NATIONAL TRANSPORTATION SAFETY BOARD

An independent Federal agency

Testimony of the Honorable Christopher A. Hart
Chairman
National Transportation Safety Board
Before the
Subcommittee on Aviation Operations, Safety, and Security
Committee on Commerce, Science and Transportation
United States Senate
Washington, DC
on
FAA Reauthorization: Aviation Safety and General Aviation
April 28, 2015

Good afternoon Chairman Ayotte, Ranking Member Cantwell, and the Members of the Subcommittee. Thank you for inviting the National Transportation Safety Board (NTSB) to testify before you today.

The NTSB 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.

Since its inception, the NTSB has investigated more than 140,500 aviation accidents and thousands of surface transportation accidents. On call 24 hours a day, 365 days a year, NTSB investigators travel throughout the country and internationally to investigate significant accidents and develop factual records and safety recommendations with one aim—to ensure that such accidents never happen again. The NTSB's annual Most Wanted List highlights safety-critical actions that the US Department of Transportation (DOT), United States Coast Guard, other Federal entities, states, organizations, and others need to take to help prevent accidents and save lives.

To date, we have issued over 14,000 safety recommendations to nearly 2,300 recipients. Because we have no formal authority to regulate the transportation industry, our effectiveness depends on our reputation for conducting thorough, accurate, and independent investigations and for producing timely, well-considered recommendations to enhance transportation safety.

In January, 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 three multimodal items that affect aviation safety as well as three aviation-specific issues --

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

Each of these Most Wanted List issues emphasizes the need for critical actions by the aviation safety regulator – the FAA– manufacturers, operators, pilots, and airport authorities. The NTSB readily acknowledges the impressive work and oversight performed by the FAA, and

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

its track record in ensuring that this country's aviation system is the safest in the world. 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.

General Aviation Safety

The U.S. commercial aviation system is experiencing an unprecedented level of safety. With regard to general aviation (GA) accidents, there has been a decrease in all measures. The total number of general aviation accidents decreased by 249 in 2013, bringing the number to 1,222.[2] The number of fatal accidents (221) and fatalities (387) also declined from the previous year; however, the accident rate per 100,000 flight hours (5.85) has remained relatively the same. Although GA represented almost 50 percent of the estimated total flight time of all U.S. civil aviation in 2013, it accounted for 94 percent of fatal accidents. As required by statute, the NTSB determines the probable cause of all aviation accidents, and one thing we have learned is that unfortunately, the same factors continue to cause most of the accidents.

The leading causes of GA accidents are loss of control, engine failure, flying in conditions that are beyond the pilot or aircraft's abilities, and collision with terrain. GA is essentially an airline of one, which means the entire aviation community must work harder to reach each pilot or mechanic who populates this community to address these issues and prevent accidents. Preventing Loss of Control in Flight in GA is on the NTSB's 2015 Most Wanted List in order to bring attention to the issue.[3]

Last month, the NTSB issued four Safety Alerts, which are included with my testimony, and last week we issued a Video Safety Alert.[4] The NTSB's purpose in issuing these safety alerts and video is to increase awareness, education, and training for private pilots and aviation maintenance technicians. The alerts are brief information bulletins that pinpoint particular safety hazards and offer practical remedies to address these risks. They also serve to focus the NTSB's GA outreach efforts during the coming year. Three of the safety alerts are geared towards pilots and address mountain flying skills and survival equipment considerations, transition training before flying an unfamiliar aircraft with different flight characteristics or avionics, and performing thorough and advanced preflight checks on aircraft that have just received flight control or trim system maintenance. The Safety Alert aimed at mechanics discusses flight control and trim system misrigging problems. Each Safety Alert includes accident summaries from some of our accident investigations and the role the safety issue played in those accidents. The Video Safety Alert titled, *Airplane Misrigging: Lessons Learned from a Close Call*, highlights an inflight emergency that occurred near St. Louis in December 2014. The video features interviews with the two pilots who experienced reversed trim system control in a Cessna T182T and the mechanic who performed the maintenance. Both the pilots and the mechanic provide important insight to help other pilots and mechanics avoid becoming involved in a

[2] http://www.ntsb.gov/investigations/data/SiteAssets/Pages/Accident-data-review/2013%20Preliminary%.
[3] http://www.ntsb.gov/safety/mwl/Documents/MWL_2015_Factsheet_07.pdf.
[4] Mastering Mountain Flying, SA-039; Understanding Flight Experience, SA-040; Pilots: Perform Advanced Preflight After Maintenance, SA-041; and Mechanics: Prevent Misrigging Mistakes, SA-042.

similar situation. I'm pleased to report that within the first 24-hours after we posted the video on the NTSB public website, the video received over 44,000 separate "hits." The Safety Alerts and video provide general guidance on how to apply the lessons learned from accidents and incidents and provide pilots and mechanics with free educational resources to learn more about prevention strategies.

