NATIONAL TRANSPORTATION SAFETY BOARD

An independent federal agency

The Honorable Christopher A. Hart
Acting Chairman

Before the
Committee on Transportation and Infrastructure
United States House of Representatives

Hearing on
FAA Reauthorization: Reforming and Streamlining the FAA's Regulatory Certification Processes

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Good morning Chairman Shuster, Ranking Member DeFazio, and Members of the Committee. Thank you for the opportunity to address you today concerning the National Transportation Safety Board's (NTSB) perspective on the Federal Aviation Administration's (FAA) certification programs and processes. Our views on this important subject are based primarily on the lessons learned from our aviation accident and incident investigations over more than four decades.

Introduction

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating every civil aviation accident and significant incidents in the United States and significant accidents and incidents in other modes of transportation – railroad, highway, marine and pipeline. The NTSB determines the probable cause of accidents and other transportation events and issues safety recommendations aimed at preventing future accidents. In addition, the NTSB carries out special studies concerning transportation safety and coordinates the resources of the Federal Government and other organizations to provide assistance to victims and their family members impacted by major transportation disasters.

Just last week, the NTSB released its Most Wanted List for 2015.[1] It identifies our top 10 areas for transportation safety improvements. Each year, we develop our Most Wanted List based on safety issues we identify as a result of our accident investigations. This year our priority areas include 3 multimodal items that affect aviation safety as well as aviation-specific issues --

- Ending Substance Impairment in Transportation
- Disconnecting from Deadly Distractions
- Requiring Medical Fitness for Duty
- Preventing Loss of Control in Flight in General Aviation
- Strengthening Crewmembers' Procedural Compliance
- Enhancing Public Helicopter Safety

Each of these Most Wanted List issues emphasizes the need for critical actions by the aviation safety regulator – the FAA. The NTSB readily acknowledges the impressive work and oversight performed by the FAA, and its track record in ensuring that this country's aviation system is the safest in the world. The effectiveness of the aircraft certification process is an important factor in achieving and maintaining these successes. Yet, there will always be room for improvement, and the accidents and incidents that the NTSB investigates attest to the fact that safety improvements are still necessary to prevent future accidents.

As discussed in this statement, the NTSB has, on numerous occasions, examined FAA certification processes, pointed out short comings, and issued recommendations to address needed improvements in the these processes. In our investigative work, we have examined the roles of the FAA's Aircraft Certification Service and the Flight Standards Service. Although both of these offices are part of the Aviation Safety Office, the former is responsible, among other

[1] See www.ntsb.gov/mostwanted for more details.

things, for administering safety standards governing the design, production, and airworthiness of civil aeronautical products and overseeing design, production, and airworthiness certification programs to ensure compliance with prescribed safety standards. The latter is responsible, among other things, for setting the standards for certification and oversight of airmen, air operators, air agencies, and designees. and inspecting, investigating, and enforcing the Federal Aviation Regulations (FAR) and other FAA requirements.

Aircraft Certification

History

The FAAwas first given authority for aircraft certification by the Air Commerce Act of 1926. Section 3(b) of the Act required the Secretary of Commerce to

> [p]rovide for the rating of aircraft of the United States as to their airworthiness … and may require for any aircraft first applying therefor… full particulars of the design and of the calculations upon which the design is based and of the materials and methods used in the construction.

The Act also authorized the Secretary of Commerce to

> accept in whole or in part the reports of properly qualified persons employed by the manufacturer or owners of aircraft.

