# National Transportation Safety Board

**490 L'Enfant Plaza, SW**
**Washington, D.C. 20594**
**(202) 314-6000**


**Deborah A.P. Hersman**
**Chairman**

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**Testimony of the Honorable Deborah A. P. Hersman**
**Chairman**
**National Transportation Safety Board**
**Before the**
**Aviation Subcommittee**
**Committee on Commerce, Science and Transportation**
**U. S. Senate**

**Hearing on**
**Aviation Safety: One Year After the Crash of Flight 3407**
**February 25, 2010**

Good morning. On February 12, 2009, about 22:17 eastern standard time, a Colgan Air, Inc., Bombardier DHC-8-400, N200WQ, operating as Continental Connection Flight 3407, was on an instrument approach to Buffalo-Niagara International Airport in Buffalo, New York, when it crashed into a residence in Clarence Center, New York, about 5 miles northeast of the airport. The 2 pilots, 2 flight attendants, and 45 passengers on board the airplane were killed, 1 person on the ground was killed, and the airplane was destroyed by impact forces and a post-crash fire.

Within minutes of the accident, the NTSB was notified, and a go-team was launched to the accident site early the next morning. The NTSB named 6 parties to the investigation, including:

- Federal Aviation Administration (FAA)
- Air Line Pilots Association
- National Air Traffic Controllers Association
- United Steelworkers Union (representing the flight attendants)
- Transportation Safety Board of Canada
- Air Accidents Investigation Branch of the United Kingdom

In addition to the parties, other organizations participated in the investigation—more than 60 in total—including Transport Canada, Bombardier, Pratt & Whitney Canada, Dowty Propellers, as well as representatives from state agencies, area-wide county and city offices, emergency responders, police departments, service organizations, and many others.

As part of its investigation, the NTSB held a 3-day public hearing in Washington, D.C., May 12 through 14, 2009. Witnesses included representatives of FAA, Colgan Air, the Air Line Pilots Association, and Bombardier. The issues presented and explored during the hearing were the effect of icing on airplane performance, cold weather operations, sterile cockpit rules, flight crew experience, fatigue management, and stall recovery training.

This tragic accident significantly changed countless lives. Many family members and friends of the victims of Flight 3407 have come together to tirelessly advocate for improved aviation safety. The NTSB made a commitment to the families some months ago that we would aggressively pursue the issues uncovered in the accident and endeavor to complete the

investigation before the one-year anniversary. Holding a public hearing and then finalizing this investigation in less than a year was a challenge for the agency; the last time we accomplished both a hearing and completion of a major investigation in less than a year was more than 15 years ago. This effort required a significant amount of staff overtime and reprioritizing other investigative activities. Nevertheless, our dedicated staff presented a draft final accident report late last month, and in a public Board meeting on February 2, the Board voted unanimously to adopt the report, thus concluding this significant accident investigation.

The final report includes 46 separate findings and a determination that the probable cause of the accident was the captain's inappropriate response to the activation of the stick shaker, which led to an aerodynamic stall from which the airplane did not recover. Contributing to the accident were the (1) flight crew's failure to monitor airspeed in relation to the rising position of the low-speed cue, (2) the flight crew's failure to adhere to sterile cockpit procedures, (3) the captain's failure to effectively manage the flight, and (4) Colgan Air's inadequate procedures for airspeed selection and management during approaches in icing conditions. The final report also makes 25 new recommendations to the FAA and reiterates 3 previously issued recommendations. The recommendations cover a wide range of safety issues that were factors in this accident, including pilot training and fatigue.

## Pilot Training

Although the NTSB's investigation was broad-reaching, the performance of the pilots in this accident was the primary focus of the investigation. Not only was the captain's inappropriate response to the stick shaker identified as the primary cause of the accident, but several performance lapses on the part of the crew were cited as contributing factors to the accident. Therefore, the NTSB staff spent considerable time reviewing the pilots' performance on the night of the accident, documenting their activities in the days leading up to the crash, and scrutinizing their previous performance including detailed reviews of their past proficiency checks and the training they received while employed by Colgan Air.