Additionally, over the past five years, the NTSB has conducted several GA safety studies. In 2014, we examined the prevalence of drug use by all pilots who died in crashes and found an upward trend in the use of both potentially impairing medications and illicit drugs.[5] Almost all of the crashes – 96 percent – were in general aviation. I will discuss this study in more detail later. Last year, NTSB also issued a Special Investigation Report on the Safety of Agricultural Aircraft Operations.[6] As a result of the safety issues identified in the study, the NTSB issued safety recommendations to the FAA and the National Agricultural Aviation Research & Education Foundation urging the two organizations to work together to develop and distribute agricultural operations-specific guidance on fatigue management, risk management, aircraft maintenance, and pilot knowledge and skills tests. In 2012, we examined the safety of experimental amateur-built aircraft, which represent about 10 percent of the GA fleet but are involved in a higher proportion of GA accidents.[7] The NTSB recommended expansion of documentation requirements for initial aircraft airworthiness certification, verification of the completion of Phase I flight testing, improvement of pilots' access to transition training, encouragement of the use of recorded data during flight testing, ensuring that buyers of used experimental aircraft receive necessary operating and performance documentation, and improvement of aircraft identification in registry records. In a study of airbag restraints in GA aircraft, the NTSB concluded that aviation airbags can mitigate occupant injuries in some severe but survivable crashes.[8] In 2010, the NTSB looked at "glass cockpits" in GA, which are the newer electronic displays in some planes.[9] The results of this study suggested at the time that the introduction of glass cockpits had not yet resulted in a measurable improvement in safety when compared to similar aircraft with conventional instruments. There is a need to ensure pilots have system specific knowledge to safely operate aircraft with glass cockpit avionics and to capture maintenance and operational information to assess the reliability of glass cockpit avionics.

We will continue our efforts to improve the safety record of general aviation, and we look forward to finding new and innovative ways to communicate this message to more pilots and mechanics.

---

[5] NTSB, *Drug Use Trends in Aviation: Assessing the Risk of Pilot Impairment*, No. NTSB/SS-14/01 (September 9, 2014).
[6] NTSB, *Special Investigation Report on the Safety of Agricultural Aircraft Operations*, No. NTSB/SIR-14/01 (May 7, 2014).
[7] NTSB, *The Safety of Experimental Amateur-Built Aircraft*, No. NTSB/SS-12/01 (May 22, 2012).
[8] NTSB, *Airbag Performance in General Aviation Restraint Systems*, No. NTSB/SS-11/01 (January 11, 2011).
[9] NTSB, *Introduction of Glass Cockpit Avionics into Light Aircraft*, No. NTSB/SS-10/01 (March 9, 2010).

Strengthening Procedural Compliance

The NTSB continues to seek new ways to strengthen procedural compliance, from identifying inadequate procedures, to ensuring comprehensive training, to reemphasizing practices that reinforce crew compliance. Recent accidents underscore the importance of procedural compliance. In 2013 there were two major controlled flight into terrain accidents in which crews did not follow standard operating procedures -- Asiana flight 214 in San Francisco, California, and UPS flight 1354 in Birmingham, Alabama. The NTSB is examining whether procedural compliance may have played a role in a number of other ongoing air carrier accident and incident investigations as well. Over the last 10 years, the NTSB has investigated more than a dozen airline or commercial charter accidents involving procedural, training or compliance issues.

Sometimes crews do not comply with air carriers' standard operating procedures, such as flying stabilized approaches, making required callouts, maintaining quiet (or sterile) cockpits, and monitoring critical flight parameters like airspeed. But other times, the procedures themselves aren't good enough. For example, an airplane ran off the end of the runway in a case in which an airline did not require crews to calculate landing distance on arrival.[10] This is only one of many such cases. In other cases, training does not adequately prepare crews.[11]

Aviation accidents and incidents can be prevented through collaborative efforts by crews, operators, and regulators. Working together, they can develop effective procedures and training, and ensure that crews do what they are trained to do. I am a strong believer in the power of collaboration to produce continuous improvement because of the amazing safety improvement that this industry has enjoyed as a result of its collaborative process known as CAST, the Commercial Aviation Safety Team. The core of the CAST process is very simple: everyone who is involved with this issue – in this case, further reducing the risk of aviation fatalities and improving a safety record that is already very good – should be involved in developing the solution, including industry, organizations representing employees, and government agencies. This model has more recently been extended to the general aviation community through the General Aviation Joint Steering Committee (GAJSC) which uses the CAST processes to improve GA safety through data-driven risk reduction efforts that focus on education and training. Similarly, GAJSC participants include the FAA and industry stakeholders such as pilot organizations, instructors, mechanics, builders and manufacturers. Collective and collaborative leadership is needed to promote and reinforce a culture of continuous safety improvement beyond mere compliance – a culture essential to safety.

---

[10] NTSB, *Runway Overrun and Collision Southwest Airlines Flight 1248, Boeing 737-7H4, N471WN, Chicago Midway International Airport, Chicago, Illinois on December 8, 2005*, Rpt. No. AAR-07-06 (October 2, 2007).
[11] *See e.g.*, NTSB, *Runway Overrun During Rejected Takeoff, Global Exec Aviation,Bombardier Learjet 60, N999LJ, Columbia, South Carolina on September 19, 2008*, Rpt. No. AAR-10-02 (April 6, 2010); NTSB, *Loss of Control and Crash, Marlin Air, Cessna Citation 550, N550BP, Milwaukee, Wisconsin on June 4, 2007*, Rpt. No. 09-06 (October 14, 2009).