The Civil Aeronautics Act of 1938 created the Civil Aeronautics Authority, the precursor to the FAA, and authorized the Authority to issue type certificates for aircraft, aircraft engines, propellers, or appliances, as well as production certificates, airworthiness certificates, and air carrier operating certificates. (The 1938 Act also established the predecessor agency to the NTSB -- the Air Safety Board, which was authorized to investigate aviation accidents and report to the Authority the facts, circumstances, probable cause of each accident and recommendations to prevent similar accidents in the future.) The Federal Aviation Act of 1958 created the Federal Aviation Agency (which under the terms of the Department of Transportation (DOT) Act of 1966, was renamed as the Federal Aviation Administration and subsumed as an operating administration in the new DOT), provided greater specificity concerning the agency's authority to certify aircraft and aircraft operations, and authorized the Administrator to

> delegate to any properly qualified private person or to any employee or employees under the supervision of such person, any work, business, or function respecting … the examination, inspection, and testing necessary to the issuance of certificates … in accordance with standards set by him.

In many major respects, although FAA certification processes have changed over time, the underlying program continues to rely heavily on the assistance of private persons to manage aviation safety. A major 1984 U.S. Supreme Court decision that held the U.S. Government was not liable for delegating certification responsibilities to manufacturers and allegedly failing to

inspect certain design work -- United Sates v. Varig Airlines[2] -- succinctly described the FAA compliance review process as follows:

> FAA certification process is founded upon a relatively simple notion: the duty to ensure that an aircraft conforms to FAA safety regulations lies with the manufacturer and operator, while the FAA retains the responsibility for policing compliance. Thus, the manufacturer is required to develop the plans and specifications and perform the inspections and tests necessary to establish that an aircraft design comports with the applicable regulations; the FAA then reviews the data for conformity purposes by conducting a "spot check" of the manufacturer's work.[3]

The FAA's Organization Designation Authorization (ODA) Program

Since the 1940s, the FAA's predecessor agencies have used established programs to appoint designees to perform certain tasks for certification approvals and airworthiness approvals. In 2005, the FAA published a final rule establishing its current ODA program in order to standardize its oversight of organizational designees. In its final rule the FAA pointed out that the ODA program

> improves the FAA's ability to respond to [its] increasing workload by expanding the scope of authorized functions of FAA organizational designees [and] reduce[s] the time and cost for … certification activities.[4]

NTSB Activities and Actions Related to the FAA's Certification Processes

Boeing 787-8 Auxiliary Power Unit Battery Fire

The NTSB's most recent in-depth review of the FAA's certification processes occurred as a result of its investigation of a fire that originated on January 7, 2013, in an auxiliary power unit (APU) battery in the aft cabin of a Japan Airlines 787-8 that was parked at a gate at Logan International Airport in Boston, Massachusetts. Our investigation looked into the introduction of new lithium ion battery technology into transport aircraft design. When Boeing applied for an FAA type certificate for its new Boeing Model 787-8 passenger airplane in March 2003, the 787 design included the planned use of large, permanently installed, high-capacity rechargeable lithium-ion batteries. Because these batteries were a novel and unusual design feature in transport category airplanes, the applicable FAA airworthiness regulations at that time did not contain adequate or appropriate safety standards for these design features. As a result, the FAA prescribed a number of special conditions that the FAA considered necessary to establish a level of safety equivalent to that established by the existing design standards. Similarly, as further advances in aviation technology become available at a quickening pace, the NTSB's report on the Boeing battery fire pointed to the continuing challenges in ensuring the safe introduction of

[2] 467 U.S. 797 (1984).
[3] Id. at 816-817.
[4] 70 *Federal Register* 59932, 59933 (October 13, 2005).

these new technologies into aircraft designs. Among these challenges was the need for the FAA to work with neutral, independent experts from government, test standards organizations, and the private sector in certifying the safety of new technology to be used on new or existing aircraft and the need for FAA personnel to have adequate training. Additionally, the NTSB's report recognizes the need for the FAA to more thoroughly consider a system's safety requirements and assumptions when approving the methods and data used in the certification of designs incorporating new technology.

