Loss of Control on Approach
Colgan Air, Inc.
Operating as Continental Connection Flight 3407
Bombardier DHC-8-400, N200WQ
Clarence Center, New York
February 12, 2009

Accident Report

NTSB/AAR-10/01
PB2010-910401

National
Transportation
Safety Board

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Notation 8090A
Adopted February 2, 2010

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490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

National Transportation Safety Board. 2010. ***Loss of Control on Approach, Colgan Air, Inc., Operating as Continental Connection Flight 3407, Bombardier DHC-8-400, N200WQ, Clarence Center, New York, February 12, 2009*****. NTSB/AAR-10/01. Washington, DC.**

Abstract: This report discusses the accident involving a Colgan Air, Inc., Bombardier DHC-8-400, N200WQ, operating as Continental Connection flight 3407, which experienced a loss of control on an instrument approach to Buffalo-Niagara International Airport, Buffalo, New York, and crashed into a residence in Clarence Center, New York, about 5 nautical miles northeast of the airport. The safety issues discussed in this report focus on strategies to prevent flight crew monitoring failures, pilot professionalism, fatigue, remedial training, pilot training records, airspeed selection procedures, stall training, Federal Aviation Administration (FAA) oversight, flight operational quality assurance programs, use of personal portable electronic devices on the flight deck, the FAA's use of safety alerts for operators to transmit safety-critical information, and weather information provided to pilots. Safety recommendations concerning these issues are addressed to the FAA.

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Abbreviations

AAIB	Air Accidents Investigation Branch of the United Kingdom
AC	advisory circular
ACARS	aircraft communications addressing and reporting system
AFM	airplane flight manual
agl	above ground level
AIM	*Aeronautical Information Manual*
AIRMET	Airmen's Meteorological Information
ALB	Albany International Airport
ALPA	Air Line Pilots Association
AOA	angle-of-attack
AOM	airplane operating manual
APM	aircrew program manager
ASAP	aviation safety action program
ASIAS	aviation safety information analysis and sharing
ASOS	automated surface observing system
ASRS	Aviation Safety Reporting System
ATC	air traffic control
ATCT	air traffic control tower
ATIS	automatic terminal information service
ATOS	air transportation oversight system
BTV	Burlington International Airport
BUF	Buffalo-Niagara International Airport

CFM	company flight manual
CFR	*Code of Federal Regulations*
CRM	crew resource management
CVR	cockpit voice recorder
CWA	Center Weather Advisory
DOD	Department of Defense
eice	en route ice accumulation
EWR	Newark Liberty International Airport
FAA	Federal Aviation Administration
FDR	flight data recorder
FOQA	flight operational quality assurance
FRMS	fatigue risk management system
FSDO	flight standards district office
GIA	Gulfstream International Airlines
Hg	mercury
IAH	George Bush Intercontinental Airport
IAS	indicated airspeed
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IEP	internal evaluation program
IFR	instrument flight rules
ILS	instrument landing system
InFO	information for operators
IOE	initial operating experience

LOSA	line operations safety audit
MEM	Memphis International Airport
METAR	meteorological aerodrome report
msl	mean sea level
MSP	Minneapolis-St. Paul International/Wold-Chamberlain Airport
NASA	National Aeronautics and Space Administration
NDB	nondirectional beacon
nm	nautical mile
NOTAM	notice to airmen
NPRM	notice of proposed rulemaking
NTSB	National Transportation Safety Board
NWS	National Weather Service
ORF	Norfolk International Airport
PF	pilot flying
PFD	primary flight display
PIC	pilot-in-command
PIREP	pilot report
PM	pilot monitoring
POI	principal operations inspector
PRIA	Pilot Records Improvement Act
PST	Pacific standard time
QAR	quick access recorder
RDU	Raleigh-Durham International Airport
ROC	Greater Rochester International Airport

SAFO	safety alert for operators
SEA	Seattle-Tacoma International Airport
SIC	second-in-command
SIGMET	Significant Meteorological Information
SMS	safety management system
TSB	Transportation Safety Board of Canada
Vfri	flap retract speed
Vga	go-around speed
V_{ref}	reference landing speed
VSR	reference stall speed
VMC	visual meteorological conditions
VOR	very high frequency omnidirectional radio range
VVM	verbalize, verify, and monitor
YYZ	Toronto Pearson International Airport

Executive Summary

On February 12, 2009, about 2217 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, Buffalo, New York, when it crashed into a residence in Clarence Center, New York, about 5 nautical miles northeast of the airport. The 2 pilots, 2 flight attendants, and 45 passengers aboard the airplane were killed, one person on the ground was killed, and the airplane was destroyed by impact forces and a postcrash fire. The flight was operating under the provisions of 14 *Code of Federal Regulations* Part 121. Night visual meteorological conditions prevailed at the time of the accident.

The National Transportation Safety Board determines that the probable cause of this 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 (1) the 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 safety issues discussed in this report focus on strategies to prevent flight crew monitoring failures, pilot professionalism, fatigue, remedial training, pilot training records, airspeed selection procedures, stall training, Federal Aviation Administration (FAA) oversight, flight operational quality assurance programs, use of personal portable electronic devices on the flight deck, the FAA's use of safety alerts for operators to transmit safety-critical information, and weather information provided to pilots. Safety recommendations concerning these issues are addressed to the FAA.

1. Factual Information

1.1 History of Flight

On February 12, 2009, about 2217 eastern standard time,[1] a Colgan Air, Inc., Bombardier DHC-8-400 (Q400),[2] N200WQ, operating as Continental Connection flight 3407,[3] was on an instrument approach to Buffalo-Niagara International Airport (BUF), Buffalo, New York, when it crashed into a residence in Clarence Center, New York, about 5 nautical miles (nm) northeast of the airport. The 2 pilots, 2 flight attendants, and 45 passengers aboard the airplane were killed, one person on the ground was killed, and the airplane was destroyed by impact forces and a postcrash fire. The flight was operating under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121. Night visual meteorological conditions (VMC) prevailed at the time of the accident.

The home base of operations for both the captain and the first officer was Liberty International Airport (EWR), Newark, New Jersey. On February 11, 2009, the captain had completed a 2-day trip sequence, with the final flight of the trip arriving at EWR at 1544. Also that day, the first officer began her commute from her home near Seattle, Washington, to EWR at 1951 Pacific standard time (PST), arriving at EWR (via Memphis International Airport [MEM], Memphis, Tennessee) on the day of the accident at 0623. The captain and the first officer were both observed in Colgan's crew room on February 12 before their scheduled report time of 1330.[4] The flight crew's first two scheduled flights of the day, from EWR to Greater Rochester International Airport (ROC), Rochester, New York, and back, had been canceled because of high winds at EWR and the resulting ground delays at the airport.[5]

The company dispatch release for flight 3407 was issued at 1800 and showed an estimated departure time of 1910 and an estimated en route time of 53 minutes. The airplane to be used for flight 3407, N200WQ, arrived at EWR at 1854. A first officer whose flight arrived at EWR at 1853 saw, as he exited his airplane, the flight 3407 captain and first officer walking toward the accident airplane. The airplane's aircraft communications addressing and reporting system (ACARS) showed a departure clearance request at 1930 and pushback from the gate at

[1] All times in this report are eastern standard time based on a 24-hour clock unless otherwise noted.

[2] According to Bombardier's website, the DHC-8 has been known as a Q-series airplane since 1996. The Q400 entered service in 2000.

[3] Continental Airlines and Colgan Air were involved in a code-sharing arrangement, but each air carrier had separate 14 *Code of Federal Regulations* Part 121 certificates, and Federal Aviation Administration oversight of each air carrier was conducted by separate certificate management teams.

[4] The captain's and the first officer's activities before and after their scheduled report time are detailed in section 1.5.

[5] As part of the airlines' code-sharing arrangement, Colgan flights were subject to cancellation by Continental. The Colgan EWR regional chief pilot stated, during a postaccident interview, that Continental's EWR operations center had called him to cancel multiple Continental Connection flights that day.

1945.[6] According to the cockpit voice recorder (CVR) recording, the EWR ground controller provided taxi instructions for the flight at 2030:28,[7] which the first officer acknowledged.

About 2041:35, the first officer stated, "I'm ready to be in the hotel room," to which the captain replied, "I feel bad for you." She continued, "this is one of those times that if I felt like this when I was at home there's no way I would have come all the way out here."[8] She then stated, "if I call in sick now I've got to put myself in a hotel until I feel better … we'll see how … it feels flying. If the pressure's just too much … I could always call in tomorrow at least I'm in a hotel on the company's buck but we'll see. I'm pretty tough." The captain responded by stating that the first officer could try an over-the-counter herbal supplement, drink orange juice, or take vitamin C.

The CVR recorded the tower controller clearing the airplane for takeoff about 2118:23. The first officer acknowledged the clearance, and the captain stated, "alright cleared for takeoff it's mine." According to the dispatch release, the intended cruise altitude for the flight was 16,000 feet mean sea level (msl).[9] The flight data recorder (FDR) showed that, during the climb to altitude, the propeller deice and airframe deice equipment were turned on (the pitot static deicing equipment had been turned on before takeoff) and the autopilot was engaged.

The airplane reached its cruising altitude of 16,000 feet about 2134:44. The cruise portion of flight was routine and uneventful. The CVR recorded the captain and the first officer engaged in an almost continuous conversation throughout that portion of the flight, but these conversations did not conflict with the sterile cockpit rule, which prohibits nonessential conversations within the cockpit during critical phases of flight.[10] About 2149:18, the CVR recorded the captain making a sound similar to a yawn. About 1 minute later, the captain interrupted his own conversation to point out, to the first officer, traffic that was crossing left to right. About 2150:42, the first officer reported the winds to be from 250° at 15 knots gusting to 23 knots; afterward, the captain stated that runway 23 would be used for the landing.

About 2153:40, the first officer briefed the airspeeds for landing with the flaps at 15° (flaps 15) as 118 knots (reference landing speed [V_{ref}]) and 114 knots (go-around speed [V_{ga}]), and the captain acknowledged this information. About 2156:26, the first officer stated, "might be easier on my ears if we start going down sooner." About 2156:36, the captain instructed the first officer to "get discretion to twelve [thousand feet]." Less than 1 minute later, a controller from Cleveland Center cleared the flight to descend to 11,000 feet, and the first officer acknowledged the clearance.

[6] ACARS enables pilots to communicate with company personnel on the ground. ACARS is used to exchange routine flight status messages and weather information. Some of these messages, such as the time that a flight leaves the gate, takes off, and touches down, are sent and received automatically.

[7] About 7 minutes earlier, the captain had made an announcement over the public address system, indicating that the taxi delay was the result of the weather conditions at the time.

[8] The CVR recorded the first officer sneezing and sniffling.

[9] All altitudes in this report are expressed as msl unless otherwise noted.

[10] The sterile cockpit rule refers to 14 CFR 121.542, "Flight Crewmember Duties," which is discussed in section 1.17.3.

About 2203:38, the Cleveland Center controller instructed the flight crew to contact BUF approach control, and the first officer acknowledged this instruction. The first officer made initial contact with BUF approach control about 2203:53, stating that the flight was descending from 12,000 to 11,000 feet with automatic terminal information service (ATIS) information "romeo,"[11] and the approach controller provided the airport altimeter setting and told the crew to plan an instrument landing system (ILS) approach to runway 23.

About 2204:16, the captain began the approach briefing. About 2205:01, the approach controller cleared the flight crew to descend and maintain 6,000 feet, and the first officer acknowledged the clearance. About 30 seconds later, the captain continued the approach briefing, during which he repeated the airspeeds for a flaps 15 landing. FDR data showed that the airplane descended through 10,000 feet about 2206:37. From that point on, the flight crew was required to observe the sterile cockpit rule.

About 2207:14, the CVR recorded the first officer making a sound similar to a yawn. About 2208:41 and 2209:12, the approach controller cleared the flight crew to descend and maintain 5,000 and 4,000 feet, respectively, and the first officer acknowledged the clearances. Afterward, the captain asked the first officer about her ears, and she indicated that they were stuffy and popping.

About 2210:23, the first officer asked whether ice had been accumulating on the windshield, and the captain replied that ice was present on his side of the windshield and asked whether ice was present on her windshield side. The first officer responded, "lots of ice." The captain then stated, "that's the most I've seen—most ice I've seen on the leading edges in a long time. In a while anyway I should say." About 10 seconds later, the captain and the first officer began a conversation that was unrelated to their flying duties. During that conversation, the first officer indicated that she had accumulated more actual flight time in icing conditions on her first day of initial operating experience (IOE) with Colgan than she had before her employment with the company.[12] She also stated that, when other company first officers were "complaining" about not yet having upgraded to captain, she was thinking that she "wouldn't mind going through a winter in the northeast before [upgrading] to captain." The first officer explained that, before IOE, she had "never seen icing conditions … never deiced … never experienced any of that."

About 2212:18, the approach controller cleared the flight crew to descend and maintain 2,300 feet, and the first officer acknowledged the clearance. Afterward, the captain and the first officer performed flight-related duties but also continued the conversation that was unrelated to their flying duties. About 2212:44, the approach controller cleared the flight crew to turn left onto a heading of 330°. About 2213:25 and 2213:36, the captain called for the descent and approach checklists, respectively, which the first officer performed. About 2214:09, the approach controller cleared the flight crew to turn left onto a heading of 310°, and the autopilot's

[11] An ATIS broadcasts continuous weather observations and other advisory information to pilots operating on or near an airport. ATIS broadcasts are updated hourly or more frequently if conditions change. ATIS information "romeo" relayed information from a BUF weather observation at 2154; see section 1.7 for information about the observation.

[12] According to the CVR, the first officer stated, about 2210:58, that she had accumulated 1,600 hours during flights in the Phoenix, Arizona, area. Section 1.5.2 provides additional details about the first officer's flying experience.

altitude hold mode became active about 1 second later as the airplane was approaching the preselected altitude of 2,300 feet. The airplane reached this altitude about 2214:30; the airspeed was about 180 knots at the time.

About 2215:06, the captain called for the flaps to be moved to the 5° position, and the CVR recorded a sound similar to flap handle movement. Afterward, the approach controller cleared the flight crew to turn left onto a heading of 260° and maintain 2,300 feet until established on the localizer for the ILS approach to runway 23. The first officer acknowledged the clearance.