### *Remedial Training*

The captain of Flight 3407 had multiple certificate and rating failures which were a matter of record with the FAA. His training records at Gulfstream International Airlines showed that his flying skills needed improvement, although he met the minimum standards required for completion of the training. His continued demonstrated weaknesses in basic aircraft control and attitude instrument flying during annual checks at Colgan Air should have made the captain a candidate for remedial training. However, at the time of the accident, Colgan Air did not have a formal program for pilots who demonstrated ongoing weaknesses. Furthermore, Colgan Air's electronic pilot training records did not contain sufficient detail for the company or the FAA Principal Operations Inspector (POI) to properly analyze the captain's trend of unsatisfactory performance.

In 2005, the NTSB recommended that the FAA require all Part 121 air carrier operators to establish oversight and training programs for pilots who have demonstrated performance

deficiencies or have experienced failures in the training environment (A-05-14). In response, the FAA issued SAFO 06015, "Remedial Training for Part 121 Pilots," the purpose of which was to promote voluntary implementation of remedial training for pilots with persistent performance deficiencies. While the FAA had recently conducted surveys to determine if carriers have remedial training programs consistent with the SAFO, the POI for Colgan Air stated during the NTSB's public hearing that he was not aware of the existence of this SAFO.

Remedial training and additional oversight for pilots with training deficiencies and failures would help ensure that the pilots have mastered the necessary skills for safe flight. In 2003, during our investigation of a landing accident involving a Fed Ex MD-10 in Memphis, the NTSB's review of FedEx's pilot training procedures and oversight revealed that, consistent with other operators in the aviation industry, it focused on a pilot's performance on the day of the checkride with little or no review of that pilot's performance on checkrides months or years earlier. The NTSB was concerned that this single-event focus does not allow a carrier to monitor changes or patterns in a pilot's performance history that could provide significant information about the competency of a pilot. For example, in the FedEx case, the first officer's repeated substandard performances on checkrides were addressed as singular events that did not require further evaluation or monitoring after the checkride was satisfactorily completed. Yet, postaccident review of the first officer's training history and postaccident interviews suggested a pattern of below-standard performance. In our report on Flight 3407, we reiterated our 2005 recommendation to the FAA (A-05-14) and issued several additional recommendations focused on pilot training.

The NTSB also reiterated our concern about reviewing all available pilot records for new hires. Following the 2003 Air Sunshine ditching accident near the Bahamas, which involved a pilot who had failed 9 FAA flight checks, the NTSB issued recommendations to address the importance of obtaining all pilot records prior to hiring. In addition to reiterating our 2005 recommendations (A-05-01), we issued 3 additional recommendations addressing the maintenance and sharing of pilot training records (A-10-17, A-10-19, and A-10-20).

*Stall Training*

As pilots transition to larger transport-category airplanes, they do not have an opportunity to experience stalls in flight or in a simulator, because air carrier training does not require pilots to practice recoveries from fully developed stalls. The FAA's practical test standards for pilot certification currently require pilots to recover from an "approach to stall" with minimal altitude loss. This recovery procedure can be effective as long as an airplane is not fully stalled. However, altitude loss standards are not appropriate for responding to a fully developed stall. Once a stall has occurred, an airplane cannot be recovered until the wing's angle of attack (AOA) is reduced, which will usually necessitate a loss of altitude.

The current air carrier approach-to-stall training did not fully prepare the crew for an unexpected stall in the Q400 and did not address the actions that are needed to recover from a fully developed stall. The stick shaker, which is a component of the stall warning system in the Q-400, produces an audible vibration of the control yoke when it activates to alert the pilot to take immediate action. However, the existing industry practice of training to approach-to-stall does

not prepare pilots for unexpected situations where the stick shaker activates and simultaneously disconnects the autopilot. The stick pusher response is another feature designed to prevent and/or recover from a stall by pushing the control yoke forward and achieving a nose down attitude. Stick pusher training was not consistently provided to pilots of Q400s, nor was it required by the FAA.