After an extensive investigation, including an investigative hearing in April 2013, the NTSB adopted its report concerning this incident last November.[5] The NTSB determined that the probable cause of this event was an internal short circuit within one of the eight cells in the APU lithium-ion battery. As a result of the short circuit, the cell experienced an uncontrollable increase in temperature and pressure (known as a thermal runaway) that cascaded to adjacent cells, resulting in the release of smoke and fire outside the battery case. This type of failure was not anticipated based on the testing and analysis of the APU battery system that Boeing performed as part of the 787 certification program. The incident resulted from Boeing's failure to incorporate design requirements to mitigate the most severe effects of an internal short circuit within an APU battery cell and the FAA's failure to identify this design deficiency during the type design certification process.

During the NTSB's April 2013 investigative hearing, Boeing and FAA representatives testified that only those failure conditions resulting in cell venting with smoke and fire were considered relevant to special condition 2.[6] The Boeing and FAA representatives also testified that, at the time of the 787 certification, they believed that thermal runaway of the battery could only occur if a cell or a battery was overcharged. The NTSB's investigation did not find any evidence indicating the Boston incident battery was overcharged, yet thermal runaway of the battery occurred.

Also during the investigative hearing, an FAA witness, in responding to an NTSB Board Member's question concerning the importance of the ODA system, indicated

> It would be virtually be impossible to keep up with industry, because there's no way that we'd be able to staff to a level to keep up with the work that's coming into our office.[7]

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[5] NTSB/AIR-14/01.

[6] Special condition 2 states:

> Design of the lithium ion batteries must preclude the occurrence of self-sustaining, uncontrolled increases in temperature or pressure.

72 *Federal Register* 57844 (October 11, 2007).

[7] Transcript of Hearing in the Matter of: Investigation Of Japan Airlines, JA829J, Boeing 787-8 Battery Fire, Boston, Massachusetts, January 7, 2013, DCA13IA037, p. 364.

It is clear to the NTSB that as the FAA's dependence on designees continues to increase, the FAA must ensure it has trained certification engineers on its staff and designees to enable it to provide effective certification services.

Prior to issuing its November 2014 final report, the NSTB issued a number of safety recommendations to the FAA concerning the certification process for rechargeable lithium-ion batteries and, more generally, the process for certifying the safety of new technology to be used on new or existing aircraft. In addressing the introduction of new technology into aircraft, the NTSB's May 22, 2014, safety recommendation letter recognized that new, first-of-a-kind technology can offer substantial improvements in operational efficiency, capabilities, and/or safety, and its safe introduction into the aviation system is a key objective of the aircraft certification process. The letter also stated

> The nature of the aircraft certification process requires manufacturers to "lock down" designs early in the program because of the multiyear timeframe needed to complete the testing and evaluation required to demonstrate regulatory compliance. As a result, it is difficult for manufacturers to incorporate new information into the aircraft design as the certification program progresses. Incorporating new information becomes even more difficult once the aircraft design goes into service because design changes can require extensive recertification activity. As a result, the involvement of outside experts as early as possible in a certification program could be the most efficient way to help ensure the operational safety of a new technology.
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> The NTSB concludes that technical knowledge imparted by independent and neutral experts outside of the FAA and an aircraft manufacturer could provide the agency with valuable insights about best practices and test protocols for validating system and equipment safety performance during certification when new technology is incorporated. As a result, the NTSB recommends that the FAA develop a policy to establish, when practicable, a panel of independent technical experts to advise on methods of compliance and best practices for certifying the safety of new technology to be used on new or existing aircraft. The panel should be established as early as possible in the certification program to ensure that the most current research and information related to the technology could be incorporated during the program.

In its response to our recommendation to develop a policy to establish a panel of technical experts to provide advice in certifying the safety of new technology, the FAA indicated its agreement with the intent of this safety recommendation and that it was setting up meetings with internal FAA stakeholders on how to best implement this recommendation.