The captain began to slow the airplane less than 3 miles from the outer marker to establish the appropriate airspeed before landing. According to FDR data, the engine power levers[13] were reduced to about 42° (flight idle was 35°) about 2216:00, and both engines' torque values were at minimum thrust about 2216:02. The approach controller then instructed the flight crew to contact the BUF air traffic control tower (ATCT) controller. The first officer acknowledged this instruction, which was the last communication between the flight crew and air traffic control (ATC). Afterward, the CVR recorded sounds similar to landing gear handle deployment and landing gear movement, and the FDR showed that the propeller condition levers had been moved forward to their maximum RPM position and that pitch trim[14] in the airplane-nose-up direction had been applied by the autopilot.[15]

About 2216:21, the first officer told the captain that the gear was down; at that time, the airspeed was about 145 knots. Afterward, FDR data showed that additional pitch trim in the airplane-nose-up direction had been applied by the autopilot and that an "ice detected" message appeared on the engine display in the cockpit. About the same time, the captain called for the flaps to be set to 15° and for the before landing checklist. The CVR then recorded a sound similar to flap handle movement, and FDR data showed that the flaps had been selected to 10°.[16] FDR data also showed that the airspeed at the time was about 135 knots.

At 2216:27.4, the CVR recorded a sound similar to the stick shaker. (The stick shaker warns a pilot of an impending wing aerodynamic stall[17] through vibrations on the control column, providing tactile and aural cues.) The CVR also recorded a sound similar to the autopilot disconnect horn, which repeated until the end of the recording. FDR data showed that,

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[13] The pilots set the power lever angle and the propeller condition lever angle for each engine.

[14] Pitch trim is used to reduce the long-term pilot or autopilot forces required to maintain a target attitude and counter the effects of changes to the airplane's center of gravity, airspeed, or lift during flap extension or retraction. The pitch trim actuators can be either automatically controlled by the autopilot or manually controlled by a pilot. For the accident flight, after the autopilot was selected on (shortly after takeoff), the FDR pitch trim adjustments were applied by the autopilot. (There was no activity in the four discrete parameters dedicated to each pilot's use of manual pitch trim once the autopilot was selected on.)

[15] FDR data showed the airplane's airspeed as the following for each of these events: landing gear selected down, about 180 knots; propeller condition levers selected to maximum, about 170 knots; and pitch trim applied by the autopilot in the airplane-nose-up direction, about 160 knots.

[16] Although the captain called for flaps 15, the flap handle needed to be positioned in the 10° detent before moving to the 15° detent. The trailing edge flap position reached 10° about 2216:34.

[17] Stalls occur when the AOA of the wing—that is, the angle between the direction of airflow and the wing—exceeds a critical angle at which the air can no longer flow smoothly over the wing. Stalls disrupt lift, increase drag, and decrease roll control.

when the autopilot disengaged, the airplane was at an airspeed of 131 knots. FDR data showed that the control columns moved aft at 2216:27.8 and that the engine power levers were advanced to about 70° (rating detent was 80°) 1 second later.[18] The CVR then recorded a sound similar to increased engine power, and FDR data showed that engine power had increased to about 75 percent torque.

FDR data also showed that, while engine power was increasing, the airplane pitched up; rolled to the left, reaching a roll angle of 45° left wing down; and then rolled to the right. As the airplane rolled to the right through wings level, the stick pusher activated (about 2216:34), and flaps 0 was selected. (The Q400 stick pusher applies an airplane-nose-down control column input to decrease the wing angle-of-attack [AOA] after an aerodynamic stall.) About 2216:37, the first officer told the captain that she had put the flaps up. FDR data confirmed that the flaps had begun to retract by 2216:38; at that time, the airplane's airspeed was about 100 knots. FDR data also showed that the roll angle reached 105° right wing down before the airplane began to roll back to the left and the stick pusher activated a second time (about 2216:40). At the time, the airplane's pitch angle was -1°.

About 2216:42, the CVR recorded the captain making a grunting sound. FDR data showed that the roll angle had reached about 35° left wing down before the airplane began to roll again to the right. Afterward, the first officer asked whether she should put the landing gear up, and the captain stated "gear up" and an expletive. The airplane's pitch and roll angles had reached about 25° airplane nose down and 100° right wing down, respectively, when the airplane entered a steep descent. The stick pusher activated a third time (about 2216:50). FDR data showed that the flaps were fully retracted about 2216:52. About the same time, the CVR recorded the captain stating, "we're down," and a sound of a thump. The airplane impacted a single-family home (where the ground fatality occurred), and a postcrash fire ensued.[19] The CVR recording ended about 2216:54.

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[18] The rating detent for the engine power levers (80° in this case) is a low-force, or soft, detent on the power quadrant at which the engines' fully rated power for takeoff, climb, and cruise is achieved. Power lever travel beyond the rating detent is possible but is available only for emergency use.

[19] The postcrash fire was also the result of a severed natural gas service pipeline at the home, as discussed in section 1.15.2.

1.2 Injuries to Persons

Table 1. Injury Chart

Injuries	Flight Crew	Cabin Crew	Passengers	Other	Total
Fatal	2	2	45	1	50
Serious	0	0	0	0	0
Minor	0	0	0	0	0
None	0	0	0	0	0
Total	2	2	45	1	50

1.3 Damage to Aircraft

The airplane was destroyed by impact forces and a postcrash fire.

1.4 Other Damage

One house and two cars in the driveway of the house were destroyed as a result of the airplane's impact and the postcrash fire. The house's detached garage remained intact, but an attached garage of an adjacent house was damaged from the impact of a section of the airplane's outboard right wing.

1.5 Personnel Information

1.5.1 The Captain

The captain, age 47, held an airline transport pilot certificate and a Federal Aviation Administration (FAA) first-class medical certificate dated August 22, 2008, with a limitation that required him to wear corrective lenses while exercising the privileges of this certificate. The captain received a type rating on the DHC-8 on November 18, 2008.

According to his application for employment with Colgan, from August 2004 to April 2005,[20] the captain attended the first officer program at Gulfstream Training Academy, Fort Lauderdale, Florida, where he was the second-in-command (SIC) on the Beech BE-1900D for Gulfstream International Airlines (GIA).[21] Between April and August 2005, the captain worked

[20] FAA records indicated that the captain received his private pilot single-engine and instrument certificates in June 1990 and October 1991, respectively. FAA records also indicated that the captain received his commercial pilot instrument and single-engine certificates in June 2002 and his multiengine certificate in April 2004.

[21] The CVR recorded the captain stating, about 2050:33, "I went through Gulfstream's program 'cause … it was the best program for … the timeframe that I had. You know how fast I wanted to get into the one twenty one environment … so it really worked out well for me." Information on the Gulfstream Training Academy is provided in section 1.18.5.

in a non-aviation-related field. He was hired by Colgan in September 2005. The captain reported on his employment application that, in addition to the BE-1900D, he had flown the Piper PA-32 and PA-28 and the Cessna C-172. He also reported 618 total flight hours, including 38 hours of actual instrument time, and 71 hours of simulator instrument time.

Colgan's flight records indicated that the captain had accumulated 3,379 hours of total flying time, including 3,051 hours in turbine airplanes, 1,030 hours as a pilot-in-command (PIC), and 111 hours on the Q400. He had flown 116, 56, and 16 hours in the 90, 30, and 7 days, respectively, before the accident.[22] (These times do not include the accident flight.) The captain's transition (from the Saab 340 to the Q400) ground training occurred on October 31, 2008; his transition proficiency check occurred on November 18, 2008; and his transition line check occurred on December 3, 2008. FAA records indicated that the captain received four certificate disapprovals (as discussed in section 1.5.1.2). FAA records also indicated no accident or incident history or enforcement action, and a search of records at the National Driver Register found no history of driver's license revocation or suspension.

The check airman who conducted the captain's Q400 simulator training and line-oriented flight training characterized the captain's decision-making abilities as very good. The check airman stated that the captain, when receiving unusual attitude[23] training in the simulator, had somewhat overcontrolled the roll axis but had progressed during his subsequent simulator experience. The check airman who provided the captain with his IOE described the captain's performance as good and indicated that his greatest strength was being methodical and meticulous. Other check airmen indicated that the captain had difficulties with the Q400 flight management system, but one of the check airmen pointed out that such difficulties were typical for pilots transitioning to the Q400.

The first officer who flew with the captain on February 10 and 11, 2009, stated that the captain handled the airplane well, used checklists, and did not miss callouts. The first officer reported that, during their flights, the captain stated that the workload for the Q400 was significantly less than that for the Saab 340. First officers who flew with the captain in January 2009 indicated that he flew the Q400 competently. These first officers also indicated that the captain created a relaxed atmosphere in the cockpit but adhered to the sterile cockpit rule.

The captain's wife reported that his health was good and that he did not have any injuries or illnesses in the days before the accident. She also reported that no changes in his health had occurred in the year preceding the accident. The captain's wife further reported that the captain did not take any medications, other than those to treat his hypertension,[24] or nutritional supplements in the days before the accident and that he drank alcohol occasionally.

[22] Colgan could not explain the discrepancy between the captain's total number of hours on the Q400 (111 hours) and his flight time during the 90 days that preceded the accident (116 hours). There is no record of the captain flying an airplane other than the Q400 during the 90 days before the accident.

[23] Attitude describes an aircraft's pitch, roll, and yaw in relation to the horizon.

[24] According to his wife, the captain was taking Gemfibrozil, Diltiazem, and Hydrochlorot for this purpose. FAA medical records indicated that the captain had been undergoing treatment for hypertension since 1999, and these medications were included in his medical records.

In addition, the captain's wife reported that normally he went to sleep about 2200 and awoke about 0900 or earlier if he were getting up with their children. The captain's wife indicated that he would normally receive between 8 and 10 hours of sleep each night and that he slept well and would sometimes nap. She further indicated that his sleep and wake times when he worked depended on his schedule.

A first officer who flew with the captain frequently during January 2009 remembered that the captain had stated that he wanted to get a "crash pad" [25] near EWR but that he was trying to get around having to pay for a crash pad by bidding trips that had overnights or commutable ends. This first officer also indicated that the captain had slept in hotels or the EWR crew room[26] during their trips. Another first officer who had flown with the captain in January 2009 indicated that the captain did not have a crash pad and that he would commute to his home in Florida after a trip had concluded. According to Colgan, after the accident, the captain's wife reported that he did not have a crash pad but that he would sometimes stay overnight with a friend in the EWR area.

1.5.1.1 Activities in the 72 Hours Preceding the Accident

On February 9, 2009, the captain traveled aboard a commercial air carrier from his home near Tampa International Airport, Tampa, Florida, to EWR,[27] departing about 1713 and arriving about 2005.[28] His last known activity on February 9 (a telephone call) ended about 2247. The first officer who flew with the captain the next day stated that the captain spent the night in the crew room at EWR. On February 10, the captain began a 2-day trip with a report time of 0530. The first day of the trip comprised three flights. About 0641, the captain departed EWR and arrived about 0819 at Toronto Pearson International Airport (YYZ), Toronto, Canada. About 0911, he departed YYZ and arrived about 1049 at EWR. About 1139, the captain departed EWR and arrived at BUF about 1259. The captain spent the rest of the day at a hotel in the BUF area.

The captain's duty day on February 10, 2009, was 7 hours 49 minutes, of which 4 hours 36 minutes was flight time. The first officer stated that the airplane encountered icing conditions briefly while en route to the destination airports. He indicated that the captain engaged the deicing system and selected the "increase" position for the reference speeds switch[29] before entering clouds (and disengaged the systems after exiting the clouds). The first officer also

[25] This term denotes temporary lodging, such as an apartment or a shared room, used by pilots.

[26] The EWR regional chief pilot stated, during a postaccident interview, that the company's crew room at the airport has couches, recliners, and a television. The chief pilot described the room as a place for pilots to relax but indicated that the room was not adequate for rest before a trip. Section 1.17.6 provides additional information about Colgan's policy concerning the use of the EWR crew room.

[27] The captain had been a commuting pilot since he was hired by the company.

[28] The captain's most recent flight activity before February 9, 2009, began on February 2, when he flew as a nonrevenue passenger to Albany International Airport (ALB), Albany New York, for a 3-day trip that started the next day. The trip ended on February 5 at 1522 in ALB; the captain then flew as a nonrevenue passenger to EWR, arriving at 1742. The captain's specific activities after that flight are not known (including information about his return to Tampa), but the captain's wife described his activities in the days before the accident as routine.

[29] The reference speeds switch (commonly referred to as the ref speeds switch) and the deicing system are discussed in sections 1.6.2 and 1.6.4, respectively.

indicated that the captain used the autopilot on approaches and disengaged the autopilot by 800 feet above ground level (agl). The first officer further stated that no extraneous conversations took place below 10,000 feet (the altitude at which sterile cockpit procedures are in effect).

On February 11, 2009, the captain and the first officer departed the hotel about 0515 to check in for the second day of their trip, which had a report time of 0615. The second day of the trip comprised three flights. The captain departed BUF about 0722 and arrived at EWR about 0837. The captain departed EWR about 1003 and arrived at Raleigh-Durham International Airport (RDU), Raleigh, North Carolina, about 1138. The captain departed RDU about 1334 and arrived at EWR about 1544.

The captain's duty day on February 11, 2009, was 9 hours, 49 minutes, of which 5 hours was flight time. The first officer stated that the captain was well rested and alert during the trip. The captain's last known activity that day (logging into the CrewTrac computer system, which Colgan pilots use to access company-related information, including crew schedules and company messages) ended about 2151. No information was found regarding where the captain slept that night.

On February 12, 2009, the captain was scheduled to begin a 3-day trip. At 0310, the captain logged into the CrewTrac system. While the captain was logged into the system, he acknowledged a revision to that day's trip schedule. The captain logged into the CrewTrac system again at 0726. Two flight crewmembers, who reported at 0655 for a flight that departed at 0754, saw the captain in the crew room. Another first officer, who reported to EWR at 0525 for a 0632 flight and returned to EWR at 0956, saw the captain asleep in the crew room during the morning. Between 1012 and 1058, the captain made and received telephone calls. A flight attendant, who reported to EWR at 1130 for an 1153 flight, stated that she saw the captain eating lunch.

