviation technology and to operate the safest and most efficient aviation system in the world.

This concludes my statement. I will be happy to answer your questions at this time.