The NTSB final report further addressed ways for the FAA and its ODA Holders to better improve the certification process for designs incorporating new technology. Specifically, our report pointed to the need to validate assumptions related to failure conditions that impact safety and emphasized that the validation process must employ a level of rigor that is consistent with the potential hazard to the aircraft in case an

assumption is incorrect. In addition, we cautioned that Boeing should have taken a more conservative approach in its safety analyses by including the possibility and worst case effects of cell to cell propagation of thermal runaway resulting from an internal short circuit within a single cell. If this approach had been taken, FAA certification engineers and Boeing designees reviewing the analyses would likely have required more extensive data or the incorporation of enhanced design features to more confidently demonstrate that the safety risks had been effectively mitigated. The NTSB concluded that written guidance and training for FAA certification engineers would help ensure that key assumptions, data sources, and analytical techniques are properly incorporated in applicants' safety assessments and challenged where necessary for designs incorporating new technologies. We also recommended that during its annual recurrent training for engineering designees, the FAA discuss the need for applicants to identify, validate, and justify key assumptions and supporting engineering rationale used in safety assessments addressing new technology.

FAA Oversight of Part 125 and Part 135 Carriers and Part 145 Repair Stations

Also this past November, the NTSB issued an accident report following its investigation of the March 15, 2012, crash of a cargo flight into a lagoon east of Luis Muñoz Marin International Airport, San Juan, Puerto Rico. The flight was operated under Part 125 of the FAR (14 CFR part 125).[8] As a result of its investigation, the NTSB identified numerous basic gaps in oversight of the operator by multiple FAA inspectors related to cargo loading, pilot currency, company recordkeeping, and pilot evaluation practices. The NTSB concluded that these oversight failures were possibly due to inspectors' belief that Part 125 operations merit less scrutiny than Part 121 and 135 operations, despite the fact that cargo airplanes fly within the national airspace system over populated areas. We recommended that the FAA evaluate the effectiveness of its Part 125 oversight program and ensure that Part 125 operations are conducted at the same level of safety as that of Parts 121 and 135. We also recommended that the FAA require all its principal operations inspectors of Part 125 certificate holders to conduct at least one en route inspection annually on each airplane type operated by the certificate holder. This recommendation was just issued on December 2, 2014, and the FAA has not yet replied.

On June 4, 2007, a Cessna Citation 550, N550BP, impacted Lake Michigan shortly after departure from General Mitchell International Airport, Milwaukee, Wisconsin. The two pilots and four passengers were killed, and the airplane was destroyed. The airplane was being operated under the provisions of 14 CFR Part 135. The NTSB determined that the probable cause of this accident was the pilots' mismanagement of an abnormal flight control situation through improper actions, including failing to control airspeed and to prioritize control of the airplane, and lack of crew coordination. Contributing to the accident was the FAA's failure to detect and correct those deficiencies, which placed a pilot who inadequately emphasized safety in the position of company chief pilot and designated check airman and placed an ill-prepared pilot in the first officer's seat. The principal operations inspector at the FAA Flight Standards District Office (FSDO) assigned to the company's airworthiness certificate acknowledged that he was supposed

[8] NTSB/IR-14/04.

to observe all checkmen under his surveillance perform their duties once every two years but had not provided this level of oversight.[9]

The NTSB also investigated a Part 135 cargo flight that crashed into a department store garden center shortly after takeoff from Manchester-Boston Regional Airport, Manchester, New Hampshire in 2005. The airplane was destroyed, and the certificated airline transport pilot was seriously injured. Our review of the operator's maintenance records revealed numerous deficiencies in its preventive maintenance program that appear to have gone undetected by the local FSDO. We issued several safety recommendations to the FAA, including one that the agency evaluate the effectiveness of the local FSDO's surveillance of maintenance programs and implement necessary changes so that inadequate maintenance programs are identified and improved.[10]