The EWR regional chief pilot stated that the captain had offered to do office work and was inserting revisions into airplane manuals between 1200 and 1400.[30] During this time, the captain made a telephone call to his wife, which lasted a few minutes.

The captain's specific activities during the remainder of the afternoon are not known, but he was observed in the crew room watching television and talking with other company pilots. He logged into the CrewTrac system at 1421 and 1658, made telephone calls at 1624, 1801, 1915, and 1930,[31] and received a call at 1649.

1.5.1.2 Federal Aviation Administration Certificate Disapprovals and Colgan Air Training Events

The captain's record of FAA certificate disapprovals showed the following:

[30] The EWR regional chief pilot reported that such administrative duties are considered part of duty time.

[31] The call at 1930, to the EWR regional chief pilot's mobile telephone, lasted 43 seconds.

- On October 1, 1991, the captain was disapproved for his instrument airplane rating during his initial flight check. He flew a PA-28 during the flight test, and the tasks disapproved were ATC clearance and compliance with ATC clearance, instrument cockpit check, partial panel[32] very high frequency omnidirectional radio range (VOR) approach, nondirectional beacon (NDB) approach, and holding. He passed the flight test for the rating on October 25, 1991. On his 2005 application for employment with Colgan,[33] the captain stated that he had failed his FAA checkride for an instrument rating and provided the following explanation: "I missed the NDB approach, received additional instruction, then repeated the approach and passed."
- On May 14, 2002, the captain was disapproved for his commercial single-engine land airplane flight certificate during his initial flight check. He flew a Cessna C-177 during the flight test, and the tasks disapproved were takeoffs, landings, go-arounds, and performance maneuvers. (He did not report this disapproval on his application for employment with Colgan.) He passed the flight check for the certificate on June 25, 2002.
- On April 9, 2004, the captain was disapproved for his commercial multiengine land airplane flight certificate during his initial flight check. He flew a PA-44 during the flight test and was notified that the entire flight portion of the practical exam would need to be repeated. (He did not report this disapproval on his application for employment with Colgan.) He passed the flight check for the certificate on April 29, 2004.
- On October 15, 2007, while a first officer for Colgan, the captain was disapproved for his airline transport pilot certificate during his initial flight check. He flew a Saab 340 during the flight test, and the disapproved task was approach and landing with a powerplant failure in a multiengine airplane. He passed the flight check for the certificate on October 18, 2007.

Colgan's training records indicated that the captain, while a first officer, needed additional training in the following areas:

- On October 28, 2005, the captain was graded "train to proficiency" on his initial proficiency check in the Saab 340. This grade indicated that his overall performance was satisfactory but that a checkride item (in this case, normal and abnormal procedures) needed to be repeated during the checkride.
- On October 17, 2006, the captain received an unsatisfactory grade on his recurrent proficiency check in the Saab 340. The unsatisfactory tasks were rejected takeoffs, general judgment, landings from a circling approach, oral exam, and nonprecision approach. The captain attended recurrent training and completed his requalification proficiency training on November 1, 2006.

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[32] Partial panel means that certain instruments are covered or are intentionally failed.

[33] Colgan's application for employment asked whether the applicant had "ever failed any proficiency check, FAA check ride, IOE, or line check."

- On October 3, 2007, the captain received an unsatisfactory grade on his upgrade proficiency check in the Saab 340. The disapproved task was approach and landing with a powerplant failure in a multiengine airplane (as stated previously in the FAA information about this failed flight check). He accomplished upgrade line-oriented flight training on October 14 and simulator training on October 14 and 15. He completed a satisfactory upgrade proficiency checkride on October 15, 2007. (These dates conflict with those in the FAA's record, which indicated that the captain's unsatisfactory checkride occurred on October 15 and his satisfactory checkride occurred on October 18.)

1.5.2 The First Officer

The first officer, age 24, held a commercial pilot certificate and an FAA first-class medical certificate dated January 22, 2009, with no limitations. The first officer received a type rating (SIC privileges only) on the DHC-8 on March 16, 2008.

According to a résumé in her personnel file at Colgan and her application for employment with the company, from August to December 2006, the first officer worked part time as a flight instructor at Sawyer Aviation, Scottsdale, Arizona. From January 2007 to January 2008, the first officer was a flight instructor at Sabena Airline Training Center, Phoenix, Arizona.[34] She was hired by Colgan in January 2008. Her résumé indicated that she had flown the following piston-powered airplanes: Piper PA-44, PA-34, and PA-28; Cessna C-152 and C-172; Beech BE-19 and BE-23; and Diamond DA-40. (The first officer reported no experience with turbine-powered airplanes on her résumé and employment application.) The first officer had accumulated 1,470 total flight hours, including 6 hours of actual instrument time, and 86 hours of simulated instrument time before her employment with Colgan.

Colgan's flight records indicated that the first officer had accumulated 2,244 hours of total flying time, including 774 hours in turbine airplanes and on the Q400. She had flown 163, 57, and 16 hours in the 90, 30, and 7 days, respectively, before the accident. (These times do not include the accident flight.) The first officer's initial proficiency check occurred on March 16, 2008; her IOE occurred on March 22, 2008; and her recurrent ground school occurred on January 15, 2009. FAA records indicated that the first officer received a notice of disapproval, issued on May 7, 2006, for her initial flight instructor certificate. The areas that needed to be reexamined were technical subject areas; performance maneuvers; preflight procedures; airport base operations; and takeoff, landings, and go-arounds. (These areas pertained to her instructional methods and abilities.) She subsequently passed the test and was issued her flight instructor certificate (airplane single-engine land) on May 12, 2006. FAA records also indicated no accident or incident history or enforcement action, and a search of records at the National Driver Register found no history of driver's license revocation or suspension.

[34] The first officer's résumé and employment application indicated additional aviation-related experience before her flight instructor positions. She worked as a mechanic's assistant for Big Bend Aviation, Moses Lake, Washington, from 2003 (month unknown) to January 2004. Also, she worked at Midstate Aviation, Ellensburg, Washington, from January 2004 to August 2006, dispatching aircraft, assisting pilots on the Unicom (a common traffic frequency), and performing office duties.

A first officer who went through training with the accident first officer stated that she had good knowledge of the airplane. The check airman who conducted the first officer's IOE recalled that she did not have any problems with handling the airplane and described her as a good pilot who was sharp, assertive, and thorough. A captain who had flown with the first officer numerous times indicated that she was average to above average for her level of experience. This captain further indicated that the first officer, as a monitoring pilot, was always ahead of the airplane and cross-checked her actions. Other captains indicated that, because of her abilities, the first officer could have upgraded to captain. None of the captains interviewed after the accident reported any problems with the first officer's adherence to sterile cockpit procedures or stated that the first officer had made any unprompted configuration changes to the airplane while they were the flying pilot. The ground school instructor for the first officer's recurrent training stated that she had good knowledge of the airplane, and another first officer in the class stated that the accident first officer had more technical knowledge than an average first officer.

In late January 2009, the first officer relocated from Norfolk, Virginia, to the Seattle area to be closer to family. (She and her husband were living at her parents' home at the time of the accident.) She also changed her base from Norfolk International Airport (ORF)[35] to EWR because it was reportedly easier to commute to EWR from Seattle-Tacoma International Airport (SEA) than from ORF.[36] The first officer's husband indicated that she had no significant changes in her life during the year preceding the accident. He reported that her finances were stable but that she had taken a significant pay decrease when she began working for Colgan.[37]

The first officer's husband described her as "very healthy" and indicated that she had no injuries or illnesses in the days before the accident. He acknowledged that she would get sniffles from cold air but stated that no medication was necessary. The first officer's husband reported that she did not take any medications regularly but had taken some ibuprofen 2 days before the accident after returning home from skiing. He also reported that she drank alcohol occasionally in social situations.

In addition, the first officer's husband indicated that she would normally go to sleep between 2000 and 2200 and awake between 0700 and 1000. Her husband described her sleep and wake schedule as "very adaptable" and stated that she would sometimes sleep until 1300. He further stated that she had no difficulties sleeping and no diagnosed sleep disorders.

[35] The first officer, while based at ORF, had worked briefly at a coffee shop when not flying. At the time of the accident, she was not employed outside of Colgan.

[36] According to her mother, the first officer had spoken to two other company pilots who lived in the Seattle area and told her that the commute to EWR was easier from SEA than from ORF because more flights were available and the distance allowed for sleep opportunities during the flights. The first officer's mother also stated that the first officer's decision to move to the Seattle area was also based on her concern that the ORF base would close.

[37] The CVR recorded the first officer stating, about 2030:02, that she earned a gross salary of $15,800 during the previous year (her date of hire with the company was January 16, 2008) and that "I'm just lucky 'cause I have a husband that's working." (The CVR recorded the captain stating that he earned a gross salary of about $60,000 during the previous year.) About 2103:03, the first officer stated that her husband had earned more in one weekend of military drill exercises than she earned in an entire pay cycle. She added that a recent pay raise would result in an extra $200 each paycheck.

The first officer did not have a crash pad in the EWR area.[38] A captain who had flown with the first officer when she was based at ORF stated that she planned to stay overnight at hotels once she began commuting from SEA to EWR.[39] According to a cargo air carrier captain who met the first officer in December 2008 while they were jumpseat passengers, the first officer stated that she did not need a crash pad at EWR because she could stay in the crew lounge. A flight attendant who saw the first officer on the morning of the accident asked her how commuting was going, to which the first officer replied, "great."

1.5.2.1 Activities in the 72 Hours Preceding the Accident

On February 8, 2009, the first officer completed a 5-day trip that ended at EWR at 1455. Specifics of the first officer's trip from EWR to her home are not known. The first officer's husband described her activities in the days preceding the accident as routine. Her telephone records for February 9 indicate that outbound text messages were sent between 2152 and 2218 PST. According to her husband, the first officer awoke between 0900 and 1000 PST on February 10. Her activities that day included skiing and watching television at home. She went to sleep between 2000 and 2200 PST.

On February 11, 2009, the first officer awoke between 0900 and 1000 PST. She arrived at SEA about 1730 PST to board a cargo flight, as a jumpseat passenger,[40] that departed for MEM about 1951 PST. The captain of this flight spoke with the first officer while the airplane was being loaded. The captain stated that she seemed to be alert, well rested, and in a good mood and that she did not show any symptoms of being sick. Another jumpseat passenger (a captain for the cargo air carrier) reported that the first officer slept for about 90 minutes during the flight. The flight arrived in MEM about 2330 PST (0230 eastern standard time on February 12).

On February 12, 2009, the first officer traveled from MEM to EWR aboard another cargo flight that departed about 0418 and arrived about 0623.[41] According to the captain of this flight, after the airplane landed, the first officer told him that she had slept during the entire flight. The captain stated that he asked the first officer whether she had a crash pad at EWR and that she replied that she did not need one. The captain also stated that he asked her what she would be doing until her report time and that she responded that one of the couches in the crew room "had her name on it." In addition, the captain, who met the first officer in December 2008 when both were jumpseat passengers, stated that she did not appear to be tired and showed no symptoms of being sick.

[38] According to her mother, the first officer was looking into the possibility of getting a crash pad, but she was concerned about finding appropriate accommodations for a female pilot in a male-dominated profession. The first officer's mother also stated that the first officer had planned to bid trips that would allow her to commute.

[39] The first officer's mother stated that the first officer thought it would be less expensive to stay in a hotel when needed rather than maintain a crash pad.

[40] The jumpseat was a normal passenger-type seat located in the cabin of the airplane. The area was free from interruptions associated with flight deck activities, and no cabin service was provided.

[41] The first officer's mother stated that the first officer had done the same commute before and described it as easy, stress-free, and less time-consuming than the commute from ORF to EWR.

At 0651 the first officer logged into the CrewTrac system and acknowledged changes to her upcoming trip sequence. At 0732 she made a telephone call to a number associated with Colgan operations. Two flight crewmembers, who reported at 0655 for a flight that departed at 0754, saw the first officer in the crew room. The first officer's specific activities on the day of the accident are not known, but several pilots reported seeing the first officer in the crew room watching television, talking with other pilots, and sleeping.[42] The first officer also logged into the CrewTrac system at 1459 and 1625. In addition, telephone records indicated text message activity during several periods of the day,[43] as well as calls she placed at 1425, 1747, and 1851 and received at 1726.[44] Notable text messages or text message activity included the following:

- At 0729, the first officer sent a text message indicating that she had arrived at EWR and that her only flight of the day was to BUF. She also indicated that she would be going to sleep and would call when she woke up.
- At 1305, the first officer sent a text message indicating that she felt good and had taken a 6-hour nap on a recliner.
- At 1534, the first officer sent a text message referring to her sleep.
- At 2113, during the taxi phase of the accident flight, the first officer sent a text message.

1.5.2.2 Previous Stall Training

In the year before her employment with Colgan, the first officer was a certified flight instructor on the Piper PA-28 Archer, which is a light propeller-driven, trainer-type airplane. According to her supervisor during that time, the first officer had taught or performed between 600 and 1,000 approach-to-stall recoveries. These recoveries would have been performed by the flying pilot by raising the flaps incrementally during the recovery (at an airspeed that was at least 10 to 15 knots above stall speed) as the airplane accelerated while maintaining altitude. Also, when she was demonstrating approach-to-stall recoveries to a student, the first officer would have retracted the flaps herself using her left hand while sitting in the right seat. These procedures were in contrast with the approach-to-stall training that the first officer received for the Q400, which was to be performed as a coordinated maneuver with flap changes commanded by the flying pilot.[45]

[42] A first officer who reported to EWR at 0525 for a 0632 flight and returned to EWR at 0956 reported seeing the first officer asleep during the morning. A captain, who had reserve duty at EWR starting at 1400, recalled seeing the first officer asleep about 1200. Another first officer, who arrived at EWR at 0910 and departed at 1437, reported seeing the accident first officer asleep in the afternoon. A captain reported that the first officer might have been asleep during the 1100 to 1400 time period.

[43] These periods included the following: 1305 to 1312, 1355, 1416 to 1424, 1514, 1522 to 1534, 1611 to 1612, 1635 to 1636, 1646 to 1647, 1659, 1723, and 1958. The first officer's husband stated that he and the first officer had sent text messages throughout the morning (PST) and that he had awakened her from a nap with a text message or a telephone call that he initiated.