The NTSB has investigated other accidents in which the pilots applied inappropriate nose-up pitch control inputs during an attempted stall recovery, including West Caribbean Airways Flight 708 in 2005, Pinnacle Airlines Flight 3701 in 2004, and an Airborne Express DC-8 in 1996. We remain concerned that classroom training of this important system is incomplete because the training does not familiarize pilots with the forces associated with stick pusher activation or provide them with experience in learning the magnitude of the airplane's pitch response.

The NTSB believes that more realistic stall and upset training is possible due to advances in simulator technology. Flight crew training on full stalls and recoveries has not previously been included in simulator training partly because of industry concerns about the lack of simulator aerodynamic model fidelity in the post-stall flight regime. However, research demonstrates that simulator fidelity can be significantly improved and the useful data envelope for upset training can be expanded. Pilots could have a better understanding of an airplane's flight characteristics during the post-stall flight regime if realistic, fully developed stall models are incorporated into simulators that are approved for such training.

Colgan Air pilots were trained to address tailplane stalls through a NASA-produced video intended to enhance a pilot's ability to assess hazardous icing conditions. The tailplane stall recovery procedure discussed in the video required pilots to pull back on the control column, reduce flap setting, and for some aircraft, reduce power. However, the tailplane stall recovery procedure presented in the video was the opposite of the recovery procedure for a conventional wing stall, which requires lowering the nose and adding power. Many Colgan pilots believed the Q400 was susceptible to tailplane stalls, but according to Bombardier, the manufacturer, it was not. Training in tailplane stalls, when it is not appropriate for the aircraft for which the pilot is being trained, may add confusion to a pilot's reaction in addressing conventional wing stalls.

To address stall recovery and stick pusher training in simulators, NTSB recommended that the FAA:

- Require Part 121, 135, and 91K operators and Part 141 pilot schools to develop and conduct training that incorporates stalls that are fully developed, are unexpected, involve autopilot disengagement, and include airplane-specific features, such as a ref speeds switch (A-10-22);
- Require part 121, 135, and 91K operators with stick pusher-equipped aircraft to provide their pilots with pusher familiarization simulator training (A-10-23);
- Define and codify minimum simulator model fidelity requirements to support expanded stall recovery training (A-10-24);
- Identify which airplanes operated under Part 121, 135, and 91K are susceptible to tailplane stalls and then require operators of those airplanes to provide appropriate stall

recovery training, and direct operators of airplanes that are *not* susceptible to tailplane stalls to ensure that their training does not include tailplane stall recovery.

*Training for Active Monitoring*

The flight crew of Flight 3407 failed to monitor the airplane's pitch attitude, power, and especially its airspeed, and they failed to notice, as part of their monitoring responsibilities, the rising low-speed cue on the indicated airspeed (IAS) display. There are multiple strategies to use to protect against catastrophic outcomes resulting from monitoring failures like this one, not the least of which is pilot training.

Current pilot training programs often do not address monitoring skills in a systematic manner. Some of Colgan Air's guidance to its pilots referenced the importance of monitoring, and the subject was discussed and evaluated during simulator training and initial operating experience. However, the company did not provide specific pilot training that emphasized the monitoring function. Further, the company's crew resource management (CRM) training did not explicitly address monitoring or provide pilots with techniques and training for improving their monitoring skills.

As a result of this accident investigation, the NTSB reiterated a recommendation that was issued in 2007. That recommendation called for the FAA to require that all pilot training programs be modified to contain modules that teach and emphasize monitoring skills and workload management and include opportunities to practice and demonstrate proficiency in these areas (A-07-13).