In investigating an accident that occurred on January 23, 2003, when a Beech 95 lost control after takeoff from an airport in Upland, California, and crashed into a residence after a blade section separated from the propeller, the NTSB found all four propeller blades were improperly overhauled. The owner of the repair station had previously been employed as the chief inspector at another repair station that had its part 145 certificate revoked for performing improper maintenance and overhauls on aircraft propellers. We were concerned that the FAA lacked a mechanism for preventing individuals associated with a previously revoked repair station from continuing to operate through a new repair station. Although the FAR authorized the FAA to deny an application for a Part 121 or Part 135 air carrier or operating certificate if the applicant held a certificate that was previously revoked or held a key management position or exercised control over a new operator, there was no similar regulation applicable to Part 145 repair stations. As a result, we recommended that the FAA issue a regulation that applies to applicants for a Part 145 repair station certificate, so the FAA can prevent individuals who have been associated with a repair station whose Part 145 certificate had been revoked from continuing to operate through a new repair station.[11] In response to the recommendation, the FAA published a notice of proposed rulemaking on May 21, 2012, but as of yet – nearly 11 years after we issued our recommendation -- the agency has not issued a final rule.

NTSB Safety Report on the FAA's Evaluation of Safety-Critical Systems in Transport Aircraft

As stated previously, the NTSB has paid close attention to FAA safety certification issues for several decades. As the result of lessons learned from our investigations of four air carrier accidents that occurred between 1994 and 2001, we issued a safety report in 2006 that examined in detail the FAA's certification process for safety-critical systems in transport-category airplanes.[12] These four accidents resulted in 715 fatalities and accounted for 60 percent of the air

[9] NTSB/AAR-09/06.
[10] NTSB Letter to FAA Administrator dated October 1, 2009 (Safety Recommendations A-09-108 through A-09-111).
[11] NTSB Letter to FAA Administrator dated February 9, 2004 (Safety Recommendations A-04-01 and A-04-02).
[12] NTSB/SR-06/02. Appendix A to the Safety report provides an extensive description of the FAA type certification process.

carrier fatalities that occurred within this timeframe. The safety report highlighted these four accidents and pointed to FAA certification issues we previously raised in the Board Accident Reports we issued for each of these accidents. In summary, in1999, we expressed concern about the adequacy of the 737 rudder system design after our investigation of the uncontrolled descent and collision with terrain by USAir flight 427 near Aliquippa, Pennsylvania, on September 8, 1994.[13] In 2000, we suggested the need for a directed examination of the certification process in the investigation of the center wing fuel tank in TWA flight 800.[14] Subsequent investigations of the horizontal stabilizer jackscrew in Alaska Airlines flight 261[15] and the rudder system in American Airlines flight 587[16] also raised questions about the certification process used by the FAA to determine compliance with airworthiness standards.

Our concerns about certification that we discussed in the 2006 Safety Report and previously raised in each of the four accident reports and focused on two areas. The first area concerned the ways in which hazards to safety of flight are identified, assessed, and documented during the type certification process. Our analysis of the FAA certification process considered how compliance with the FAR is demonstrated and how the FAA documented safety assessment efforts. Of particular concern were assessments of safety-critical systems that evaluated structural failures but did not adequately consider system safety risks, and did not consider human/system interaction failures. The second area focused on the ongoing assessment of safety-critical systems throughout the life of the airplane. The FAA uses the safety assessment process to identify and evaluate safety-critical functions in systems based on criteria set forth in guidance material it developed for identifying and evaluating failure conditions classified as major or catastrophic. Through the safety assessment process, FAA considers a system as critical if its failure would prevent the continued safe flight and landing of the airplane, or its failure would reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions. The NTSB concluded that a program must be in place, once the type certification process is completed, to ensure the ongoing assessment of risks to safety-critical systems. Such a program must recognize that ongoing decisions about design, operations, maintenance, and continued airworthiness must be done in light of operational data, service history, lessons learned, and new knowledge, for designs that are derivatives of previously certificated airplanes.

The Report found that the FAA's certification process is sound and produces a high level of safety. We did, however, issue several safety recommendations for improving the process. These recommendations dealt with documenting the identification of safety-critical systems, ensuring that the identification process includes evaluation of structural failures and human/airplane system interaction failures, and assessing safety-critical systems throughout the life of the aircraft.