[44] The husband of the first officer indicated that he spoke with her sometime between 1400 and 1500 and that she sounded "great" during the conversation.

[45] Colgan's approach-to-stall training is discussed in section 1.17.1.1.

1.6. Aircraft Information

The Q400 is manufactured by Bombardier, Inc., as a medium-range, all metal, high-wing, T-tail airplane powered by two turbopropellers. The airplane was certified for flight in icing conditions according to the requirements of 14 CFR Part 25 Appendix C and was designed to carry 74 passengers and 4 crewmembers. The accident airplane was manufactured in April 2008. The airplane was equipped with two Pratt & Whitney Canada PW150A engines and two Dowty R408/6-123-F17 six-bladed propellers. At the time of the accident, the airplane had accumulated 1,819 total hours and 1,809 total flight cycles. (A flight cycle is one complete takeoff and landing sequence).

1.6.1 Weight and Balance Information and Performance Data

Colgan was authorized by the FAA to contract with AeroData, Inc., for weight and balance information and real-time takeoff, en route, and landing performance data for its Q400 airplanes. (AeroData's information was derived from the Bombardier Q400 Airplane Flight Manual [AFM].) Flight crews were to request these performance data using ACARS.

The Colgan Q400 company flight manual (CFM) explained how flight crews were to transmit a landing data request and receive landing performance data from AeroData. Specifically, crews were required to enter the airport, runway, and airplane gross landing weight and could enter a secondary runway, flap setting, and wind.[46] This information was transmitted via datalink to the AeroData computer system, which would provide the required performance data on the ACARS display within 10 to 30 seconds. These data included V_{ref} (reference landing speed), V_{ga} (go-around speed), the flap retract speed (V_{fri}), the climb speed, and the maximum allowable landing weight and landing distance. The AeroData system provided the accident flight crew with landing performance information, including a V_{ref} of 118 knots, at 2153.

A Colgan check airman explained that, in the remarks section of the data request screen, flight crews could enter the keyword "icing," which would cause the V_{ref} speed provided by the AeroData computer system to increase by 20 knots for a flaps 15 landing and 15 knots for a flaps 35 landing. The check airman also stated that crews could enter the keyword "eice" (en route ice accumulation), which would add 90 pounds to the airplane's calculated landing weight to compensate for the accumulated ice. The accident flight crew did not enter the keywords "icing" or "eice" in its request to AeroData. (AeroData provided the downlink from the accident airplane, and the area in which the keywords "icing" and "eice" would have appeared if they had been entered was blank.) If the flight crew had made either entry, then AeroData would have provided a V_{ref} of 138 knots to the crew.

On November 23, 2009, Colgan issued Flight Standards Memo 09-013 regarding AeroData keyword inputs. The memo stated that, if keywords such as "icing" or "eice" were misspelled, AeroData would provide the clean (no ice) landing speeds. The memo indicated that,

[46] If a flap setting or wind was not entered, then the AeroData system would provide an optimal flap setting and assume that the winds were calm.

for any previous AeroData requests that included a misspelling of these words, the discrepancy could have been noticed in the remarks section of the landing report returned by AeroData, which would have shown “none” instead of “icing conditions.” The memo further stated that AeroData has corrected this issue so that any misspelled keywords would result in the error message, “invalid keyword,” and include the keyword that is not recognized.

1.6.2 Airspeed Indications

Airspeed indications on the Q400 are located on the left and right primary flight displays (PFD). According to the Q400 Airplane Operating Manual (AOM), indicated airspeed (IAS) is displayed digitally on the vertical scale (or airspeed tape) on the left side of the PFD. The vertical scale shows the airplane’s current IAS with marks every 10 knots to ± 42 knots from the actual IAS. The airspeeds that could be displayed on the vertical scale ranged from 30 to 500 knots. An airspeed trend vector (an upward- or downward-facing white arrow) indicates whether the airspeed is increasing or decreasing. According to Bombardier, the airspeed trend vector predicts the airspeed at which the airplane will be flying in 10 seconds. Five “bugs” indicate the airspeeds that may be programmed by the flight crew for takeoff, and two bugs indicate the airspeeds that may be programmed for landing. The two bugs that can be displayed for landing are represented on the airspeed indicator by a solid blue triangle and an open blue triangle, which Colgan used for V_{ref} and V_{ga}, respectively.

A low-speed cue is shown as a red and black vertical bar that extends from the bottom right of the vertical scale. The low-speed cue warns pilots of an inappropriately low airspeed for the airplane configuration or operating condition.[47] If the airplane’s IAS is less than or equal to the IAS at the top of the low-speed cue, the stick shaker activates. Also, the numbers on the IAS display change from white to red, providing pilots with another visual warning of an inappropriately low airspeed. Figure 1 shows the IAS digital display on the Q400 PFD.

[47] The low-speed cue can also represent the minimum control speed during approach and landing with all engines operating.

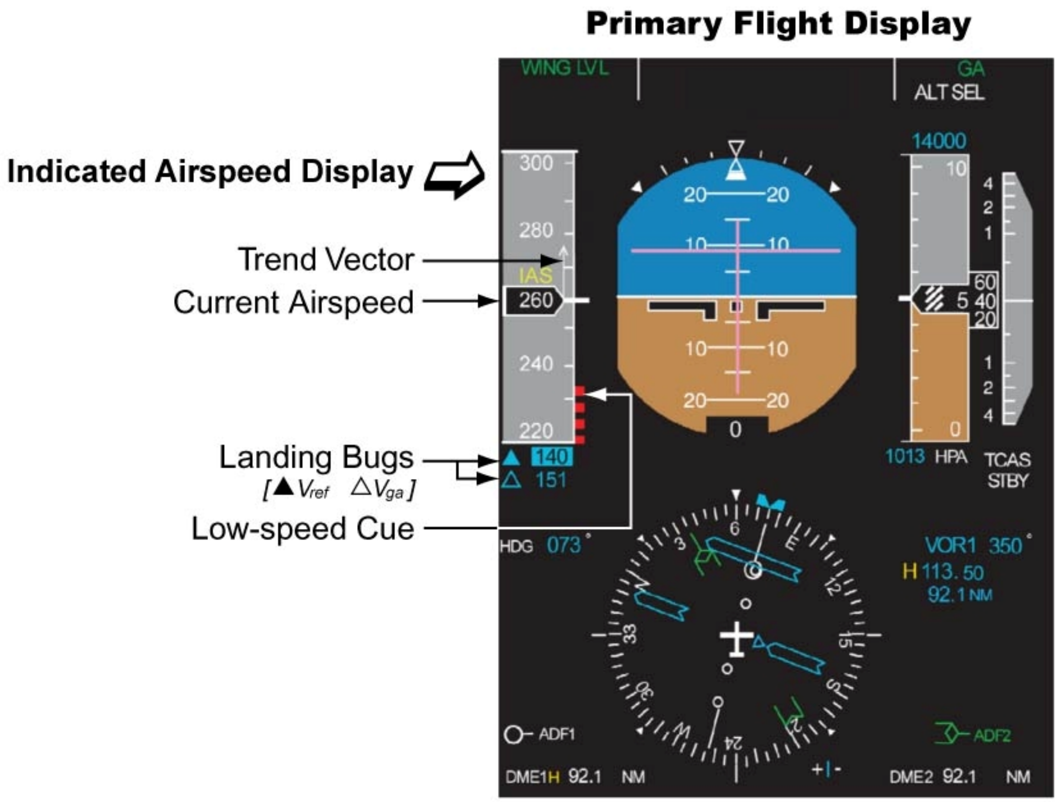

Figure 1. Q400 Indicated Airspeed Display

Source: Bombardier.

The ice protection panel, which is located on the overhead panel on the captain's side of the cockpit, includes a "REF SPEEDS" switch that can be set to the INCR (increase) or OFF positions, as shown in figure 2. During the May 2009 public hearing on this accident,[48] an engineering manager from Bombardier stated that the ref speeds switch, when set to the increase position, advances the stall warning so that the stick shaker would activate at a lower AOA;[49] as a result, the airplane would have the same performance margins relative to the stall speed during operations in icing conditions as it would have with a clean (no ice accretion) configuration (and the ref speeds switch set to the off position). The engineering manager also stated that, because the stick shaker would activate at a lower AOA with the ref speeds switch set to the increase position, the flight crew would need to increase landing airspeeds between 15 and 25 knots depending on the flap setting (to remain above the stall warning threshold).

[48] Appendix A provides information about the public hearing for this accident.

[49] The ref speeds switch position does not change the AOA value that triggers stick pusher activation.

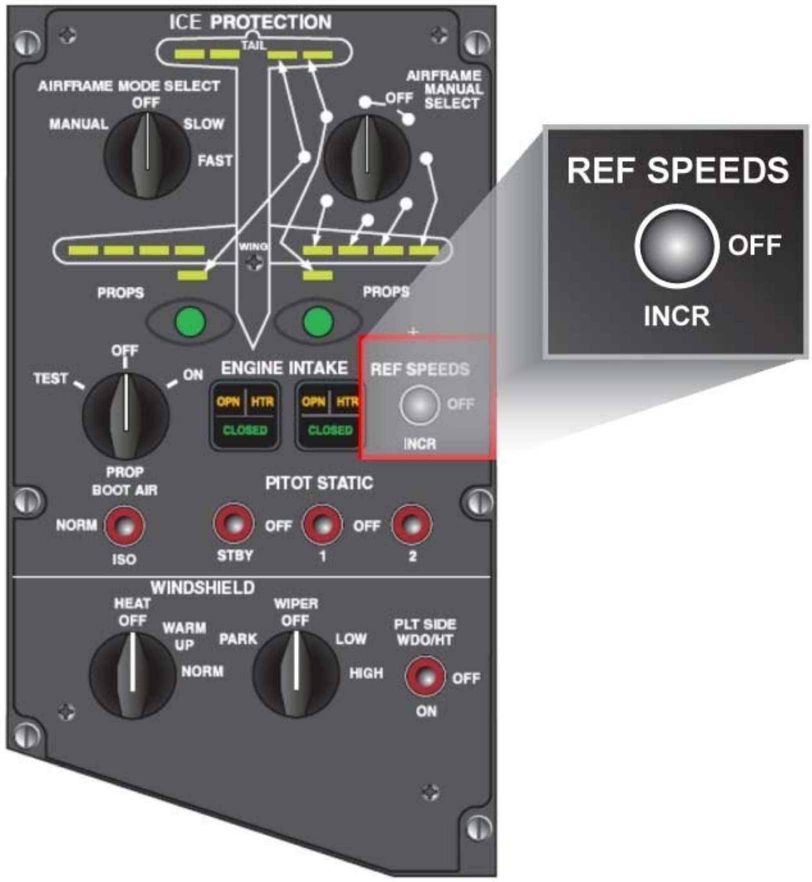

Figure 2. Q400 Reference Speeds Switch

Source: Bombardier.

The Bombardier Q400 AFM, section 4.7.2, Ice Protection Procedures, dated July 13, 2005, stated that the ref speeds switch was to be in the increase position before entering icing conditions and in the off position after the airplane is aerodynamically clean (that is, all ice is removed from the visible leading edges and wing tips). The Q400 AFM also cautioned that a stall warning might occur if airspeed was not increased before the ref speeds switch was selected to the increase position. The ref speeds switch on the accident airplane was found in the increase position.

1.6.3 Stall Protection System

The Q400 stall protection system includes a stick shaker and stick pusher. The stick shaker is a stall warning device on each control column that provides pilots with an aural and tactile warning of an impending stall. Even though the stick shaker on each control column is independently controlled by one of two units in the stall protection system, both columns vibrate simultaneously when a stick shaker activates because both columns are interconnected.

The Q400 stick pusher is a stall identification device that, according to Bombardier, positions the elevator to 2° nose down and provides a nose-down input to both control columns after an AOA threshold has been reached and an aerodynamic stall has occurred.[50] The stick pusher thus provides pilots with a tactile cue that they need to push forward on the control column to gain airspeed and alleviate the stall condition rather than pull back on the column. The stick pusher was designed to remain engaged (subject to certain constraints)[51] until the AOA decreases below the stick shaker activation angle. The engineering manager from Bombardier testified at the public hearing that the stick pusher system could be overpowered or disengaged by flight crew action.[52]

The airplane's two stall protection modules provide output commands to the stick shaker and stick pusher. The stall protection modules use AOA, flap position, body axis attitudes, normal acceleration, true airspeed, Mach number,[53] engine torque, and icing status data to calculate when the airplane is approaching a stall condition. The stick shaker activates when these parameters, in particular AOA, reach a specific threshold. The Q400 AOM stated that, when the stall protection modules operate the stick shakers, the autopilot automatically disengages,[54] and the ground proximity warning system "pull up" alert is inhibited. In addition, the stall protection modules use AOA, flap position, body axis attitudes, normal acceleration, true airspeed, Mach number, power lever angle, and condition lever angle data to calculate the AOA at which the stick pusher activates.

1.6.4 Ice Detection and Deicing System

At the public hearing, an engineering manager from Bombardier testified that visual cues provide the most reliable means of ice detection.[55] In addition, ice detector probes are installed on each side of the Q400 forward fuselage, below the pilot's and copilot's windows, to detect when ice is accumulating on the airplane. When ice accumulates on the probe sensors, the probes send an electronic signal to the avionics system to indicate that ice is present. The ice detector probes also cycle heat to the sensors to melt ice and ensure that the sensors can continue

[50] It is important to note that the Q400 stick pusher system differs from the stick pusher systems on other regional airplanes (for example, the CRJ-200 and ATR-42/72), which activate before a stall occurs. These stick pusher systems were designed to warn pilots of, and prevent them from encountering, undesirable pre-stall and stall characteristics.

[51] These constraints include limits on radio altitude, bank angle, pitch attitude, and normal load factor.

[52] The Bombardier engineering manager further testified that the nominal control column force was significant enough to get a pilot's attention to relax back pressure on the column but was not too excessive for a pilot to override if an inadvertent system failure had occurred. Overriding the stick pusher requires 80 pounds of opposite breakout force and then 66 pounds of sustained force. Disengaging the pusher is accomplished by pressing the stick pusher shutoff switchlight on the glareshield.