Pilot Training and Professionalism and Disconnecting from Distractions

Colgan Air flight 3407 crashed on approach to the Buffalo Niagara International Airport in Buffalo, NY on February 12, 2009.[12] As a result of that accident investigation, the NTSB issued recommendations to address pilot and crew training, maintaining detailed training records, making this information available to other airlines that are considering hiring a pilot, and mentoring and professionalism programs.[13] Congress enacted some of these recommendations into law in the Airline Safety and Federal Aviation Administration Extension Act of 2010 (the 2010 Act), such as the requirement that FAA create a new centralized database of FAA and air carrier pilot records that are retained for the life of a pilot and that airlines review those records during the hiring process.[14] These recommendations[15] remain open as the FAA works to develop a notice of proposed rulemaking (NPRM) to create a pilot records database (PRD), and we will determine if the rulemaking meets the intent of the recommendations. While some of the NTSB's recommendations have been or are being addressed by FAA, other recommendations concerning pilot leadership training and professionalism remain open with unacceptable responses.[16] Also, in the Colgan Air flight 3407 accident investigation, we found that industry changes, including two-pilot cockpits, had resulted in opportunities for pilots to upgrade to captain without having accumulated significant experience as a first officer in a Part 121 operation. Without important opportunities for mentoring and observational learning, which characterize time spent in journeyman pilot positions, it was difficult for a pilot to acquire effective leadership skills to manage a multicrew airplane.

The 2010 Act included a mandate for the FAA to develop regulations to encourage and promote airline flight crew professionalism and mentoring. The FAA developed an NPRM and submitted it to the Office of Management and Budget in May 2011. Three years later, in April 2014, the NPRM was returned to the FAA for revisions. As of today, despite the 2010 Act, the NPRM has not yet been published.

In addition to Colgan Air, we have seen other accidents and incidents that are tragic reminders that more needs to be done to improve aviation safety. As we have learned through our accident investigations, when flight crews and controllers deviate from standard operating procedures and established best practices, the consequences can be tragic.

- In the March 15, 2012, fatal crash following an in-flight fire involving a Convair CV-440-38, N153JR, operated by Fresh Air, Inc, the flight crew's failure to

[12] NTSB, *Loss of Control on Approach: Colgan Air, Inc. Operating as Continental Connection Flight 3407, Bombardier DHC-8-400, N200WQ, Clarence Center, New York on February 12, 2009*, Rpt. No. AAR-10-01 (February 2, 2010).
[13] A-10-10 through -34; reiterated recommendations A-05-1, A-05-14, and A-07-13.
[14] Pub. L. 111-216, August 1, 2010.
[15] A-10-17 through -20.
[16] Recommendations A-10-10, -16, and -30 have been closed with unacceptable action. Recommendations A-10-13, -14, -15, and -22 remain open with unacceptable responses.

maintain adequate airspeed after shutting down the right engine due to an in-flight fire resulted in either an aerodynamic stall or a loss of directional control.[17]

- In the July 31, 2008, accident involving East Coast Jets flight 81, a Hawker Beechcraft Corporation 125-800A, N818MV, crashed while attempting to go around after landing on runway 30 at Owatonna Degner Regional Airport, Owatonna, Minnesota. The two pilots and six passengers were killed, and the airplane was destroyed by impact forces. The captain allowed an atmosphere in the cockpit that did not comply with well-established procedures, and this atmosphere permitted inadequate briefing of the approach and monitoring of the current weather conditions; inappropriate conversation; nonstandard terminology; and a lack of checklist discipline throughout the descent and approach phases of the flight.[18]

- An engine fire on an American Airlines MD-80 in 2007 involved a crew engaged in non-pertinent discussion during taxi and after landing "indicating that a casual atmosphere existed in the cockpit." This casual atmosphere "before takeoff affected and set a precedent for the pilots' responses to the situations in flight and after landing, eroding the margins of safety provided by the SOPs and checklists, and increased the risk to passengers and crews."[19]

- In the 2006 fatal wrong runway takeoff accident in Lexington, KY, involving Comair, it was "the flight crew's noncompliance with standard operating procedures [which]… most likely created an atmosphere in the cockpit that enabled the crew's errors." Contributing to the probable cause was "the flight crew's non-pertinent conversation during taxi, which resulted in a loss of positional awareness."[20]

Another concern for the NTSB is the mode confusion that can result from increasing automation. A classic accident of this type was the crash of Asiana Airlines flight 214 in 2013 when it struck a seawall while on approach to San Francisco International Airport.[21] The pilots relied too much on automation that they didn't fully understand and mismanaged the landing as it went wrong. As the airplane reached 500 feet above the airport elevation, the approach was not stabilized as the airplane was slightly above the desired glidepath. The descent rate was too high, and the airspeed was decreasing. Based on these indications, the flight crew should have

