Statement of Mike Sinnett
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Chairman LoBiondo, Ranking Member Larsen, members of the Subcommittee, my name is Mike Sinnett, and I am the vice president and chief project engineer for the Boeing 787 program.

It is my pleasure to appear before you today to support your continuing efforts to improve U.S. aviation. I know that you take that responsibility seriously, and I want you to know that Boeing is committed to supporting your work in any way that we can.

Mr. Chairman, Boeing's highest priority is the safety of the passengers and crews who fly on our airplanes. Every Boeing employee is committed to safety. It is part of our DNA as a company, and it is that unwavering commitment that has helped to make air travel the safest form of transportation. Last year, as many of you may know, was the safest year for commercial jet travel in history.

Boeing has been in the airplane business for nearly 100 years, and we have been designing, manufacturing and servicing commercial jets for more than 50 years. We have delivered more than half of the commercial jets in service around the world today, and with every new airplane we create, we build on the knowledge we have gained from that broad, deep, and ever-increasing experience.

The approach we take to every new airplane design employs methodologies that have served us well throughout our history as we have worked to ensure the highest level of airplane safety. It is a data-driven approach in which risk is carefully assessed and managed. Our designs feature multiple layers of protection, and redundancy of critical systems, so that no single component failure, or even an extremely remote combination of failures, can endanger an airplane.

The FAA has certified all of our airplane designs, indicating that they satisfy the agency's extensive safety requirements. It also has certified all of our production lines, indicating that we have established and shown that we can maintain a quality control system to ensure that each aircraft produced conforms to the approved design. And each aircraft that comes off of our assembly lines receives an airworthiness certificate indicating that it has been thoroughly checked out both on the ground and in flight and is ready for safe operation in commercial service.

These certification processes are robust and recognized globally as the gold standard for airplane certification. They also have been continuously improved over the past 50 years. With each new airplane design, the certification process has become more rigorous.

Importantly, this strong focus on safety by both industry and government continues long after our airplanes move through our factory doors – literally for as long as the airplanes remain in service. We continuously monitor the performance of our airplanes, carefully analyze the data we collect, share

safety-related findings with customers and regulatory authorities, and work with all relevant parties to incorporate lessons learned into the active fleet and into new production aircraft and future designs.

Boeing learned a great deal from the two highly-publicized events in January of this year involving 787 lithium-ion batteries. These were significant events, which we took very seriously. We devoted more than 200,000 engineering hours to understanding the two events, to developing a comprehensive set of solutions that I will describe in a moment, and to working with the FAA to test and certify those improvements. We also fully supported, and will continue to fully support, the ongoing investigations into the two incidents that the National Transportation Safety Board and the Japan Transport Safety Board are leading.

Mr. Chairman, flying is as safe as it is because airplane manufacturers, regulators, airlines, airports, air traffic service providers, investigators and suppliers work together on safety and have done so for decades. We all share a firm commitment to safety, and we work with each other literally day in and day out. That is why we have been able to achieve such an impressive record – and why we are able to continuously improve upon that record.

The 787 and Boeing's Response to Battery Incidents

The 787 illustrates that deep commitment. The design process started, as it does with all of our new airplane programs, with a comprehensive review of everything the industry and its regulators have learned about designing, building and operating safe airplanes. For example, as part of the 787 design review we evaluated every safety issue on the 777 airplane to ensure that our 787 design addressed all of those issues. I have worked on the 787 program from its start, and I can personally attest to the team's strong focus on safety throughout the design, build, and test phases of the program. I also can attest to the strength of the certification process, which was more rigorous for the 787 than it was for any of our previous airplane programs, several of which I have worked on, including the 777.

The result of all that hard work is an exceptional, safe and reliable airplane – the first commercial jet of the 21st Century, with a very strong, low-maintenance composite structure, 20% better fuel efficiency than the models it replaces, a lower cabin altitude and bigger windows, to name just a few of its many innovative features. Over its initial 15 months of service, with eight airlines operating a total of 50 airplanes, the 787 also achieved a schedule reliability rate of 98.2%. That is better than the 777 over its first 15 months of service, which until the 787 came along was widely recognized as the best in its class.

But as this Committee is aware, at the end of that 15 month period we experienced two 787 battery failures. On January 7, a Japan Airlines 787-8 experienced an auxiliary power unit battery failure while parked at Boston's Logan International Airport. No passengers or crew members were aboard the airplane, and none of the maintenance or cleaning personnel aboard the airplane were injured. Roughly one week later, an All Nippon Airways 787-8 experienced a battery failure during flight from Yamaguchi-Ube Airport to Tokyo. The crew diverted the airplane and performed a safe landing at Takamatsu

airport. In response to these incidents, the FAA and other regulatory agencies issued directives suspending 787 operations that remained in effect for more than three months.