[53] Mach number equals an object's speed divided by the speed of sound.

[54] The airplane's autopilot can also be disengaged manually. An autopilot button is located on the automatic flight control system control panel, which is mounted on the glareshield directly in front of a flight crew. An autopilot disengage button is also located on each control wheel.

[55] According to Bombardier, observations of the outboard wing leading edge and the windshield wiper spigots are the primary means to indicate when an airplane has entered icing conditions. During nighttime operations, the spigots can be illuminated by a lamp inside the cockpit.

detecting ice. The ice detection probe sensors have a continuous self-testing feature to ensure that they are working properly. When both sensors fail, an "ice detect fail" light illuminates on the caution and warning panel in the cockpit.[56]

The Q400 engine display shows an "ICE DETECTED" message, as shown in figure 3, when one or both ice detector probes detect more than 0.5 millimeter (0.02 inch) of ice. The message appears in reverse video (black letters on a white background) for 5 seconds if the ref speeds switch has already been set to the increase position. After the 5-second period, the message appears in normal video (white letters on a black background, as shown in figure 3) when ice is detected and the ref speeds switch remains set to the increase position. If the ref speeds switch is set to the off position when ice is detected, the message flashes with yellow letters on a black background until the switch is turned to the increase position. In addition, when the switch has been selected to the increase position, an "INCR REF SPEED" message (also shown in figure 3) appears in normal video, regardless of whether ice has been detected.

Figure 3. Q400 Engine Display Showing Ice Detected and Increased Reference Speeds Message

Source: Bombardier.

The ice detected message appears periodically during icing conditions—the message is in view for a minimum of 60 ± 5 seconds when ice is detected—and is out of view when no ice is

56 The CVR did not record the crew discussing the illumination of this or any other caution light.

detected. For the accident flight, FDR data showed that the ice detected parameter transitioned from “not detected” to “detected” and then transitioned back to “not detected” during the following times: 2207:53 to 2208:53, 2209:21 to 2211:05, and 2211:17 to 2212:17. FDR data also showed that the parameter transitioned from “not detected” to “detected” from 2216:25 to the end of the recording.[57]

The airplane’s airframe deicing system uses bleed air from the engines to inflate rubber boots that break apart accumulated ice on the wing and tail (horizontal stabilizer and vertical stabilizer) leading edges as well as the nacelle air intakes.[58] The propeller deicing system includes electrical heating elements in the leading edge of each propeller blade to remove ice accumulations. A rotary switch on the ice protection panel is used to select propeller heat. Both front windshields and the pilot’s side window have electronically controlled heater elements that are laminated into the panels. These heater elements are designed to keep the windshield and windows at a predetermined temperature to prevent icing and misting.

1.6.5 Maintenance Records

Two line checks were performed on the accident airplane on the day of the accident after the airplane had arrived at Albany International Airport (ALB), Albany, New York, from EWR.[59] The ice detector probes and deice boots were checked visually, with no discrepancies reported.

Also, the flight crew of the flight from EWR to ALB reported, in the airplane’s logbook, that an “ice detect fail” caution light had illuminated during the flight. Maintenance personnel at ALB replaced the right-side ice detector probe and reported that an operational check of the ice detection system was satisfactory.

A review of the accident airplane’s logbook from April 2008 to February 2009 revealed no chronic issues with the airplane’s primary or secondary flight control systems. Also, no discrepancies with the primary or secondary flight control systems were reported after the airplane’s last L-1, L-2, and A checks.[60]

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[57] The FDR showed that the airplane was at the following altitudes when the ice detected parameter transitioned from “not detected” to “detected”: about 8,700 feet, about 7,300 feet, about 5,300 feet, and about 2,400 feet.

[58] The ice protection panel, shown in figure 2, includes a total of 14 boot inflation advisory lights that allow pilots to monitor deicing boot operation. Pilots can also check the operation of the wing deice boots by looking out their windows at the boots.

[59] Line checks involve servicing and a walk-around visual inspection of the airplane’s general condition. The first line check, known as the L-1 check, is accomplished every 3 days or 36 flight hours, whichever occurs first. The second line check, known as the L-2 check, is performed every 6 days or 50 flight hours, whichever occurs first.

[60] A checks are performed every 400 flight hours. The accident airplane’s last A and 2A checks were performed on December 24, 2008, and the last 3A check was performed on October 23, 2008.

1.7 Meteorological Information

BUF has an automated surface observing system (ASOS) that is maintained by the National Weather Service (NWS). The FAA is responsible for the augmentation and backup of the ASOS, which are provided by NWS-certified observers at BUF. The ASOS records continuous information on wind speed and direction, cloud cover, temperature, precipitation, and visibility in statute miles. The ASOS transmits an official meteorological aerodrome report (METAR) each hour and special weather observations as conditions change. The ASOS also records weather observations every 5 minutes, but this information is not disseminated to pilots.

The 2154 METAR for BUF indicated winds from 240° at 15 knots gusting to 22 knots, visibility 3 miles in light snow and mist, a few clouds at 1,100 feet agl, ceiling broken at 2,100 feet agl, overcast at 2,700 feet agl, temperature 1° C, dew point -1° C, and altimeter 29.79 inches of mercury (Hg). (This METAR became the basis for ATIS information "romeo.") The 5-minute observation at 2215 indicated wind from 250° at 14 knots, visibility 3 miles in light snow and mist, a few clouds at 1,100 feet agl, ceiling overcast at 2,100 feet agl, temperature 1° C, dew point -1° C, and altimeter 29.80 inches of Hg.

The NWS terminal aerodrome forecast that was current at the time of the accident was an amended forecast issued at 1920. The amended forecast expected, from 1900 to 2100, winds from 240° at 15 knots, visibility 1 1/2 miles in light snow showers, and ceiling overcast at 1,500 feet agl. From 2100 to 0100, the forecast expected winds from 250° at 14 knots gusting to 24 knots, visibility 5 miles in light snow showers and mist, and ceiling overcast at 2,000 feet agl.

Numerous pilot reports (PIREPs) about icing conditions in the BUF area were received during the day of the accident between 1250 and 1815. These PIREPs included reports of light, light-to-moderate, and moderate rime icing from 3,000 to 14,000 feet in the BUF area.[61] The 1815 PIREP, which was received from an Airbus A319 pilot about 4 hours before the accident, reported light-to-moderate rime icing at 5,000 feet and a temperature of -7° C.

The weather document for the accident flight (which accompanied the dispatch release) did not include pertinent NWS Airmen's Meteorological Information advisories (AIRMETs),[62] which inform pilots of significant weather phenomena. One of these AIRMETs extended over the airplane's route and expected moderate rime icing from below 8,000 feet. Another AIRMET extended over a larger region in the northeast, including the accident site, and expected occasional moderate icing below 18,000 feet. The icing conditions in both AIRMETs were expected to continue from 2145 to 0400 the next day. Other AIRMETs were in effect for instrument flight rules (IFR) conditions and turbulence over the BUF area. The only icing information included in the weather document consisted of the reports and forecast of snow at

[61] The FAA's *Aeronautical Information Manual*, chapter 7, Safety of Flight, section 7-1-21, describes rime ice as rough, milky, opaque ice formed by the instantaneous freezing of small supercooled water droplets.

[62] An AIRMET is one of five weather advisory categories used by the NWS. The other categories are Severe Weather Forecast Alerts, Significant Meteorological Information (SIGMETs), Convective SIGMETs, and Center Weather Advisories (CWAs). AIRMETs, SIGMETs, and Convective SIGMETs are issued from the NWS Aviation Weather Center in Kansas City, Missouri, and CWAs are issued from NWS Center Weather Service Units within FAA centers.

BUF and two PIREPs indicating light-to-moderate rime icing in the BUF area between 3,000 and 14,000 feet.

The ATC transcript showed that, after the accident, the controller who was handling the accident flight asked pilots of other airplanes whether icing was occurring. About 2221:12, a Delta Air Lines pilot, whose airplane was at an altitude of 2,300 feet at the time, told the controller that the airplane was not accumulating any ice at that altitude but that some ice might have been accumulating while descending between 6,500 and 3,500 feet. About 2225:11, the pilot reported that the airplane had accumulated between 1/4 and 1/2 inch of ice during the descent. About 2225:25, a US Airways pilot reported that his airplane, which was south of the airport and had been cleared to descend from 5,000 to 2,300 feet, had been accumulating rime ice for about 10 minutes. The controller asked the pilot to let him know when the airplane was out of icing conditions and mentioned that pilots of other arriving airplanes that were south of the airport did not report similar icing conditions. About 2227:04, after being instructed to maintain 2,300 feet until established on the localizer, the pilot reported that ice was starting to come off the windscreen.

The National Transportation Safety Board (NTSB) conducted a postaccident survey of pilots operating into BUF about the time of the accident to determine the icing environment at the time. Of the 22 surveys issued, 12 (about 55 percent) were returned. The survey found that varying (trace, light-to-moderate, and moderate) intensities of icing conditions were occurring between 2,000 and 12,000 feet. The surveys indicated that the pilots were aware of the potential for icing conditions and were not surprised by the encounters. None of the pilots indicated that they had formally reported the icing conditions because the pilots did not consider the icing conditions to be significant.

Ten of the surveys were from pilots of air carrier jet airplanes; two of the surveys were from pilots of turboprop airplanes. The two turboprop airplanes were an AirNow Embraer EMB-110 and another Colgan Q400 (flight 3268, also from EWR to BUF), which landed about 2200 and 2230, respectively. The AirNow pilot reported moderate rime ice while descending between 5,000 and 2,000 feet, with 2 to 3 inches of ice accumulation noted on the propeller spinners and some unprotected areas after arriving at BUF. The AirNow pilot also stated that the flight was in icing conditions for about 10 minutes. The Colgan Q400 pilot reported light-to-moderate rime ice while descending between 5,000 and 3,000 feet.

1.8 Aids to Navigation

During a postaccident interview, one air carrier reported that, when some of its airplanes attempted to intercept the BUF runway 23 ILS from a right downwind position, the glideslope would indicate that the airplane was well above the glideslope. The air carrier further reported that, just before intercepting the localizer, the glideslope would move upward to the proper interception indication. As a result, airplanes that had the autopilot and flight director engaged would capture the glideslope as it moved up, which would result in a climb and loss of airspeed.[63]

The accident flight intercepted the ILS from the left side,[64] and no problems with this or any other navigational aid was reported for flight 3407.

1.9 Communications

No technical communications problems were reported.

1.10 Airport Information

BUF is located 5 miles east of Buffalo, New York, at an elevation of 728 feet. BUF has two runways, 5/23 and 14/32; runways 5/23 and 32 had published ILS instrument approach procedures. The ILS runway 23 approach plate, dated April 20, 2007, included a note stating, "glideslope unusable beyond 5° right of course."

1.10.1 Air Traffic Control

BUF is a combined ATCT and terminal radar approach control. Radar data are provided by an airport surveillance radar-9 at the airport.

The accident flight was handled by the BUF approach controller at the east radar position. The controller stated that, after he instructed the flight crew to contact the ATCT, he continued to monitor the airplane's progress. The controller reported seeing the altitude readout in the radar display data block change to "XXX," which was an indication that the radar system had interpreted the altitude readout to be unreliable. Afterward, the airplane target and the data block disappeared from the radar display.

The approach controller contacted the tower controller to find out if something had happened to the flight and asked the tower controller to attempt to contact the airplane. The ATC transcript showed that both controllers attempted to contact the airplane during the next minute. The approach controller also asked the pilot of a Delta Air Lines airplane (which was being vectored for an ILS approach to runway 23) to see if the Colgan airplane was off to the right. The pilot of the Delta flight reported that he did not see the airplane and that no target for it appeared on the traffic alert and collision avoidance system. The approach controller reported that this information seemed to be confirmation that the airplane had been involved in an

[63] The National Aeronautics and Space Administration's Aviation Safety Reporting System (described in section 1.17.7.3) received several reports regarding the BUF glideslope issue, including one report dated December 2004, two reports dated January 2009, and one report dated April 2009.

[64] The FDR showed that the airplane had not captured the glideslope.

accident. The controller asked the controller-in-charge to call the airport fire department, which coordinated all off-airport events.

The approach controller who handled the accident flight stated that he then began trying to figure out what had happened to the flight. He asked other airplanes operating in the area about icing (as previously indicated in section 1.7) and learned that some airplanes had encountered icing but that the conditions did not seem to be "especially serious." The controller also checked the ILS monitor panel to see if a problem had occurred with the ILS equipment but found everything working normally. The controller was notified that an accident had occurred by the controller-in-charge, who had been told of the accident by the airport fire department about 10 minutes after the loss of contact with the flight.

The controller stated that icing conditions were common in the BUF area throughout most of the winter and characterized the icing conditions on the day of the accident as "routine stuff that pilots fly in here every day." Also, he indicated that the air traffic at the time of the accident was "fairly typical."

1.11 Flight Recorders

1.11.1 Cockpit Voice Recorder

The airplane was equipped with a Honeywell model 6022 SSCVR 120 solid-state CVR, serial number 97896. The CVR did not sustain any heat or structural damage. The audio information was extracted normally and without difficulty.

The CVR was sent to the NTSB's laboratory for readout. The CVR recording contained a 2-hour 1-minute digital recording of a flight crew microphone channel and a cockpit area microphone channel. Both channels contained excellent-quality audio data.[65] Also, for the last 30 minutes of flight, the CVR contained four channels[66] of excellent-quality audio data. (The last 30 minutes of the two 2-hour channels recorded the same information as the four 30-minute channels.) A transcript was prepared of the recording (see appendix B).

A CVR sound spectrum study was performed to resolve an inconsistency involving stick shaker activation information. Specifically, the CVR transcript indicated the stick shaker was only audible from 2216:27.4 to 2216:34.1 and from 2216:35.4 to the end of the recording (2216:53.9). During the 1.3-second time period during which the stick shaker was not audible on

[65] The NTSB rates the audio quality of CVR recordings according to a five-category scale: excellent, good, fair, poor, and unusable. The NTSB considers an excellent-quality audio recording to be characterized by the following traits: virtually all of the crew conversations could be accurately and easily understood. The transcript that was developed might indicate only one or two words that were not intelligible. Any loss in the transcript was usually attributed to simultaneous cockpit/radio transmissions that obscured each other.