[17] NTSB, *Crash Following In-Flight Fire Fresh Air, Inc. Convair CV-440-38, N153JR, San Juan, Puerto Rico on March 15, 2012*, Rpt. No. AAR-14-04 (November 17, 2014).
[18] NTSB, *Crash During Attempted Go-Around After Landing, East Coast Jets Flight 81, Hawker Beechcraft Corporation 125-800A, N818MV, Owatonna, Minnesota on July 31, 2008 7*, Rpt. No. AAR-11-01 (March 15, 2011).
[19] NTSB, *In-Flight Left Engine Fire American Airlines Flight 1400, McDonnell Douglas DC-9-82, N454AA, St. Louis, Missouri on September 28, 2007*, Rpt. No. AAR-09-03 (April 7, 2009).
[20] NTSB, *Attempted Takeoff From Wrong Runway, Comair Flight 5191 Bombardier CL-600-2B19, N431CA, Lexington, Kentucky on August 27, 2006*, Rpt. No. AAR-07-05 (July 26, 2007).
[21] NTSB, *Descent Below Visual Glidepath and Impact With Seawall, Asiana Airlines Flight 214 Boeing 777-200ER, HL7742, San Francisco, California on July 6, 2013*, Rpt. No. AAR-14-01 (June 24, 2014).

determined that the approach was unstabilized and initiated a go-around, but they did not do so. The crew did not become aware of the problem until the airplane reached 200 feet, and did not initiate a go-around until the airplane was below 100 feet, at which point the airplane did not have the performance capability to accomplish a go-around. The flight crew's insufficient monitoring of airspeed indications during the approach resulted in part from over reliance on automation. Unfortunately, this manifests a problem that is industry-wide, and not just limited to these pilots having a bad day. The bottom line is that automation is very beneficial, and it has a demonstrated history of improving safety, reliability, and productivity. Unfortunately, however, the industry still has a way to go to achieve a better understanding of the human/automation interface.

Last but not least, while new connectivity has enabled new safety technologies, it has also enabled new forms of distraction, leading to accidents, even in the most strictly regulated transportation enterprise of aviation. As a result of the NTSB's investigation of both Northwest Flight 188 that overflew its Minneapolis destination because the pilot and co-pilot were distracted by their laptops and Colgan Air Flight 3407, where the first officer sent a text message on her personal cell phone during the taxi phase of the accident flight, we issued a safety recommendation to the FAA to amend the Federal Aviation Regulations (FAR) to require Part 121, 135, and 91 subpart K operators to incorporate explicit guidance to pilots prohibiting the use of personal portable electronic devices on the flight deck.[22] In addition, Congress mandated that the FAA promulgate a rule which would prohibit the use of personal wireless communications devices and laptop computers by flight crewmembers during all phases of flight in Part 121 operations. The FAA issued an NPRM for this requirement in January 2013.[23] The NTSB submitted comments to the docket in support of the proposed rule but recommended that the final rule incorporate the broader scope of its February 2010 safety recommendation by expanding the proposed rule to Part 135 and 91 subpart K operators. The final rule, published in February 2014,[24] limited the prohibition to flight crew members in operations under Part 121. While the final rule is a step in the right direction, it is not enough and more needs to be done to expand the applicability of the rule to Part 135 and 91 subpart K operators. Accidents like that on August 26, 2011, near Mosby, Missouri, involving an Emergency Medical Service helicopter and a distracted pilot drive this fact home. All on board that helicopter were killed in the accident.[25]

Requiring Fitness for Duty, Ending Substance Impairment, and Addressing Human Fatigue

Requiring Medical Fitness for Duty is on the NTSB's 2015 Most Wanted List in order to bring attention to this critical issue in all modes of transportation.[26] Medical conditions and treatments that impair transportation professionals' performance directly affect safety. To

[22] A-10-30.
[23] 78 Fed. Reg. 2912 (January 15, 2013).
[24] 79 Fed. Reg. 8257 (February 12, 2014).
[25] *NTSB, Crash Following Loss of Engine Power Due to Fuel Exhaustion Air Methods Corporation Eurocopter AS350 B2, N352LN, Near Mosby, Missouri, August 26, 2011*, Rpt. No. AAR-13-02 (April 9, 2013).
[26] http://www.ntsb.gov/safety/mwl/Documents/MWL_2015_Factsheet_08.pdf.

mitigate the risk to the public, the NTSB has made recommendations for a comprehensive medical certification system for safety-critical transportation personnel, including these features:

- a complete medical history of the applicant, taken at prescribed intervals, that includes medications, conditions, and treatments as well as a physical examination
- specific historical questions and physical examination procedures to identify applicants at high risk for sleep disorders
- identification of specific conditions, treatments, and medications that initially disqualify applicants for duty, with certification contingent on further testing (specific to each condition)
- explicit and uniform processes and criteria for determining when the applicant has a treated but otherwise disqualifying condition
- certificates that are good only for a limited time for applicants with conditions that are currently stable but known to be likely to deteriorate, to ensure appropriate retesting
- medical examiners who
    - are licensed or registered to both perform examinations and prescribe medication in a given state;
    - are specifically trained and certified to perform medical certification exams; and
    - have ready access to information regarding disqualifying conditions and required further evaluation
- a review system for medical examiners' work product(s) with both the information and capacity to identify and correct errors and substandard performance
- the capacity to prevent applicants who have been deferred or denied certification from finding another provider who will certify them
- a process for dealing with conditions which could impair safety and are diagnosed between certification exams.

The medical requirements for pilots are robust. These standards are important because of the impact that accidents can have on public safety and passengers, and we find in all modes that adverse health conditions can lead to accidents. Some pilots are not medically fit to operate aircraft, and those suffering from impairing medical disorders should not be at the controls unless and until they receive medical treatment that mitigates the risk to the public.