The crash of Flight 3407 and a subsequent event near Burlington, Vermont, revealed that Colgan Air's standard operating procedures did not promote effective monitoring behavior. The NTSB is concerned that other air carriers' standard operating procedures may also be deficient in this area. We therefore recommended that the FAA require Part 121, 135, and 91K operators to review their standard operating procedures to verify that they are consistent with the flight crew monitoring techniques described in the FAA's advisory circular, AC 120-71A, and to revise the procedures if they are not (A-10-10).

*Training Captains for Leadership*

The captain of a flight is responsible for setting the appropriate tone in the cockpit and managing communications and workload in a manner that promotes adherence to standard operating procedures. The captain of Flight 3407 did not establish a professional environment in the cockpit when he performed checklists and callouts late, initiated and encouraged non-pertinent conversation in flight, and failed to effectively manage the workload in the cockpit or communicate with the first officer during an emergency situation.

Industry changes have resulted in opportunities for pilots to upgrade to captain without having accumulated significant experience as a first officer in a Part 121 operation. Furthermore, Part

121 operators are not required to provide upgrading captains with specific training on leadership skills. When the captain of Flight 3407 upgraded in October, 2007, Colgan Air provided an 8-hour training course on duties and responsibilities, the content of which focused on the administrative duties associated with becoming a captain. It did not contain significant information about developing in-cockpit leadership skills, management oversight, and command authority.

The NTSB recommended that the FAA issue an advisory circular with guidance on leadership training for upgrading captains at Part 121, 135, and 91K operators (A-10-13). The guidance should include:

- methods and techniques for effective leadership;
- professional standards of conduct;
- strategies for briefing and debriefing;
- reinforcement and correction skills;
- other knowledge, skills, and abilities that are critical for air carrier operations.

*Training Pilots for Adherence to Sterile Cockpit and SOPs*

Both pilots of Flight 3407 engaged in non-pertinent conversation during the flight, and neither pilot addressed the other pilot's deviation from sterile cockpit procedures. Their ease in engaging in non-pertinent conversation suggested that the practice is not unusual among company pilots during critical phases of flight.

The sterile cockpit rule (14 CFR 121.542) is intended to ensure that a pilot's attention is directed to operational concerns during critical phases of flight rather than nonessential activities or conversation. In 2006, the NTSB recommended that the FAA direct POIs of all Part 121 and 135 operators to reemphasize the importance of strict compliance with the sterile cockpit rule (A-06-7). In response to this recommendation, the FAA issued SAFO 06004 on April 28, 2006, to emphasize the importance of sterile cockpit discipline. Four months after the SAFO was issued, the crew of Comair Flight 5191 attempted to take off on the wrong runway in Lexington, Kentucky. There were 49 fatalities in that accident, and the NTSB determined that the crew missed important cues during their taxi because they were engaged in non-essential conversation. Since the SAFO was issued, the NTSB has continued to investigate other accidents where the sterile cockpit rule was violated.

Even though the responsibility for sterile cockpit adherence is ultimately a matter of a pilot's own professional integrity, pilots work within the context of professionalism created through the mutual efforts of the FAA, operators, and pilot groups. The continuing number of accidents involving a breakdown in sterile cockpit discipline warrants innovative action by the FAA and the aviation industry to promptly address this issue. In the accident report for Flight 3407, the NTSB recommended that the FAA develop and distribute to all pilots multimedia guidance materials on professionalism in aircraft operations (A-10-15). The guidance should contain:

- standards of performance for professionalism;
- best practices for sterile cockpit adherence;

- techniques for assessing and correcting pilot deviations;
- examples and scenarios;
- detailed review of accidents involving breakdowns in sterile cockpit and other procedures, including this accident.

**Fatigue**

The crash of Flight 3407 gave the NTSB an opportunity to reexamine fatigue in aviation, an issue that has been on our Most Wanted List of Transportation Safety Improvements since 1990. Numerous accident investigations, research data, and safety studies show that flight crews who are on duty but have not obtained adequate rest present an unnecessary risk to the traveling public. Fatigue results from continuous activity, inadequate rest, sleep loss or nonstandard work schedules. The effects of fatigue include slowed reaction time, diminished vigilance and attention to detail, errors of omission, compromised problem solving, reduced motivation, decreased vigor for successful completion of required tasks, and poor communication.