As mentioned a moment ago, Boeing has worked diligently with the governmental bodies charged with investigating those incidents – the NTSB and JTSB – as well as the FAA and other civil aviation authorities responsible for ensuring the safety of the 787's lithium-ion batteries. Boeing worked around the clock, dedicating hundreds of its best engineers and consulting with experts in lithium-ion battery technology from across industry and government. We appreciate the efforts of the government agencies that participated in that process, as well as those from our supplier-partners and other industries who supported our efforts to find a solution. We also are deeply grateful to our airline customers, who stood by us and remained confident in the promise of the 787 during a challenging period of significant service disruption.

As we explained in our public testimony at the NTSB's recent hearing, the incidents – while serious – demonstrated the effectiveness of the design philosophy that I spoke about earlier. The airplane's redundant safety features prevented the battery failures from putting the airplane, its passengers, and crew in jeopardy. With that said, the work done in the wake of the two incidents revealed ways that we could improve the batteries, and on March 12 we received FAA approval of a certification plan for a proposed comprehensive and multi-layered set of battery system improvements.

Our solution employed three layers of protection. First, we made design changes and manufacturing process enhancements that reduce the likelihood of a battery failure in the first place. Second, we proposed additional changes within the battery to reduce the probability that a cell failure will propagate from cell to cell. And third, we designed a new steel enclosure that isolates the battery from the rest of the electronic equipment bay and which, in the unlikely event of a failure, will vent all battery vapors outside the airplane. Importantly, the enclosure's design minimizes the amount of oxygen inside the box, thus eliminating the possibility of a fire.

Taken in combination, these improvements to the 787's battery system significantly reduce the likelihood of a battery failure and further ensure that should a failure occur there will be no significant impact on the airplane. After a series of rigorous certification tests, the FAA and other regulatory agencies gave 787 operators approval to resume commercial flights. We have high confidence in our solution, which enhances what was already a very safe airplane. But as mentioned earlier, we will continue to fully support the ongoing NTSB and JTSB investigations, and we will take into account any future findings those investigations may reach.

The FAA was deeply involved in the process that culminated in the certification of our battery solution. After the first incident, the FAA and Boeing began evaluating all of the known facts and data through the Continued Operational Safety Program, or COSP, a disciplined process established in 1999 to assess in-service incidents. Using COSP, we determine whether an incident demonstrates a significant safety issue, and if so, we determine what immediate mitigating actions might be needed (if any) until a longer term, more permanent solution is found.

After the second battery incident, the FAA and Boeing again evaluated the situation using the COSP process. And following the FAA Administrator's subsequent decision to suspend 787 operations, experts from the agency closely monitored the design work and the tests we conducted to validate the proposed improvements to the battery, and of course supervised the rigorous process that certified the new design.

I will share more thoughts about certification in a minute because I know that is a subject of great interest to this Committee. But first I want to give you an update on the status of the 787 fleet. I am very happy to report that the 787 modifications certified by the FAA have been completed on all of the 50 airplanes that had been delivered prior to the suspension of operations, and as of June 4th all 50 were back in revenue service. In addition, Boeing has been delivering new 787s from its factories with the approved modifications since May 14. A great airplane has returned to the sky, and I am confident it will serve our airline customers and the traveling public extremely well for decades to come.

The High Standards for Airplane Certification and Delegated Authority

That confidence is rooted not only in my own experience on the 787 program, and with the Boeing team and outside experts from industry and government who worked on the battery solution, but also in the certification process that, like our airplane designs, has continuously improved through the years. It is a process wherein the FAA defines the requirements that a new airplane must meet, and the manufacturer demonstrates through FAA-approved analyses and tests that the designs, and the airplanes built to those designs, meet all FAA requirements.

A key component of every airplane certification is the FAA's process for the delegation of authority. Delegated authority furthers the top priority of industry and government that I mentioned at the beginning of my remarks – safety. The ability to delegate authority for more routine certification tasks to qualified individuals enables FAA specialists to focus on the highest-priority issues. As the certification process has grown more robust, delegation also enables Boeing and the FAA to complete the certification process more efficiently and robustly.