In addition, NTSB investigations have found impairment by various substances as a cause or a contributing factor in transportation accidents, and use of over-the-counter (OTC) and prescription medications as well as illicit drugs is generally increasing. Since there is a great amount of overlap among these groups – the same substance may be available by prescription or over the counter and many medications are also used illicitly by people without a prescription for their psychoactive effects – I will use the term "drugs" broadly to mean any of these substances. Aircraft are complex machinery that require pilots to be at their best – not impaired by alcohol or drugs. In September 2014, the NTSB issued a safety study that examined trends in the

prevalence of drugs identified by toxicology testing of fatally injured pilots between 1990 and 2012.[27] The goals of the study were to describe the prevalence of OTC, prescription, and illicit drug usage among fatally injured pilots over time and evaluate the need for safety improvements related to pilots' use of drugs. Study results showed the prevalence of potentially impairing drugs increased from an average of 11 percent of fatally-injured accident pilots during the period from 1990-1997 to an average of 23 percent of accident pilots during the period 2008-2012. During the same time periods, positive marijuana results increased from 1.6 percent to 3.0 percent. But the most commonly found impairing substance in fatal crashes was diphenhydramine, a sedating antihistamine and an active ingredient in many OTC allergy formulations, cold medicines, and sleep aids. Of note, 96% of the pilots in this study were flying in general aviation operations when their fatal accident occurred.

As a result of this safety study, the NTSB recommended that FAA: (1) develop, publicize, and periodically update information to educate pilots about the potentially impairing drugs identified in FAA toxicology test results of fatally injured pilots, and make pilots aware of less impairing alternative drugs if they are available; (2) obtain information about the number and flight hours of pilots flying without medical certificates because the FAA identifies "active pilots" as those who maintain their medical certification; (3) develop and distribute a clear policy regarding any marijuana use by airmen regardless of the type of flight; and (4) conduct a study to assess the prevalence of OTC, prescription, and illicit drug use among flying pilots not involved in accidents, and compare those results with findings from pilots who have died from aviation accidents to assess the safety risks of using those drugs while flying.[28] In addition, the NTSB recommended that the 50 states, the District of Columbia, and the Commonwealth of Puerto Rico: (1) include in all state guidelines regarding prescribing controlled substances for pain a recommendation that health care providers discuss with patients the effect their medical condition and medication use may have on their ability to safely operate a vehicle in any mode of transportation and (2) enhance communication among prescribers, pharmacists, and patients about the transportation safety risks associated with some drugs and medical conditions.[29]

In addition, fatigue remains an issue of concern. For more than 20 years, the issue of reducing accidents caused by fatigue was on the NTSB's Most Wanted List of safety improvements. Since 1972, the NTSB has issued more than 200 human fatigue-related safety recommendations in all modes of transportation, including more than 53 recommendations addressing fatigue in aviation.[30] For example, we have recommended that all pilots be appropriately evaluated for obstructive sleep apnea and treated, if necessary.

We removed fatigue from our Most Wanted List in November 2012 to acknowledge the new flight and duty time rules for commercial passenger operations promulgated by the FAA. For the first time, the new rules recognize the universal factors that lead to human fatigue such as time of day, length of duty day, workload, whether an individual is acclimated to a new time

[27] NTSB, *Drug Use Trends in Aviation: Assessing the Risk of Pilot Impairment*, No. NTSB/SS-14/01 (September 9, 2014).
[28] A-14-92 through -95.
[29] I-14-1 and -2.
[30] *See, e.g.*, A-06-10, A-08-44, and A-09-61 through -66.

zone and the likelihood of being able to sleep under different circumstances. However, flight and duty time rules cannot control what employees do on their own time. In addition, we remain concerned that the new rule does not apply to cargo pilots, nor to Part 135 operations. Fatigue is fatigue, whether passengers or pallets are being transported; it degrades every aspect of human capability. Another fatigue issue not addressed by the new rules is pilot commuting; a concern the NTSB identified in the Colgan Air accident. We have seen the effects of fatigue in too many of our accident investigations. We will continue working toward one level of safety throughout the industry.

Enhancing Public Helicopter Safety

On September 27, 2008, a Maryland State Police (MSP) helicopter, Trooper 2, received a medevac flight request to pick up two patients involved in an automobile accident. Trooper 2 reached the accident site, loaded the patients, but never reached the hospital. On June 9, 2009, a New Mexico State Police (NMSP) helicopter pilot received a request for an aerial search for a lost hiker. The NMSP pilot landed the helicopter, located the hiker, departed from the mountain, but did not make it back to base. A very similar situation occurred on March 30, 2013. The Alaska Department of Public Safety (ADPS) helicopter pilot received a request to rescue a stranded snowmobiler. The pilot landed the helicopter, located the snowmobiler, departed from the frozen lake, but did not reach the designated landing zone. Prior to accepting their missions, both the MSP and NMSP pilots expressed concern about weather conditions. Although the pilot of the ADPS helicopter did not discuss the weather with anyone, he should have been aware of the deteriorating conditions. However, all three pilots accepted and attempted to complete the missions even when faced with poor weather at night. And tragically, the helicopters crashed before reaching their destinations, killing a total of nine people. Crashes involving public helicopters are not just limited to those used by law enforcement agencies. On August 5, 2008, a U.S. Forest Service (USFS) helicopter conducting firefighting missions in California impacted trees and terrain during the initial climb after takeoff. The pilot, the safety crewmember and seven firefighters were killed in this accident.