With regard to compiling a list of safety-critical systems derived from the safety assessment process for each type certification project, the FAA replied in May 2011 that it planned to issue a Key Safety Information (KSI) advisory circular (AC) coordinated with the

[13] NTSB/AAR-99/01.
[14] NTSB/AAR-00/03.
[15] NTSB/AAR-02/01.
[16] NTSB/AAR-04/04.

findings of the Commercial Aviation Safety Team Safety Enhancement 172 (Gap Analysis of Existing Airplane Maintenance Process). Last month, we expressed our concern in a letter to the FAA with its lack of progress in fully implementing this recommendation, which is now 8 1/2 years old.

The 2006 Safety Report also recommended that the FAA amend its advisory materials associated with 14 *Code of Federal Regulations* 25.1302 (Installed Systems and Equipment for Use by the Flight Crew) to include consideration of structural failures and human/airplane system interaction failures in the assessment of safety-critical systems. The FAA published a final rule in May 2013 to amend FAR section 25.1302. Related to that, in May 2010, the FAA released for public comment a draft policy memorandum specifying that structural failures must be included in the system safety analysis. Last month we expressed our concern with the FAA's failure to issue the policy in the 4 1/2 years since this draft policy was published.

FAA Lax Oversight of a Part 121 Operator

One of the four accidents analyzed in the 2006 safety report involved the loss of control and impact with the Pacific Ocean about 2.7 miles north of Anacapa Island, California, by Alaska Airlines flight 261 on January 31, 2000.[17] The 2 pilots, 3 cabin crewmembers, and 83 passengers on board were killed, and the airplane was destroyed by impact forces.

The NTSB determined that the probable cause of the accident was a loss of airplane pitch control resulting from the in-flight failure of the horizontal stabilizer trim system jackscrew assembly's acme nut threads. The thread failure was caused by excessive wear resulting from Alaska Airlines' insufficient lubrication of the jackscrew assembly. Contributing to the accident were Alaska Airlines' extended lubrication interval and the FAA's approval of that extension, which increased the likelihood that a missed or inadequate lubrication would result in excessive wear of the acme nut threads, and Alaska Airlines' extended end play check interval and the FAA's approval of that extension, which allowed the excessive wear of the acme nut threads to progress to failure without the opportunity for detection. Also contributing to the accident was the absence on the McDonnell Douglas MD-80 of a fail-safe mechanism to prevent the catastrophic effects of total acme nut thread loss.

As a result of the flight 261 accident, the FAA conducted a special inspection of Alaska Airlines from April 3 to April 19, 2000, to determine its compliance with the FAR. In addition, in a December 2001, report on FAA oversight of continuing analysis and surveillance programs, the U.S. DOT Office of the Inspector General stated that the findings of the FAA's postaccident inspection of Alaska Airlines "raised questions as to why the FAA's routine surveillance had not identified the deficiencies in Alaska Airlines' [continuing analysis and surveillance program] and ensured that they were corrected." The DOT report stated that the FAA "needs to place greater emphasis on [continuing analysis and surveillance program] oversight" and must "ensure [that program] deficiencies identified through its oversight inspections are corrected."[18]

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[17] NTSB/AAR-02/01, supra.

[18] Report on FAA Oversight of Aircraft Maintenance, Continuing Analysis and Surveillance Systems, Report No. AV-2002-066.

The NTSB concluded that the FAA did not fulfill its responsibility to properly oversee the maintenance operations at Alaska Airlines and that at the time of the Alaska Airlines flight 261 accident, FAA surveillance of Alaska Airlines had been deficient for at least several years. It also questioned the depth and effectiveness of the carrier's corrective actions and expressed concern about the overall adequacy of Alaska Airlines' maintenance program at that time.