[66] The first through fourth channels were the passenger address system, the captain's station, the first officer's station, and the cockpit area microphone, respectively.

the CVR, an FDR sample (at 2216:34.6) indicated that the stick shaker was active.[67] The sound spectrum study revealed evidence of stick shaker operation between 2216:34.4 and 2216:35.4, but the study did not identify any frequency content consistent with stick shaker activation between 2216:34.1 and 2216:34.4.

1.11.2 Flight Data Recorder

The airplane was equipped with a Honeywell model 980-4700 FDR, serial number 14241. The FDR recorded flight information in a digital format using solid-state memory as the recording medium. Of the total number of parameters recorded by the FDR, 121 parameters were deemed to be relevant to the circumstances of the accident.[68]

The FDR was sent to the NTSB's laboratory for readout and evaluation. The FDR was in good condition, and the data were extracted normally. About 26 hours 30 minutes of data were recorded on the FDR, including about 58 minutes of data from the accident flight. The FDR recording ended about 2216:53.

1.12 Wreckage and Impact Information

The airplane wreckage was mostly contained within the property boundaries at 6038 Long Street, Clarence Center, New York.[69] The airplane was severely fragmented with extensive fire damage. About 60 percent of the main structural components could be conclusively identified, including structure from the radome and both wingtips. The empennage was found intact in the wreckage. Numerous small pieces of airplane structure were recovered but were not conclusively identified. The airplane wreckage was on a magnetic heading of 070°. All of the examined fracture surfaces exhibited signs that were consistent with overload failure; no evidence indicated any preimpact failures. Flight control continuity could not be determined because of severe fragmentation and burn damage.

The airplane impacted the south side of the house near ground level, and pieces of the airplane traveled through the house, coming to rest beyond the northeast corner of the house's foundation. A ground scar, which was found on the south side of the house about 10 feet south of the south foundation wall, measured 15 feet long, 5 feet wide, and 3 feet deep. Two trees along the southern boundary of the property were impacted by the airplane and had their tops sheared off. One tree strike occurred about 20 feet agl, and the other occurred about 25 feet agl. Tree

[67] The FDR recorded the activation of the stick shaker at 2216:30.6.

[68] Title 14 CFR 121.343, "Flight Data Recorders," required the airplane to be equipped with an FDR that recorded a minimum of 88 parameters.

[69] As discussed in section 1.4, a section of the outboard leading edge of the right wing impacted the garage of an adjacent house located to the south of the destroyed house. Also, the right forward cargo door was recovered across the street from, and east of, the destroyed house with impact damage but little fire damage. In addition, the only structure found after a search of the rooftops and yards that surrounded the destroyed house was a small section of propeller spinner.

debris located between the property boundary and the house exhibited clean, angled cuts that were consistent with propeller impact.

The right main landing gear exhibited minor fire damage to the tires, the retract actuator was broken off in the almost fully retracted position, and the right main landing gear uplock (a mechanical lock to hold the gear in the up position) was found in the open position. The left main landing gear exhibited severe fire damage with the retract actuator broken off in the almost fully retracted position, but the left main landing gear uplock was not conclusively identified. The nose landing gear was found with severe fire damage, but no conclusive evidence of the gear's position was found.

The stage 1 low pressure compressors in both engines were found with blades bent in the direction opposite rotation, fractured blades, airfoil leading edge impact damage, and ingested dirt. No evidence of a turbine failure or an uncontainment was found in either engine. Both engine power levers and the No. 1 engine condition lever appeared to be in the full forward position, and the No. 2 engine condition lever appeared to be in its midrange position. Parts of each blade tip from both propellers were found. Six No. 1 propeller blades and four of six No. 2 propeller blades were found almost full length and were fractured near the root of the blades (where the blades are installed into the propeller hub).

The ice protection panel was recovered in the wreckage and was found to be severely burned. As indicated in section 1.6.2, the ref speeds switch was found set to the increase position. The ice detector probes were not identified in the wreckage.

No segments of the leading edge deice boots from the left wing were identified. Two leading edge sections from the right wing were located in the wreckage. The deice boots from these sections appeared to still be bonded to the leading edge, except in some areas that appeared to be associated with impact damage. The pneumatic lines leading to the connections on the inside of the leading edge sections were intact. These and other deice system pneumatic lines did not show any evidence of leaks, ruptures, or missing or damaged line couplings.[70] The leading edge deice boots for the horizontal and vertical stabilizer were found in good condition. The boots were still bonded to the leading edge structure, with only minor tears in the boot surfaces and slight charring on the left horizontal stabilizer boot.

Portions of all eight flap actuators (which move the flap surfaces to a selected position and maintain the selected position against the aerodynamic forces acting on the flap surfaces) were recovered. Seven of the actuators contained the appropriate portions to measure the dimension between the overtravel stop on the jackscrew and the body of the actuator. All measurements were consistent with the flaps being close to the fully retracted position.

[70] Other deice system pneumatic lines found in the wreckage were from the center wing area, the dorsal fairing (which extends from the lower portion of the vertical stabilizer to the top of the fuselage), the aft fuselage, and the horizontal and vertical stabilizers.

1.13 Medical and Pathological Information

Toxicology tests were performed by the FAA's Civil Aerospace Medical Institute on tissue specimens from both pilots. Specimens from the captain tested negative for ethanol. Also, with the exception of Diltiazem,[71] his specimens tested negative for a wide range of drugs, including major drugs of abuse (marijuana, cocaine, phencyclidine, amphetamines, and opiates). Specimens from the first officer tested negative for ethanol and a wide range of drugs, including major drugs of abuse.

The Erie County Medical Examiner's Office determined that the cause of death for the airplane occupants and the ground victim was multiple blunt force trauma.

1.14 Fire

No evidence indicated an in-flight fire. The fire damage that occurred to the airplane and the house it impacted occurred as a result of the crash.

1.15 Survival Aspects

1.15.1 Fire Emergency Response

The Clarence Center Fire Company reported that it was the first emergency response organization to respond to the accident scene. The fire company also reported that the following other local emergency response organizations responded to the accident site within 15 minutes of the accident: Niagara Airport Police, Erie County Sheriff Department, New York State Police, Clarence Fire Company, Swormville Fire Company, and East Amherst Fire Department.

1.15.2 Natural Gas Emergency Response

About 2358 on the night of the accident, the operator of the natural gas distribution pipeline system serving the accident area, National Fuel Gas Distribution Corporation, was notified of blowing and burning gas at the home that was destroyed by the airplane's impact. A National Fuel crew truck was dispatched at 0009 on February 13, 2009, and arrived on scene about 0033. The crew shut off the flow of gas at the homes on both sides of the accident site. The crew was initially unable to shut off the flow of gas at the destroyed home because the gas shutoff valve and gas meter were directly in the fire area.

About 0130, after National Fuel had completed all of the work that it could safely accomplish, the incident commander at the accident site requested that the crew retreat from the

[71] The captain's FAA medical records indicated that he was taking this medicine to control hypertension.

site. After 0130, National Fuel developed a plan for shutting off the flow of gas at the destroyed home, which would have also required shutting down gas service to about 50 homes in the area of the accident site. National Fuel discussed the plan with the Clarence Center fire chief, who, after consultation with the incident commander, instructed National Fuel to hold off on the shutdown because it would have required the evacuation of residents in the early morning hours and in freezing temperatures.

About 0855, the incident commander allowed National Fuel to enter the front yard of the destroyed home to secure the flow of gas at the home, which put out the natural gas fire. The flow of gas into the home stopped about 1045 when the natural gas service pipeline for the home (as well as three other homes near the accident site) was squeezed off[72] from the natural gas distribution main pipeline. About 1320, the service pipeline was physically disconnected from the main pipeline.

National Fuel's investigation of the accident scene found that the fire was fed by the natural gas service pipeline. (The natural gas distribution main pipeline was not damaged and was subsequently returned to service.) National Fuel also found that the gas shutoff valve at the destroyed home's gas meter had been broken in half, causing the valve to be in the full open position and allowing natural gas to flow and feed the fire.

In addition, National Fuel found that the service gas pipeline leading to the destroyed home was not installed with an excess flow valve.[73] The service gas pipeline was installed in September 1984; at the time, service pipelines were not required to be installed with an excess flow valve.[74] Computer modeling demonstrated that, if an excess flow valve had been installed at the destroyed home, there would have been enough gas flow for the valve to have closed and stopped the flow of gas to the fire.[75]

[72] This term denotes the flattening of a plastic pipe (using a hydraulic tool) to the point at which no gas can flow through it.

[73] An excess flow valve (which is also called a gas fuse) shuts off the flow of gas if it exceeds a certain level, as determined by the utility company that services a residence.

[74] Legislation enacted in 2006 required the installation of excess flow valves after June 1, 2008, on all new and replacement service lines to single-family residences.

[75] The NTSB has issued several recommendations regarding the use of excess flow valves. For example, on June 22, 2001, the NTSB issued Safety Recommendation P-01-2, which asked the Pipeline and Hazardous Materials Safety Administration (which was the Research and Special Programs Administration at the time) to require the installation of excess flow valves in all new and renewed gas service lines, regardless of customer classification, when the operating conditions were compatible with readily available valves. Safety Recommendation P-01-2 was classified "Open—Acceptable Response" on March 18, 2008, pending publication of a final rule addressing integrity management for gas distribution pipelines.

1.16 Tests and Research

1.16.1 Aircraft Performance Study

An aircraft performance study was performed to determine the time alignment among CVR events, FDR data, and ATC radar data; calculate the airplane's flightpath; correlate the airplane's position with local reference points; and examine the actions of the stall protection system during the final portion of the flight.

Data from the FDR and a Bombardier Q400 stall protection system design document were used to calculate the fuselage AOA during the stall sequence.[76] The calculated fuselage AOA at the time that the autopilot disengaged was about 8°. The calculated fuselage AOA at the time of stick shaker activation would have been about 7.6° with the ref speeds switch selected to the increase position and about 12° with the ref speeds switch selected to the off position.[77] These AOA calculations, combined with the available CVR and FDR evidence, showed that the ref speeds switch was in the increase position at the time of stick shaker activation.[78]

Data from the FDR and the Bombardier Q400 stall protection system design document were also used to calculate the expected low-speed cue data (with and without the ref speeds switch set to the increase position).[79] The FDR airspeed and the calculated low-speed cue data were then compared with the expected approach and reference speeds for the accident flight (flaps 15, 118 knots; flaps 15 in icing conditions, 138 knots) to determine if and when the accident airplane's actual airspeed was below either the applicable approach speed schedule or the low-speed cue. The comparison showed that the airspeed was below the minimum approach speed in icing conditions for about 8 seconds before stick shaker activation and below the low-speed cue from the initial stick shaker activation to the end of the flight.

The reference stall speeds were estimated using a flap position of 6.5°, which was the approximate flap position at the time of the stall (based on an analysis of available FDR parameters and an event simulation match). On the basis of an interpolation of Bombardier Q400 AFM data, the airplane would stall at 107 knots in unaccelerated (that is, a vertical acceleration of 1 G)[80] flight for a flap position of 6.5° and an estimated landing weight of 54,700 pounds (the approximate landing weight of the accident airplane).[81] The airplane performance study

[76] Fuselage AOA is calculated from the local vane AOA using body axis pitch rate and true airspeed, among other parameters, and is an important input to the stick shaker, stick pusher, and low-speed cue calculations.

[77] The stick shaker activation angle is a function of the ref speeds switch selection, flap position, engine torque, and Mach number.

[78] The position of the ref speeds switch was not recorded by the FDR.

[79] The low-speed cue is a function of engine torque, propeller speed, fuselage AOA, vertical acceleration, flap position, calibrated airspeed, and ref speeds switch position, among other parameters.

[80] G is a unit of measurement that is equivalent to the acceleration caused by the earth's gravity (32.174 feet/second^2).

[81] This weight did not consider the effects of ice accumulation because the flight crew had not made icing entries into the ACARS system when transmitting the landing performance data request, as previously explained in section 1.6.1.

calculated that, with the extra lift required for a nose-up pitching maneuver, a Q400 airplane with no ice accretion could achieve 1.38 Gs before encountering a wing stall at 125 knots (the airspeed at the time that the airplane entered the stall).[82] The FDR indicated that the accident airplane had achieved a vertical acceleration of about 1.42 Gs during the initial pitch-up maneuver after the aft control column movement. Thus, the actual airplane performance was slightly better than the clean wing (no ice accretion) performance assumed in the AFM.

1.16.2 Aircraft Performance Simulation Study

Bombardier Q400 aerodynamics, engine, and flight controls simulation models were used to evaluate the accident airplane's performance relative to the nominal airplane simulation model (with no airframe or engine ice accumulation) and an airplane model with a degraded performance level (which was consistent with that documented in the original certification for the Q400 while operating within the Part 25 Appendix C icing envelope).[83] The calculated AOA, elevator, aileron, and rudder time history values from the closed-loop event simulation[84] closely matched the accident airplane's motion, as documented on the FDR, during the 2-minute time period that preceded the stall.

The Q400 simulation model contained an ice accumulation factor that ranged from 0.0, representing a clean airplane, to 1.0, representing an airplane with ice contamination equivalent to that demonstrated during the Q400's certification for flight in icing conditions (per Part 25 Appendix C).[85] The NTSB found that the ice accumulation factors of 0.1 and 0.2 provided the best match with the FDR data before the stall. The ice accumulation factor simulation results indicated that the accident airplane experienced a small airplane performance degradation resulting from ice accretion compared with the icing certification performance level.

The Bombardier Q400 aerodynamics, engine, and flight controls simulation models were also used to perform a kinematics parameter extraction. This method performs a dynamic trim calculation for each point in the data time history, with aircraft motion data (that is, linear and angular accelerations derived from load factor and attitude data, respectively)[86] defining the trim

[82] Aerodynamic stall depends on AOA and occurs at basically the same AOA regardless of load factor. A load factor greater than 1 G, generated by either a pitch-up or turning maneuver, requires extra lift created by an increased AOA and/or an increased airspeed. Thus, at a load factor greater than 1 G, when the stall AOA threshold is reached, the stall occurs at a higher airspeed than with a load factor of 1 G.