As a result of the 2008 USFS accident in California, the NTSB recommended that FAA develop and implement a surveillance program specifically for Part 135 civil aircraft operators that provides contract support to government entities in order to maintain continual oversight to ensure compliance with Part 135 requirements.[31] The NTSB also recommended the FAA take appropriate actions to clarify FAA's authority over public aircraft and identify and document where such oversight responsibilities reside in the absence of FAA authority.[32] In 2014, the FAA published an Advisory Circular[33] which sought to clarify oversight responsibilities for civil aircraft operators providing contract support to government entities, as recommended. However, the Advisory Circular does not provide for continual FAA oversight of the airworthiness of aircraft that hold civil airworthiness certificates and that operate part of the time as public aircraft and part of the time as civil aircraft—a position that is contrary to current guidance in FAA

[31] A-10-149.
[32] A-10-150.
[33] FAA, Advisory Circular 00-1.1A: Public Aircraft Operations (February 12, 2014).

Order 8900.1. We strongly encourage FAA to revise the Advisory Circular to provide for this oversight.

Since 2004, the NTSB has investigated more than 130 accidents involving federal, state, and local public helicopter operations, including the 4 mentioned above. Fifty people lost their lives and nearly 40 were seriously injured in these accidents. The lessons learned as a result of these investigations have the potential to make federal, state, and local public helicopter operations safer.

Aircraft Recorder Recommendations

Notwithstanding the NTSB's nearly 50 years of aviation accident investigations and role in securing improvements in recorder capabilities and locator technologies, the NTSB clearly recognizes that sophisticated aircraft accident investigation and analysis cannot be accomplished without recorded flight data. In order for our important work to continue and make a difference in saving lives, we must ensure that the technologies are available to locate aircraft wreckage and recorders after an accident and that critical flight data can be recovered.

The NTSB has long been concerned about rapid recovery of recorded information to guide investigations, help determine accident causes, and develop recommendations to prevent recurrences. To focus attention on this issue, the NTSB convened its *Emerging Flight Data and Locator Technology Forum* on October 7, 2014, in Washington, D.C.[34] Forum discussions among government, industry, and investigative experts helped identify the following safety issues:

- The need for improved technologies to locate aircraft wreckage and flight recorders following an accident in a remote location or over water

- The need for timely recovery of critical flight data following an accident in a remote location or over water

Other noteworthy information provided at the forum includes the following:

- Deployable recorder technologies: These technologies can be used to recover flight data without the delay of a long and expensive underwater recovery. Deployable recorders have been used in military and over water helicopter applications since the 1960s and are currently available from several manufacturers. They combine traditional flight data recorder and cockpit voice recorder functions into one unit and are capable of providing a comparable amount of flight data. They are designed to separate from the aircraft upon fuselage structural deformation or when submersed in water. If in water, they float indefinitely on the surface. These units are also equipped with emergency locator transmitters that operate on the 121.5 megahertz and 406 megahertz frequencies for

[34] Additional information about the forum is available at http://www.ntsb.gov/news/events/Pages/2014_Flight_Data_Locator_FRM.aspx.

location and recovery. Standards already exist for automatically deploying flight recorders.

- Triggered flight data transmission: A manufacturer of flight data transmission technology testified that triggered flight data transmission was not only feasible, but already in service on some aircraft. Additionally, at this time, manufacturers and operators are equipping their aircraft with commercial satellite communications systems that can support broadband video, voice, and data transmissions. Commercial satellite systems on the market today are primarily used for passenger and crew connectivity and can support speeds of 200-400 kilobits per second. Higher speed capability is forthcoming. Such bandwidth would enable real-time parametric flight data transmission to begin after a triggering event as well as transmission of a limited amount of stored flight data recorded before the triggering event.

On January 22, 2015, the NTSB issued a series of safety recommendations to the FAA[35] calling for improvements in locating downed aircraft and ways to obtain critical flight data faster and without the need for immediate underwater retrieval. In issuing its recommendations, the NTSB recognized that there are significant ongoing international industry and regulatory efforts to develop and adopt standards for enhanced aircraft position reporting and supplemental methods for recovering flight data. Achieving these goals on a global basis will demand a harmonized approach that addresses the needs of many stakeholders and ensures that domestic and foreign parties operate under equivalent standards. We also strongly support the need for performance-based standards for emerging technologies and data recovery. We applaud Ambassador Lawson and the International Civil Aviation Organization (ICAO) for their continued important work in addressing these issues.

The NTSB recommendations urge the FAA to:

- Require that all aircraft used in extended overwater operations (i.e., operations that occur over water at a distance of more than 50 nm from the nearest shoreline) and operating under Part 121 or Part 135 of the FAR that are required to have a flight data recorder and cockpit voice recorder be equipped with

    - a tamper-resistant method to broadcast to a ground station sufficient information to establish the location where an aircraft terminates flight as the result of an accident within 6 nautical miles of the point of impact, and

    - an airframe low frequency underwater locating device that will function for at least 90 days and that can be detected by equipment available on military, search and rescue, and salvage assets commonly used to search for and recover wreckage.