Delegation is nothing new. As a practice, it dates back to the late 1920s. And when Congress created the current FAA in 1958, it correctly surmised that if FAA officials were to analyze and review compliance with every single certification requirement, it would require thousands of new engineers and inspectors, additional facilities, and likely hundreds of millions of dollars in new annual funding. Congress recognized the fiscal and practical necessity of using private sector expertise to keep pace with the growing aviation industry, and wisely gave the FAA authority to delegate certain certification activities to qualified persons – in effect enabling the agency to leverage its own resources by tapping into the considerable expertise of the private sector.

For reasons of both effectiveness and efficiency, delegated authority has transitioned from individual designations to organizational designations. Organizations that demonstrate and maintain strict

accountability to certification requirements and processes may receive what is called Organization Designation Authorization, or ODA. As the name implies, ODA status allows an organization to perform certain certification tasks on behalf of the FAA. It is a privilege that is hard to obtain and that carries with it serious responsibilities. Notably, the FAA remains in control of the certification process. It retains authority for approval and oversight of all ODA procedures, determines which portions of any given certification project are delegated, and retains ultimate and sole authority to issue airplane type certificates.

ODA holders are governed by stringent FAA requirements that include having an FAA-approved process for selecting and training individuals to perform the delegated tasks. In accordance with FAA procedures, the agency is notified when an individual is selected for ODA membership, and it is given an opportunity to participate in the evaluation of candidates and provide feedback. The FAA also retains the right to direct the removal of an underperforming member.

I can tell you from personal experience that the members of the Boeing ODA are held to a very high standard. They are well qualified, well trained, and take their responsibilities as representatives of the FAA Administrator very seriously. These professionals focus intensely on one goal – to ensure full compliance with all FAA requirements. And they are, by design, and with the full support of the company, protected from pressures to cut corners or otherwise act in a manner inconsistent with FAA procedures and standards. Boeing has established communication channels that enable them to report undue pressure directly to senior management, as well as the FAA, which conducts oversight and formal audits. Members of the Boeing ODA also regularly check on each other through a system of peer reviews.

The Robust Nature of the 787 Certification Process

The certification process for the 787 was the most rigorous and comprehensive certification process in Boeing's history. Boeing applied for certification in March of 2003. It was an eight-year process, involving thousands of safety demonstrations, from design review to component testing to system and structural testing and finally to flight testing. The compliance checklist alone for the 787-8 was 3,342 pages long. The thousands of topics on that list included such items as takeoff speeds, performance with one engine inoperative, stall characteristics, emergency lighting, material strength properties, bird strikes, warning lights, oxygen equipment, even the shape of the knobs on cockpit controls.

It is hard to overstate the comprehensive nature and rigor of the 787 certification process, which involved three times more conformed tests than the 777 certification program, three times more data submittals showing compliance, twice as many airplane ground tests, and three times more integration testing.

Beginning with the design phase, every element of the 787 was examined and evaluated to determine how it performed, both separately and in conjunction with other parts and systems. It was a top to

bottom evaluation, spanning everything from the raw materials used to make airplane parts to the overall performance of the airplane in flight.

The 787's integrated electrical power system, which includes the batteries, underwent more than 5,000 hours of component-level testing, followed by more than 25,000 hours of laboratory testing to demonstrate the battery's interaction with various system elements during normal operations as well as during simulated, abnormal failure conditions. At the airplane level, the integrated electrical system underwent more than 10,000 hours of testing under normal operating conditions and under simulated, abnormal conditions, including extreme weather, long and short flight durations, and low and high elevations.

Two full-scale replicas of the 787 were created for static and fatigue testing of the airplane's structure. The wings and fuselage of one of the replicas were manipulated during static testing to simulate conditions far beyond what any airplane would ever experience in service. The second replica is undergoing fatigue testing that simulates the structural stress on the plane. That testing eventually will simulate a total of at least 132,000 flights.

The first flight of the 787 occurred on December 15, 2009, and in April of 2010 the 787 began the FAA's extensive flight test program. Engineers demonstrated compliance with over 25,000 test conditions as part of the flight test program.

The testing included multiple environments and scenarios. Take-offs and landings in extreme cross-winds were tested in Iceland. Cold weather starting was tested at minus 45 degrees Fahrenheit. Take-offs and operations with a single engine and simulated generator failures were demonstrated, along with a multitude of other simulated system failures. High altitude take-offs were tested in La Paz, Bolivia at an elevation of 13,000 feet. Take-offs and operations with the airplane overweight were tested, as were aborted take-offs and tail-strike take-offs.