[83] References to Appendix C icing in this section describe performance degradations resulting from ice accretions on Q400 unprotected surfaces and protected surfaces between boot cycles while operating in icing conditions with the flaps at 0° and the airplane operating at holding speeds. The operational icing speed increments were based on the Q400 icing certification flight tests.

[84] A closed-loop event simulation attempts to replicate the target airplane pitch, roll, and heading angles as a function of time by applying small increments to the nominal FDR elevator, aileron, and rudder surface position parameters used to backdrive the airplane motion. The airplane engine settings, flap position, and gear position are specified as a function of time.

[85] In the simulation study, the Q400 aerodynamic drag and lift effects of ice accretion were incremented linearly for ice accumulation factors between 0.0 and 1.0.

[86] The load factor data include the longitudinal, lateral, and vertical acceleration parameters. The attitude data include the airplane pitch attitude, bank angle, and heading angle parameters.

target. The incremental aerodynamic force and moment[87] coefficients required to match the recorded airplane motion are calculated using specific data.[88]

The kinematics parameter extraction results for aerodynamic coefficients (that is, incremental lift, drag, pitching moment, side force, rolling moment, and yawing moment) indicated that the accident airplane did not experience any (1) linear or progressive lift coefficient degradation over time, (2) measurable lift coefficient loss, or (3) sudden, substantial, progressive, or sustained increase in drag coefficient (which could be clearly isolated from Q400 engine simulation and/or airplane configuration transition modeling uncertainties) for the 2-minute time period evaluated. Only small increments in the moment coefficient values for pitch, roll, and yaw were observed before the stall.[89]

Three alternate flight control input scenarios were evaluated, with and without performance degradation as a result of icing for three engine torque settings, to quantify the airplane performance effects of (1) holding the control column at the expected autopilot disengage position, (2) targeting constant pitch attitude, and (3) targeting constant altitude. The evaluation of these alternate flight control input scenarios showed that pilot intervention was required to avoid stalling the airplane after autopilot disconnect; that is, holding the control column at a fixed position (the expected autopilot disengage position) and adding power would result in the airplane continuing to increase AOA up to an aerodynamic stall. However, the Q400 simulation airplane with a conservative icing accumulation factor of 0.3 still had adequate performance capability, with appropriate pitch axis inputs, to maintain either a constant pitch attitude of 10° or constant altitude with engine torque values at or above the values for the accident airplane.

In addition, the accident airplane's fuselage AOA achieved at the peak normal load factor[90] (13°) was compared with both the stick shaker and the stick pusher AOA schedules for the nominal stall protection system. According to calculations provided by the supplier of the Q400 stall protection system, the stick shaker for the accident flight condition was scheduled to activate at a fuselage AOA of about 11.9° with the ref speeds switch selected to the off position. The calculations also showed that the stick pusher for the accident flight condition was scheduled to activate (after an aerodynamic stall) at a fuselage AOA of 17.5°. Because the accident airplane achieved a peak normal load factor at a calculated fuselage AOA of about 13°, the airplane's AOA for maximum lift was greater than the AOA for the Q400 clean-wing stick shaker onset (by about 1°) and was less than the AOA for the Q400 stick pusher (by about 4.5°).

[87] A moment is distance multiplied by force.

[88] These data are the simulation models for the airplane aerodynamics, propulsion, and flight control system; airplane motion/state data (including altitude, airspeed, attitudes, AOA, calculated sideslip angle, and load factors); airplane configuration (such as high-lift device and landing gear position); flight control inputs and/or control surface positions; airplane loading (for example, weight and center-of-gravity location); and environment data (including winds, temperature, and pressure).

[89] The results after 2216:29 were subject to increased uncertainty because of uncertainties with the accident airplane's actual angular acceleration.

[90] The peak normal load factor was achieved after autopilot disconnect but before the development of significant bank angles.

1.17 Organizational and Management Information

According to its website, Colgan began operations in December 1991. In July 1997, the company began Continental Connection service through a marketing alliance and code-sharing agreement with Continental Airlines.[91] In December 1999, Colgan started operating as a US Airways Express carrier under a code-sharing and service agreement with US Airways. In March 2005, Colgan resumed Continental Connection service.[92] In October 2005, the company started providing flights for United Express under a code-sharing and service agreement with United Airlines. In January 2007, Colgan became a wholly owned subsidiary of Pinnacle Airlines Corporation (which was also the parent company of Pinnacle Airlines, a regional air carrier that operated as Northwest Airlink). In February 2008, Colgan began providing Continental Connection service out of EWR.[93]

At the time of the accident, Colgan's headquarters was located in Manassas, Virginia, but, on December 1, 2009, the company relocated to Memphis (where Pinnacle Airlines' headquarters is located). At the time of the accident, the company offered about 350 daily flights to 53 cities in 15 states and Canada. Also, the company had about 1,300 employees and 34 Saab 340 and 15 Q400 airplanes (including the accident airplane) in its fleet. In February 2007, Colgan announced the introduction of the Q400 into its fleet, and initial training of company flight crews on the Q400 began in September 2007 at FlightSafety International's facility in Toronto, Canada.[94] Colgan began Q400 service in February 2008 and became fully qualified to conduct its own training on the Q400 in July 2008.

The Colgan certificate is managed by the FAA's Washington Flight Standards District Office (FSDO) in Herndon, Virginia. The FAA's operational oversight of the company is conducted by a principal operations inspector (POI) and aircrew program managers (APM) for the Saab 340 and the Q400. The POI and Saab 340 APM are based at the Herndon FSDO, and the Q400 APM is based at the Teterboro, New Jersey, FSDO.

According to the Colgan vice president of administration, at the time of the accident, the company's minimum flight time requirement for pilot applicants was 600 hours total flight time with 100 hours multiengine time. This vice president also stated that a pilot with 250 to 300 hours in a Part 121 operation would be a more appealing candidate than a pilot with 1,500 hours in a general aviation airplane. The vice president further stated that, as part of a pilot applicant's

[91] According to FAA guidance, code-sharing is a marketing arrangement in which an airline (in this case, Continental) places its designator code on flights operated by another airline (in this case, Colgan) and sells and issues tickets for those flights. Airlines involved in code-sharing operations are required to disclose to consumers the corporate name of the transporting carrier.

[92] At an earlier point in time, Colgan's initial marketing alliance and code-sharing agreement with Continental had ended.

[93] Colgan operates at EWR in rooms below one of the airport's terminals. The rooms include management and administrative offices as well as three rooms for pilots and flight attendants. One of these rooms has computers, a bulletin board, and crew mailboxes. Another room has a kitchen area, a television, tables, and chairs. The other room, as previously discussed in section 1.5.1, is referred to as the crew room and has couches, recliners, and a television.

[94] Colgan was authorized to outsource initial, transition, and upgrade training, and three FlightSafety International locations, including Toronto, were permitted to conduct this training for the Q400.

background check, the company checked the paperwork required by the Pilot Records Improvement Act (PRIA)[95] but that many of the pilots that the company had hired did not have previous experience with other airlines.

Colgan indicated that it revised its flight time requirements on April 30, 2009. Newly hired pilots are now required to have 1,000 hours total flight time and 100 hours in multiengine aircraft. Q400 captains are now required to have 3,500 hours total flight time and one of the following: 1,000 hours as a PIC at Colgan, 1,500 hours in aircraft type, or 2,000 hours at Colgan. Saab 340 captains are now required to have 2,500 hours total flight time and 1,000 hours at Colgan.

1.17.1 Flight Crew Training

The Colgan Crewmember and Dispatcher Training Program Manual, page 1-7, dated April 11, 2008, contained instructions and information for training company pilots according to company policies and procedures, the *Federal Aviation Regulations*, and operations specifications. The director of crewmember and dispatcher training[96] was responsible for reviewing and implementing the policies and procedures in the company's training manual. The director was also responsible for (1) ensuring that all pilots were trained according to the airline transport pilot practical test standards, (2) continuously reviewing the adequacy and completeness of the program, and (3) tracking the failure rate of pilots during training and checkrides to ensure compliance with 14 CFR 121.401(e).[97]

The training manual stated the following with regard to performance standards:

> Flight crewmembers will be required to receive a satisfactory grade on all flight maneuvers, procedures and duties. A satisfactory grade is obtained ONLY when the student demonstrates the ability to operate the aircraft/simulator in a manner that shows he/she is obviously the master of the aircraft, and with successful outcome of each maneuver never in doubt.

Colgan used a computer record system to maintain training records for pilots, dispatchers, instructors, and check airmen. Paper training forms were used for grading simulator

[95] PRIA records include information on accidents, incidents, violations, and drug or alcohol issues during the previous 5 years for pilots that have worked for Part 121, 125, or 135 operators. Section 1.18.2.1 contains additional information about PRIA. At the time of the accident, Colgan's PRIA records were reviewed by either the company's human resources manager or administration vice president. PRIA records are now also reviewed by Colgan's flight standards or flight operations manager.

[96] According to the Colgan Flight Operations Policies and Procedures Manual, the director of crewmember and dispatcher training reports to the vice president of flight operations.

[97] Title 14 CFR 121.401(e) states the following: "a person who progresses successfully through flight training, is recommended by his instructor or a check airman, and successfully completes the appropriate flight check for a check airman or the Administrator, need not complete the programmed hours of flight training for the particular airplane. However, whenever the Administrator finds that 20 percent of the flight checks given at a particular training base during the previous 6 months under this paragraph are unsuccessful, this paragraph may not be used by the certificate holder at that base until the Administrator finds that the effectiveness of the flight training there has improved."

training events and showing satisfactory completion of a training course. The course completion information would be entered electronically into the computer training record system, and the paper training records, including pilot grading, would then be destroyed.[98]

1.17.1.1 Stall Training

Stall training for the Q400 occurs during three of eight simulator sessions during initial, transition, upgrade, and requalification training. These three simulator sessions included three approach-to-stall profiles—in the clean (cruise flight), takeoff, and landing configurations—that are evaluated during a proficiency check. The company's approach-to-stall profiles were consistent with the FAA's airline transport pilot practical test standards.

The simulator training events for the clean, takeoff, and landing approach-to-stall profiles are detailed in table 2. The Colgan training manual indicated that check airmen could waive two of the three approach-to-stall configurations when a pilot's performance in other events indicated a high degree of proficiency.

Table 2. Colgan Air's Approach-to-Stall Training Events

Stall profile	Entry into stall	During stall	Exit from stall
Clean stall	180 knots and minimum altitude of 5,000 feet agl with power at flight idle and gear and flaps retracted	PF maintains altitude and heading PF calls "stall," advances power to rating detent, and calls "check power"	PF adjusts power to maintain 180 knots
Takeoff stall	180 knots and minimum altitude of 5,000 feet agl with flaps at 15°, gear down, and power at flight idle	PF maintains altitude and begins a 20° bank turn at 120 knots PF calls "stall," advances power to rating detent, rolls wings level, and calls "check power" PM calls "positive rate" PF calls "gear up" PM calls "V_{fri}" PF calls "flaps 0"	PF adjusts power to maintain180 knots

[98] As a result, the NTSB did not have access to the accident flight crew's grading on simulator training events, including the approach-to-stall profiles.

Stall profile	Entry into stall	During stall	Exit from stall
Landing stall	180 knots and minimum altitude of 5,000 feet agl with flaps at 35°, gear down, and power at flight idle	PF maintains altitude and heading PF calls "stall," advances power to rating detent, and calls "check power, flaps 15" PM calls "positive rate" PF calls "gear up." PM calls "V_{fri}" PF calls "flaps 0"	PF adjusts power to maintain 180 knots

Note: PF, pilot flying; PM, pilot monitoring.

During postaccident interviews, the NTSB learned that, during the approach-to-stall recovery exercises for initial simulator training, pilots were instructed to maintain the assigned altitude and complete the recovery without deviating more than 100 feet above or below the assigned altitude, which had been previously required by the practical test standards for the checkride.[99] Some company check airmen indicated that any deviation outside of that limit would result in a failed checkride, but other company check airmen considered this altitude limitation to be a minimal loss of altitude (which is consistent with the current practical test standards).

Company training personnel and Q400 check airmen stated that demonstration of the airplane's stick pusher system was not part of the training syllabus for simulator training at the time of the accident. Nevertheless, one check airman indicated that he demonstrated the stick pusher during initial simulator training. The check airman stated that most of the pilots who were shown the pusher in the simulator would try to recover by overriding the pusher. Most of the company pilots interviewed after the accident reported that they had not received a demonstration of or instruction on the stick pusher.

At the public hearing for this accident, Colgan's chief Q400 instructor testified that, after the accident, pilots began receiving a demonstration of the stick pusher system during simulator training. The Q400 instructor stated that pilots were set up for a stall in the landing configuration with the autopilot on. Once the stick shaker activated, the autopilot would turn off, and the pilots would apply back pressure to the control column so that they could feel the activation of the stick pusher.[100] The instructor added that pilots also received a demonstration on how to overpower the stick pusher so that they could feel the operation of the pusher.

On April 6, 2009, Colgan issued CFM Operations Bulletin 09-004, Q400 Enhanced Flight Maneuvers Training, which described the maneuvers that would be added to initial, upgrade, transition, and recurrent training and checkrides. The additional flight maneuvers included new stall recovery training (recovery from stalls entered during actual flight scenarios

[99] The 100-foot maximum altitude standard was consistent with other practical test standards, including those for performance maneuvers, holding, and instrument approaches.

[100] The resulting airplane motion from this control input may exceed the validated simulator envelope.

rather than the "traditionally rigid profile based maneuver demonstration"), a stick pusher demonstration, and unusual attitude/upset recovery training. All three stall recoveries were to be performed by each pilot during proficiency checks, including stall conditions involving autopilot disconnect.

NTSB investigators conducted Q400 simulator observations at FlightSafety International's facility in Toronto.[101] The observations were conducted using nighttime conditions, and the temperature, winds, and altimeter settings were set to the approximate conditions at the time of the accident. The airplane gross weight was set at 54,700 pounds (the approximate landing weight of the accident airplane), and the airspeed bugs were set to 118 knots (V_{ref}) and 114 knots (V_{ga}). A clean airplane (no simulated ice) was used. FlightSafety personnel stated their belief that scenarios in which the airplane was flown to activation of the stick pusher and then recovered were within the capabilities of the simulator model but that fighting against the stick pusher and not recovering would cause the simulator to be outside of its capabilities.[102]

During observations of the planned clean, takeoff, and landing approach-to-stall profiles, the pilots in the simulator cab (the Colgan lead simulator instructor for the Q400 and the Bombardier Q-series customer service liaison pilot) noted that the recoveries did not require significant or dynamic control inputs to accomplish.[103] NTSB investigators noted that forward pressure on the control column and nose-down trim were needed during the recovery and that the numbers on the IAS display would turn red about 1 to 3 knots before the onset of the stick shaker.