[35] A-15-1 through -6.

- Require that all newly manufactured aircraft used in extended overwater operations and operating under Part 121 or Part 135 of the FAR that are required to have a flight data recorder and cockpit voice recorder be equipped with a means to recover, at a minimum, mandatory flight data parameters; the means of recovery should not require underwater retrieval. Data should be captured from a triggering event until the end of the flight and for as long a time period before the triggering event as possible.

- Coordinate with other international regulatory authorities and ICAO to harmonize the implementation of the above-identified requirements recommended by the NTSB for locating where an aircraft terminates flight as the result of an accident and recovery of mandatory flight data parameters.

- Identify ways to incorporate adequate protections against disabling flight recorder systems on all existing transport category aircraft.

- Require that all newly manufactured transport category aircraft incorporate adequate protections against disabling flight recorder systems.

In addition, the NTSB has continued to re-emphasize the need for cockpit image recorders on commercial airplanes. In 2000, the NTSB issued two safety recommendations to the FAA on cockpit image recording systems and protection against deactivation of recording systems in response to investigations of several accidents involving a lack of information regarding crewmember actions and the flight deck environment, including ValuJet Flight 592, SilkAir Flight 185, Swissair Flight 111, and EgyptAir Flight 990. One recommendation[36] asked the FAA to require that that in-service aircraft operated under 14 CFR Part 121, 125, or 135 be equipped with a crash-protected cockpit image recording system. The second recommendation[37] asked for similar action for newly manufactured aircraft that would be operated under 14 CFR Part 121, 125, or 135. Both recommendations also asked that the FAA require placing recorder system circuit breakers in locations the flight crew could not access in-flight.

In the SilkAir and EgyptAir crashes, the flight data recorder and cockpit voice recordings provided limited information about crew actions and the status of the cockpit environment. Further, in the Air France Flight 447 crash and the September 3, 2010, crash of a Boeing 747-44AF, operated by United Parcel Service while attempting to return to Dubai International Airport following an in-flight cargo fire, the accident aircraft were equipped with FDRs that greatly exceeded the minimum parameter requirements. However, in these accidents, critical information related to the cockpit environment conditions (for example, crew actions and visibility), instrument indications available to crewmembers, and the degradation of aircraft systems was not available to investigators. Modern cockpit imaging systems can provide the information needed to help determine the cause of these types of accidents and to identify revisions needed to prevent a reoccurrence of the accident.

[36] A-00-30. In 2006, the NTSB reiterated A-00-30 as a result of its investigation of a 2004 accident involving Corporate Airlines Flight 5966, a BAE-J3201 aircraft, in Kirksville, Missouri.
[37] A-00-31.

Air Transportation of Lithium Batteries

There are two types of lithium batteries: primary and secondary. Primary lithium batteries are non-rechargeable and are commonly used in items such as watches and pocket calculators. They contain metallic lithium that is sealed in a metal casing. The metallic lithium will burn when exposed to air if the metal casing is damaged, compromised, or exposed to sustained heating. Secondary lithium batteries, also known as lithium-ion batteries, are rechargeable and are commonly used in items such as cameras, cell phones, laptop computers, and hand power tools. Secondary lithium batteries contain electrically charged lithium ions, and a flammable liquid electrolyte. External damage or overheating of the battery can result in thermal runaway or the discharge of flammable electrolyte. Another type of secondary battery, known as lithium polymer batteries, contains a flammable polymeric material rather than a liquid, as the electrolyte. Halon suppression systems, the only fire suppression systems certified for aviation, can be used to help control flames in lithium battery fires but will not extinguish the fire.

The demand for primary and secondary lithium batteries has skyrocketed since the mid-1990s as the popularity and use of electronic equipment of all types has grown. As the use of lithium batteries has increased, the number of incidents involving fires or overheating of lithium batteries, particularly in aviation, has likewise grown. The NTSB has investigated three such aviation accidents: Los Angeles, California (1999); Memphis, Tennessee (2004); and Philadelphia, Pennsylvania (2006). In addition, the NTSB has participated in the investigations of two accidents involving fires that may be related to lithium batteries that occurred on cargo airline flights operating in foreign countries: Dubai, United Arab Emirates (2010), and Jeju Island, Republic of Korea (2011).

The fires in these accidents included both primary and secondary lithium batteries, and the NTSB issued several recommendations as a result of these investigations. As a result of its investigation of the Los Angeles and Memphis incidents, the NTSB recommended that the Pipeline and Hazardous Materials Safety Administration (PHMSA), with the FAA, evaluate the fire hazards posed by lithium batteries in an aviation environment and require that appropriate safety measures be taken to protect the aircraft and occupants. The NTSB also recommended that packages containing lithium batteries be identified as hazardous materials, including appropriate labeling of the packages and proper identification in shipping documents when transported on aircraft. These recommendations have been closed with acceptable action by the regulators.

Following the Philadelphia accident, the NTSB issued six safety recommendations urging PHMSA to address the problems with lithium batteries on a number of fronts, including reporting all incidents; retaining and analyzing failed batteries; researching the modes of failure; and eliminating regulatory provisions that permit limited quantities of these batteries to be transported without labeling, marking, or packaging them as hazardous materials. In January 2008, the NTSB issued additional recommendations to PHMSA and the FAA to address the

NTSB's concerns about the lack of public awareness about the overheating and ignition of lithium batteries. PHMSA issued an NPRM[38] in January 2010 to address some of these recommendations, and the final rule was issued in August 2014.[39] The final rule is discussed in further detail below.