Although the schedules of both pilots of Flight 3407 were within flight and duty time requirements, the flight crew was likely fatigued according to factual information gathered by NTSB investigators. The night before the accident, the captain likely did not obtain quality sleep because he slept in the company crew room, and his sleep time was interrupted, as evidenced by multiple log-ins to the company scheduling system at 2151, then at 0310, and again at 0726. At the time of the accident, the captain had been awake at least 15 hours. A 1994 NTSB study identified performance degradation in accident flight crews when they have been awake for 12 hours.[1]

Similarly, the first officer likely was not properly rested when she reported for duty. The night before the accident, she commuted from Seattle to Newark, changing planes shortly after midnight in Memphis, and arriving in Newark at 0630, which was 0300 Seattle time. In the preceding 34 hours, she had obtained a maximum of 8.5 total hours of sleep. Approximately 3.5 of those hours were obtained as she traveled cross-country in an airplane jumpseat, and those hours were interrupted by her stop in Memphis. She obtained the remaining 5 hours resting in the company crew room. Although the crew room had couches and recliners, it was not isolated and was subject to interruptions, uncontrolled noise and activity, lights, and other factors that prevent quality rest.

Scientific research and accident investigations have demonstrated the negative effects of fatigue on human performance, including reduced alertness and degraded mental and physical performance. Evidence suggests that both pilots were likely experiencing some degree of fatigue at the time of the accident. However, because the errors and decision made by the pilots cannot be solely attributed to fatigue, the NTSB stopped short of making fatigue a causal factor in the accident.

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[1] National Transportation Safety Board (1994). *A Review of Flightcrew-Involved, Major Accidents of U.S. Air Carriers, 1978 Through 1990*. Safety Study NTSB/SS-94-01. Washington, D.C.

*Commuting*

The NTSB continues to look at the many factors that affect a flight crew's ability to achieve adequate rest. Long-distance commuting by pilots is often a necessity because of base transfers that change a pilot's home base to a location that is far from family or is in a high-cost area. About 70% of the Colgan Air pilots based in Newark were commuters, and approximately 20% of the pilots, like the pilots of Flight 3407[2], commuted from over 1000 miles away. Some commuting pilots rent "crash pads" (shared rooms or apartments) at their base, and some operators provide crew rest facilities so that crews can obtain uninterrupted sleep. Colgan Air did not have a crew rest facility, and the neither of the pilots of Flight 3407 had a crash pad. Colgan Air's commuting policy addressed their pilots' responsibility to arrive at their base and report for duty on time, but the policy did not reference ways to mitigate fatigue resulting from commuting.

As a result of this accident investigation, the NTSB recommended that the FAA require all Part 121, 135, and 91K operators to address fatigue risks associated with commuting, including identifying the number of pilots who commute, establishing policy and guidance to mitigate fatigue risks for commuting pilots, using scheduling practices to minimize opportunities for fatigue in commuting pilots, and developing or identifying rest facilities for commuting pilots (A-10-16). Unfortunately, in the aviation industry, fatigue-related decisions by operators and pilots -- such as minimum crew hires, flight crew schedules and commuting – are decisions that too often reflect the economics of the industry, rather than the data and science of fatigue and human performance.

## Most Wanted List of Transportation Safety Improvements

The issues of pilot proficiency and human fatigue are among the NTSB's most critical areas of concern in the safety of aviation. Last week, the NTSB updated its 2010 Most Wanted List to better emphasize these two safety concerns.