Aircraft Certification Standards for in-Flight Icing Conditions

On October 31, 1994, American Eagle flight 4184, an ATR 72-212, crashed during a rapid descent after an uncommanded roll excursion that occurred near Roselawn, Indiana. The captain, first officer, 2 flight attendants and 64 passengers were killed. In our report on this accident, we determined that contributing to the cause of this accident was the FAA's failure to ensure that aircraft icing certification requirements, operational requirements for flight into icing conditions, and FAA published aircraft icing information, adequately accounted for the hazards that can result from flight in freezing rain and other icing conditions not specified in Part 25, Appendix C. On August 15, 1996, the NTSB issued recommendations to the FAA to revise the appropriate icing certification requirements.

On January 9, 1997, an Empresa Brasileira de Aeronautica, S/A (Embraer) EMB-120RT, N265CA, operated by Comair Airlines, Inc., as flight 3272, crashed during a rapid descent after an uncommanded roll excursion near Monroe, Michigan. Comair flight 3272 was being operated under the provisions of 14 CFR Part 135 as a scheduled, domestic passenger flight from the Cincinnati/Northern Kentucky International Airport Covington, Kentucky, to Detroit Metropolitan/Wayne County Airport, Detroit, Michigan. The flight included two flightcrew members, one flight attendant, and 26 passengers on board. There were no survivors. The airplane was destroyed by ground impact forces and a postaccident fire.

We determined that the probable cause of this accident was the FAA's failure to establish adequate aircraft certification standards for flight in icing conditions, the FAA's failure to ensure that a CentroTecnico Aeroespacial/FAA-approved procedure for the accident airplane's deice system operation was implemented by U.S.-based air carriers, and the FAA's failure to require the establishment of adequate minimum airspeeds for icing conditions, which led to the loss of control when the airplane accumulated a thin, rough accretion of ice on its lifting surfaces. The NTSB also determined that the icing certification process had been inadequate because it had not required manufacturers to demonstrate the airplane's flight handling and stall characteristics under a sufficiently realistic range of adverse ice accretion/flight handling conditions. We were also critical of FAA policies at the time that allowed carriers to elect not to adopt the manufacturer's changes to the airplane flight manual.[19]

The NTSB also noted that the EMB-120 exhibited a history of icing-related upsets/losses of control before being involved in a related fatal accident. At the time of the Comair accident, six icing-related EMB-120 events had been documented. In issuing safety recommendations to the FAA, the NTSB

[19] NTSB/AAR-98-04.

> note[d] with disappointment that this was the latest in a series of limited actions taken by the FAA to address the problems of structural icing in transport airplane certification and operation. Basic knowledge about the aerodynamics of icing (including the knowledge regarding the hazards of small amounts of surface roughness/ice) has been well established for the past 50 years, and there is nothing that has been learned in the most recent, postaccident wind tunnel tests and analyses that could not have been learned before this Comair accident.[20]

On November 4, 2014, 20 years after the American Eagle flight 4184 accident, and almost 18 years after the Comair flight 3272 accident, the FAA published a final rule, titled "Airplane and Engine Certification Requirements in Supercooled Large Drop, Mixed Phase, and Ice Crystal Icing Conditions," that revised sections of Part 25 to provide the aircraft design certification standards related to performance in icing conditions that we identified as necessary in this accident.

Conclusion

The overall safety of our aviation system in this country, which has resulted from the hard work of thousands of dedicated and skilled FAA professionals is undisputed. However, as the NTSB has concluded in the course of numerous aviation accident/incident investigations, including the ones summarized in this statement, there are still lessons to be learned and opportunities for improvement in the FAA's management and oversight of its certification processes. The NTSB looks forward to continuing to work with this Committee, the FAA, and other stakeholders to address the issues raised during this hearing.

Mr. Chairman, this completes my statement, and I will be happy to respond to any questions you may have.

[20] NTSB Letter to FAA Administrator dated November 30, 1988 (Safety Recommendations A-98-88 through A-98-106.