In September 2010, a Boeing 747-400F, operated by UPS, crashed on a military base in Dubai, United Arab Emirates (UAE), while the crew was trying to return to the airport for an emergency landing due to a fire in the main deck cargo compartment. Both crewmembers died as a result of injuries sustained during the crash, and the aircraft was a total loss. The UAE led this investigation,[40] and issued a final report on July 24, 2013.[41] The report found that at least three shipments of lithium ion battery packs that meet Class 9 hazardous material designation were onboard. In addition, in July 2011, a Boeing 747-400F, operated by Asiana Cargo and transporting a large quantity of lithium batteries, crashed about 70 miles west of Jeju Island, Republic of Korea, after the flight crew declared an emergency due to a cargo fire and attempted to divert to Jeju International Airport. Again, both crewmembers died as result of injuries sustained during the crash, and the aircraft was a total loss.

The NTSB held a public forum in April 2013 on lithium ion batteries in transportation.[42] We learned that lithium ion batteries are becoming more prevalent in the various transportation modes, national defense, and space exploration. Panelists stated that because of their high energy density and light weight, these batteries are natural choices for energy. These benefits, however, also are the source of safety risks. We also heard about manufacturing auditing, robust testing, and monitoring and protection mechanisms to prevent a catastrophic event.

When Congress enacted the FAA Modernization and Reform Act of 2012, it included a provision (section 828) that US hazardous materials regulations (HMR) on the air transportation of lithium metal cells or batteries or lithium ion cells or batteries could not exceed the ICAO *Technical Instructions for the Safe Transport of Dangerous Goods by Air*. Consequently, in January 2013, PHMSA published an NPRM stating that it was considering harmonizing requirements in the HMR on the transportation of lithium batteries with changes adopted in the 2013–2014 ICAO Technical Instructions and requested additional comments on (1) the effect of those changes, (2) whether to require compliance with the ICAO Technical Instructions for all shipments by air, both domestic and international, and (3) the impacts if PHMSA failed to adopt

[38] 75 Fed. Reg. 1302 (January 11, 2010).
[39] 79 Fed. Reg. 46012 (August 6, 2014).
[40] Foreign investigative entities have authority equivalent to the NTSB under ICAO Annex 13. For this accident, in particular, the NTSB has been involved as the accredited representative as the State of Operator, Registration, and Manufacturer. The operator, manufacturers, and regulator (FAA) are technical advisors to the NTSB accredited representative. The NTSB plans to issue recommendations based on the findings of the UAE investigation.
[41] General Civil Aviation Authority of the United Arab Emirates, Uncontained Cargo Fire Leading to Loss of Control Inflight and Uncontrolled Descent into Terrain, (July 24, 2013). Available at http://www.gcaa.gov.ae/en/ePublication/admin/iradmin/Lists/Incidents%20Investigation%20Reports/Attachments/40/2010-2010%20-%20Final%20Report%20-%20Boeing%20747-44AF%20-%20N571UP%20-%20Report%2013%202010.pdf
[42] Additional information about the forum is available at http://www.ntsb.gov/news/events/Pages/2013_Lithium_Batteries_FRM.aspx.

specific provisions in the ICAO Technical Instructions into the HMR.[43] In the NTSB's comments on the NPRM, we noted the disparity between requirements in the HMR, which had weaker standards at the time, and the ICAO Technical Instructions. We explained that failure to require domestic shipments of lithium batteries to comply with regulations equivalent to the ICAO Technical Instructions would place the United States in an inexplicable position of having weaker safety standards at a time when it should be leading the way in response to serious safety concerns about transporting these materials. PHMSA's final rule harmonized the HMR with the ICAO Technical Instructions as well as with applicable provisions of the United Nations Model Regulations and the International Maritime Dangerous Goods (IMDG) Code.[44]

The NTSB notes the DOT has for some years worked to ensure that the HMR are compatible with international standards and, accordingly, has been very active in the development of international standards for the transportation of hazardous materials. However, the DOT has never relinquished its rulemaking authority to an international body. The NTSB concurs with that position and firmly believes the DOT should implement more stringent standards in US regulations if deemed necessary.

Update on Crash of Scaled Composites' SpaceShip Two

On October 31, 2014, Scaled Composites' SpaceShip Two crashed in the Mojave Desert during a test flight. The NTSB launched a go team under our authority to investigate the accident. This is not the first commercial space investigation the NTSB has conducted, and we believe there are important safety lessons to learn as a result of this investigation. Our final report, which we expect to release later this summer, will cover topics such as human factors, vehicle systems, and operations. We will inform Congress and the public of our findings when the investigation is completed.

Closing

Madame Chairman, the NTSB has a long record of support for improving aviation safety. As you know, our mission is to promote safety, and the implementation of our recommendations in these areas would help promote and improve safety.

Thank you for the opportunity to testify before you today. I look forward to responding to your questions.

[43] 78 Fed. Reg. 1119 (January 7, 2013).
[44] 79 Fed. Reg. 46012 (August 6, 2014).