*Improve the Oversight of Pilot Proficiency*

The investigation of Flight 3407 demonstrated once again that there are troubling loopholes in the system under which airlines check records of prospective flight crew employees. When Colgan Air conducted a background check of the captain prior to his employment, the airline checked records from other airlines in accordance with the Pilot Records Improvement Act of 1996 (PRIA). However, these records do not include a review of FAA certificates of disapprovals. The captain of Flight 3407 had reported on his employment application that he had failed 1 FAA checkride, when in fact he had failed 3. Neither PRIA nor FAA's guidance under PRIA requires operators to obtain notices of disapproval for flight checks for certificates and ratings.

[2] The captain commuted from Florida, and the first officer commuted from Seattle.

Our testimony has already discussed the captain's demonstrated weaknesses in basic aircraft control and attitude instrument flying during annual checks at Colgan Air, which should have made the captain a candidate for remedial training. The NTSB has long recommended remedial training. On October 30, 2009, the FAA indicated that about one-third of carriers had implemented remedial training programs, including 6 of 27 regional carriers; less than 3 months later, on December 10, 2009, the FAA Administrator stated during his testimony before this Committee that two-thirds of the air carriers without advanced qualification programs had systems in place to identify and manage low-time pilots and pilots with persistent performance problems. In their "Call to Action" report published in January 2010, the FAA stated that only 15 carriers had some part of a remedial training program and 8 carriers did not have any component of a remedial training program in place. While the NTSB asked for the complete survey results, this information has not been provided, and the NTSB has not determined the extent that air carrier remedial training programs address pilot performance deficiencies and failures during training.

Therefore, we added 2 recommendations to the 2010 Most Wanted List under a new issue area, "Improve the Oversight of Pilot Proficiency:"

- Require all Part 121 and 135 air carriers to obtain any notices of disapproval for flight checks for certificates and ratings for all pilot applicants and evaluate this information before making a hiring decision. (A-05-01);

- Require all 14 *Code of Federal Regulations* Part 121 air carrier operators to establish programs for flight crewmembers who have demonstrated performance deficiencies or experienced failures in the training environment that would require a review of their whole performance history at the company and administer additional oversight and training to ensure that performance deficiencies are addressed and corrected. (A-05-14).

*Fatigue Management Systems*

In June, 2008, the NTSB issued recommendations to the FAA to develop guidance for fatigue management systems (A-08-44) and to develop and use a methodology to continually assess the effectiveness of fatigue management systems used by operators (A-08-45). A fatigue management system incorporates various components and strategies to mitigate the hazards of fatigue in aviation operations, including scheduling policies and practices, attendance policies, education, medical screening and treatment, personal responsibility during non-work periods, task and workload issues, rest environments, commuting policies and napping policies. The FAA has neither guidance nor regulations addressing fatigue management systems.

In response to the FAA's lack of action in this area, the NTSB updated the Most Wanted List issue area "reduce Accidents and Incidents Caused by Human Fatigue in the Aviation Industry" to include these recommendations on fatigue management systems.

## Conclusion

Our investigation of Flight 3407 revealed 2 other aviation safety issues which we will explore in greater depth in events planned for the coming months. On May 17-19, 2010, we will hold a Public Forum on Ensuring and Supporting High Standards in Flight Crew and Air Traffic Controller Performance. At this forum we plan to bring industry leaders together to discuss the selection of pilots and controllers, training methods, and the development of techniques that support safe practices, such as peer mentoring and support, voluntary reporting programs, and the use of technology in oversight.

Later this fall, we will hold a Public Symposium on Airline Code-Sharing Arrangements and Their Role in Aviation Safety. The symposium will provide background information on domestic and international code-sharing arrangements and their oversight, and provide insight into the best practices regarding the role of major airlines in ensuring the safety of regional code-sharing partners.

In conclusion, the tragic crash of Flight 3407 brought the world's attention to the seriousness and complexity of maintaining safety in a transportation industry that continually evolves. If we are serious about aviation safety, we must establish a system that minimizes pilot fatigue and ensures that flight crews report to work rested and fit for duty. We must also have a system in which we are steadfastly confident that all of our commercial pilots are proficient and well-trained.