To obtain certification and to test the airplane's capabilities, multiple 787s logged over 1,700 flights during testing, flying for over 5,000 hours, including endurance flights. They performed ultra-long-distance flight tests, including an indirect route from Guam to Everett, Washington, that lasted 18 hours. The pilots simulated system and engine failures to demonstrate that the airplane could still safely reach a distant airport. The 787 also set new records for both speed and distance in its weight class by flying from Seattle to Bangladesh—10,337 nautical miles, and around the world in under 42.5 hours.

The FAA oversight was extensive during the flight test program and it observed and reviewed the tests using two methods. An FAA official was aboard for approximately 25 percent of the flight test hours. The tests conducted during the remaining hours were observed by Boeing personnel qualified and trained to act as FAA delegates during the certification process.

One reason delegated authority and the overall certification process have worked so well is that both have evolved and improved in response to changing technologies and conditions in the industry. This

evolution must continue. Boeing is grateful that this Committee recognized that fact in the FAA Modernization Act of 2012, which in sections 312 and 313 directed the agency to further improve its certification and regulatory processes. In response, a number of good recommendations have emerged via the Aviation Rulemaking Committee process, but they have not been fully adopted. On behalf of Boeing and others in the aerospace industry, I encourage the Committee to continue working with the FAA to ensure timely implementation of these important recommendations. The Committee has provided a great opportunity through the reauthorization bill to achieve progress in this area, and our nation's aviation industry will be strengthened by your oversight of these provisions.

Boeing's Commitment to Continued Safe Operations

In closing I would like to return briefly to a subject I mentioned earlier in my testimony because it is such an important part of the aviation safety story. Certification is not the end of Boeing's – or the FAA's – involvement in ensuring the safety of the airplanes delivered to our customers. I mentioned that we track the performance of every airplane we build for as long as it is in service. We collect and analyze enormous amounts of operational data, and we are not alone in that regard. Airlines, manufacturers, and government regulators around the world collect, share and analyze the performance of the in-service fleet, and when we spot a safety issue, or see a troublesome trend, we work together to address the issue or trend so that safety of flight is maintained.

At Boeing, we established a formal, FAA-approved process 20 years ago to monitor the in-service fleet, identify emerging issues, make disciplined, data-driven safety decisions, and take corrective action where and when needed in coordination with our customers and the regulatory agencies. We called it the Boeing In-Service Safety Process, and in 1999 it evolved into the Continued Operational Safety Program that I mentioned earlier.

Also in the 1990s we began regular, periodic reviews of safety initiatives at other aerospace companies, at companies in other industries, and at government agencies, both here in the United States and abroad. We regularly share best practices and key findings so that we can continue to advance the safety of flight.

Collaborative action is essential to safe flight because, while we strive to design and build perfect airplanes and to anticipate all potential problems, the unexpected sometimes happens and we learn something new. It is vitally important, therefore, that we have the people and processes in place to ensure that the learning never stops, that we continue to advance our knowledge of airplanes and the conditions in which they operate, and that we incorporate those valuable lessons learned into the active fleet and future designs so that safety issues and problems do not become fatal accidents.

Our recent experience with 787 battery failures was both a surprise and a disappointment, but it also was a testament to why Boeing and the industry as a whole have achieved a superb safety record. Two batteries on separate airplanes failed. But since the safe management of potential component-level failures is central to our design philosophy, no one was hurt, and the damage to the airplane in both

cases was limited to the batteries and areas immediately around them. From that standpoint, what happened in Boston and Japan in January demonstrated a central tenet of our design philosophy.

Furthermore, what happened in the wake of those two incidents demonstrated our strong commitment to safety and the collaborative approach we take to ensuring safe flight. The unexpected occurred, talent was quickly brought to bear from both industry and government, a solution was found, tested and certified, modifications were implemented, and 787s are now flying again.

The strong commitment to safety and the collaboration we find across the aviation world, coupled with our in-service monitoring and data-driven, risk management approach to designing new airplanes, are key reasons that flying is the world's safest way to travel. You no doubt have heard these statistics, but they are worth repeating here. It is 70 times safer to fly in a commercial jet than it is to drive a car. More people die every year by accidental drowning than have died over the past 30 years of commercial flying. In the decade from 1998 to 2008 the fatal accident rate for U.S. commercial airline operations dropped by more than 80 percent, and in several years recently there have been zero deaths from airline accidents here in the United States.

None of this is happenstance.

Mr. Chairman, that ends my formal remarks. I thank you for this opportunity to testify before the Committee, and I will be happy to answer any questions..