Other simulator observations were made in which the airplane, while under autopilot control, decelerated until the stick shaker activated and the pilot flew the airplane to recovery. Several scenarios were demonstrated with the airplane's flaps and gear up, including one in which the ref speeds switch was off. The stick shaker onset for this scenario occurred when the airplane was at an airspeed of 125 knots. In a scenario in which the ref speeds switch was set to the increase position, the stick shaker onset occurred at an airspeed of 142 knots. The stick pusher did not activate during any of these demonstrated scenarios.

NTSB investigators noted that the recoveries did not result in unusual attitudes and that the stick shaker ceased as airspeed increased during the recoveries. The investigators also noted that, when the ref speeds switch was changed from the increase to the off position at stick shaker onset, the stick shaker would immediately stop, and the low-speed cue would appear in a lower position on the IAS display (compared with its position at stick shaker onset).

During a simulator demonstration of the ILS approach to runway 23 at BUF, the stick shaker activated at an airspeed of 127 knots. Afterward, the pilot intentionally applied aft control

[101] FlightSafety's simulator was capable of full motion, and the motion platform was on during the observations.

[102] Bombardier subsequently stated that the post-stall onset of the stick pusher was outside the bounds of the simulator data package the company provided to FlightSafety.

[103] The altitude deviations during recovery ranged from an altitude loss of 50 feet to an altitude gain of about 120 feet.

column movement and pulled up the airplane's nose from 10° to 30°.[104] As the airspeed decreased to between 105 and 110 knots, the stick pusher activated, but the nonflying pilot and the observers were not aware of the pusher's activation (that is, they could not tell whether the control inputs were being made by the pilot or the pusher). The recovery was successful.

1.17.1.2 Winter Operations Training

Colgan provided its flight crews with training on winter operations during initial, transition, and recurrent ground school. Subjects presented in this course included airplane deicing and anti-icing procedures, checks, and responsibilities; airplane surface contamination and its effects on performance and handling characteristics; and identification of contamination on critical surfaces. (The accident captain and first officer last received this training during his October 2008 transition ground training and her January 2009 recurrent ground training, respectively.)

In addition, a training video produced in 1999 by the National Aeronautics and Space Administration (NASA), "Icing for Regional and Corporate Pilots," was shown during winter operations training. The purposes of the video were to review icing fundamentals, enhance pilots' ability to assess hazardous icing conditions, enhance pilots' understanding of icing effects on the airplane's stability and control, present strategies that pilots can use to exit a hazardous icing encounter, and discuss supercooled large droplets.

The video also discussed the possibility of a tailplane stall, which results from an ice-contaminated horizontal stabilizer. The video described the warning signs of a tailplane stall, which included lightening of the controls, pitch excursions, difficulty in trimming pitch, buffeting of the controls, and sudden nose-down pitching.[105]

The video indicated that the differences between a wing stall and a tailplane stall could be subtle but that pilots needed to properly diagnose the icing problem because the recovery techniques for the stalls were different. According to the video, the wing stall recovery technique requires pilots to reduce the AOA by lowering the nose, adding power, and maintaining the flap setting, whereas the tailplane stall recovery technique requires pilots to pull back on the control column; reduce flap setting; and, for some aircraft, reduce power.[106]

The NTSB notes that, at the public hearing for this accident, a Bombardier engineering manager testified that the Q400 was not susceptible to tailplane stalls. The Bombardier official described the flight testing—the 0 G pushover maneuver—that was performed by Bombardier and Transport Canada to make this determination. The Bombardier engineer explained that the maneuver, which was conducted with ice accumulation on the airplane's tail (with both natural

[104] As with Colgan's stick pusher demonstration in the simulator, the resulting airplane motion from this control input may exceed the validated simulator envelope.

[105] This video was part of NASA's and the FAA's response to previous NTSB recommendations, as discussed in section 1.18.1.11.

[106] Colgan's training manual did not include any references to tailplane stalls or tailplane stall recovery techniques.

icing conditions and artificial ice shapes), involved pushing the control column forward to lower the nose of the airplane and increase the airplane's descent rate. The Bombardier engineer further stated that this maneuver tested "the most severe condition" (that is, the most negative tailplane AOA) and that the airplane showed no evidence of tailplane stall characteristics, even at -0.2 G.[107]

1.17.1.3 Remedial Training

The Colgan director of flight standards stated that pilots that failed a checkride could retrain on the specific failure item. If the pilot passed the subsequent checkride, then no further followup after this retraining would occur. The director also stated that, for pilots with multiple failed checkrides, he or the flight standards manager would coordinate with the training director to assign additional training. The director indicated that pilots could be terminated if they did not receive the additional training and pass the checkride.

The Colgan chief pilot stated that, if a pilot were considered marginal, then he would ask the flight standards department to have a check airman observe the pilot to ensure that his or her performance was satisfactory. The chief pilot indicated that, at the time of the accident, the company did not have a formal program for those pilots that were considered to be weak. In August 2009, Colgan began a formal pilot monitoring program. Colgan stated that the program had specific criteria and processes for entry into and exit from the program and that the flight operations department has been reviewing and revising the program's operation.

The Colgan director of flight standards stated that he had not tracked the accident captain in terms of his performance. The company chief pilot stated that he was aware that the captain had failed his initial Saab 340 upgrade training proficiency check and had to be retrained and perform the checkride again. The chief pilot also stated that he had informed the accident captain that his subsequent proficiency check needed to be "right on."

1.17.1.4 Crew Resource Management Training

Colgan presented crew resource management (CRM) training during initial new hire indoctrination training (an 8-hour class) and recurrent training (a 2-hour class).[108] The training was taught by either a ground school instructor or the manager of crewmember and dispatcher training, and the average class size was 12 students.[109] One of the CRM training instructors stated that the course addressed, among other things, the relationship between flight crewmembers and the need to indicate when pilots are not observing sterile cockpit procedures.

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[107] The superintendent of flight test engineering at Transport Canada testified that 0 G in the maximum landing configuration was the Q400's lower end structural limit. This official also stated that Transport Canada accomplished the pushover maneuver in a controlled maneuver down to -0.1 G.

[108] Videos, team-building exercises, and some case studies used during initial CRM training were not used during recurrent CRM training.

[109] Pilots and dispatchers attend CRM training at Colgan's headquarters. Flight attendants had occasionally attended the CRM training until their training was moved to ALB.

Two slide presentations were included in CRM training. One presentation had 45 slides that addressed topics including command, leadership and leadership styles, expectations and standardization, team management, communication, situational awareness, decision-making, and automation awareness. The other presentation had 11 slides that focused on situational awareness.

One slide in the situational awareness presentation detailed the following operational clues to indicate a loss of situational awareness: failing to meet targets, using undocumented procedures, departing from standard operating procedures, violating minimums or limitations, not flying the airplane, and not looking outside. Another slide detailed the following human factor clues associated with a loss of situational awareness: communications, ambiguity, unresolved discrepancies, preoccupation or distraction, and confusion or "empty feeling." The final slide in the presentation showed an error chain and indicated that breaking the chain involved maintaining situational awareness, checklist discipline, and standard operating procedures.

CRM training also included accident case studies that demonstrated good human factors and crew interaction.[110] Also, the manager of crewmember and dispatcher training stated that the class provided pilots with enough information to develop monitoring skills. A ground school instructor stated that CRM training discussed that the monitoring pilot needed to be attentive and assertive in communicating any concerns.

Colgan was in the process of revising its CRM training before the accident.[111] According to the POI, although the company's CRM program met the FAA's CRM guidance (see section 1.18.1.2), he and the director of flight operations, vice president of safety and regulatory compliance, and the director of crewmember and dispatcher training wanted additional emphasis in several areas to make the program more robust. These areas included decision-making, leading and following, positively communicating, and setting expectations. The POI indicated that the new CRM training would be modeled after Continental Airlines' advanced CRM components and would use information from CRM programs offered at other airlines.[112] In addition, the revised training was expected to be facilitated by line pilots (instead of a ground school instructor or the manager of crewmember and dispatcher training) to encourage more participation from students.

[110] One case study involved the United Airlines flight 232 accident in Sioux City, Iowa. In its report on this accident, the NTSB concluded that the airplane could not have been successfully landed on a runway because of the loss of all hydraulic flight controls (resulting from a catastrophic separation of the stage 1 fan disk from the No. 2 engine) and that, with these circumstances, the flight crew's performance was highly commendable and greatly exceeded reasonable expectations. For more information, see *National Transportation Safety Board, United Airlines Flight 232, McDonnell Douglas DC-10-10, Sioux Gateway Airport, Sioux City, Iowa, July 19, 1989*, Aircraft Accident Report NTSB/AAR-90/06 (Washington, DC: NTSB, 1990).

[111] Information from Colgan's third quarter 2008 safety department review included "CRM Re-design" as an issue and a challenge. (Colgan's safety departments and safety programs are discussed in section 1.17.7.)

[112] Information from the fourth quarter 2008 safety department review indicated that Pinnacle Airlines was also assisting with the CRM program redesign.

Colgan provided the NTSB with a 209-slide presentation, dated July 1, 2009, for the revised CRM/threat and error management course.[113] The slides presented industry safety data and trends and addressed CRM decision-making, situational awareness, communication, team building, workload management, threat and error management, monitoring, safety culture and safety programs, automation, fatigue, hazards associated with deviations from standard operating procedures, the company's "VVM" (verbalize, verify, and monitor) program, and professionalism. Also, industry accidents and incidents, including those involving Colgan pilots, were discussed. During the summer of 2009, Colgan began providing a 2-day CRM course to pilots, dispatchers, flight attendants, and managers at its bases at EWR and George Bush Intercontinental Airport (IAH), Houston, Texas. In addition to the revised CRM course, the company's revised Flight Operations Policies and Procedures Manual, dated September 20, 2009, contained a review of CRM/threat and error management, including discussions on error management and descriptions of behavioral skills that are necessary for effective CRM.

1.17.1.5 Captain Leadership Training

Colgan's captain upgrade training included a 1-day course on leadership to help upgrading captains transition to their new role.[114] (The accident captain received this training in October 2007 when he became a new Saab 340 captain.) The director of crewmember and dispatcher training stated that the course focused on captains' duties, their interaction with different departments, and the use of CRM in their expanded work activities.

Captain leadership training included a nine-slide presentation that discussed a captain's authority, responsibilities, and duties; the dispatch release; logbook and maintenance discrepancies; and cabin area and flight attendant duties. The leadership training also included the 11 slides on situational awareness that were presented as part of indoctrination and recurrent CRM training. The director of crewmember and dispatcher training stated that captains needed extra emphasis on situational awareness because of the additional crewmembers that they are responsible for overseeing. The syllabus showed that, of the 6 hours 45 minutes that had been programmed for this training, at least 4 hours 45 minutes were dedicated to captain administrative duties.

In addition to the training, the Colgan Flight Operations Policies and Procedures Manual provided information about the captain's leadership responsibilities during flight. Section 5 of the manual, dated August 22, 2008, stated that the captain was "to maintain at all times a businesslike environment in the cockpit that is conducive to the safe and proper conduct of the

[113] The FAA's guidance on threat and error management is contained in appendix 1 of Advisory Circular (AC) 120-90, "Line Operations Safety Audits." (See section 1.18.2.2 for more information about this AC.) The guidance clarifies the relationship between threat and error management and CRM, stating the following: "It is important to clarify that TEM [threat and error management] is not crew resource management (CRM) and should not be considered a replacement for it. TEM and CRM refer to overlapping but not equivalent activities. CRM refers specifically to activities conducted by the crew to optimize performance. These activities include threat and error countermeasures such as briefing, contingency planning, and monitor/cross-checking, but they also include higher-order concepts such as leadership and establishing open communication in the cockpit. Similarly, TEM includes crew countermeasures, but it also encompasses equipment, procedural, and regulatory countermeasures."

[114] Captain leadership training is not mandated by the FAA.

flight." Section 2 of the manual stated that the captain was responsible for actively promoting and utilizing CRM while on duty.

After a new captain completed IOE, Colgan provided no further scheduled oversight of the captain until the annual line check. After the accident, Colgan changed its policy so that all new captains would have a line check after 6 months.

1.17.2 Flight Manuals

1.17.2.1 Reference and Approach Speeds

The Bombardier Q400 AFM, section 5, dated August 4, 1999, provided reference and approach speed information for various configurations of the airplane. The information showed the following for the accident airplane at its estimated landing weight:

- With flaps set at 0°, the 1.23 reference stall speed (V_{SR}) was 145 knots and a minimum of 170 knots (1.23 V_{SR} plus 25 knots) during icing conditions.[115]
- With flaps set at 5°, the approach speed was 133 knots and a minimum of 153 knots (flaps 5 approach speed plus 20 knots) during icing conditions.
- With flaps set at 10°, the approach speed was 124 knots and a minimum of 144 knots (flaps 10 approach speed plus 20 knots) during icing conditions.
- With flaps set at 15°, the V_{ref} for the planned landing was 118 knots and a minimum of 138 knots (flaps 15 V_{ref} speed plus 20 knots) during icing conditions.

On March 18, 2009, Colgan issued CFM Operations Bulletin 09-003, REF SPEEDS Switch and Speed Guidance. The bulletin set the following specific target airspeeds during the approach phase of flight: before landing gear extension, a minimum of 180 knots; before the final approach fix, a minimum of 160 knots; and on final approach, V_{ref} plus 10 knots minus 0 knots (that is, airspeeds could deviate up to 10 knots above the V_{ref} speed, but no airspeeds below V_{ref} were allowed).

1.17.2.2 Operations in Icing Conditions

The Q400 AFM, section 4.7.2, Ice Protection Procedures, dated July 13, 2005, included the following information about operations in icing conditions:[116]

- For takeoff into icing conditions, the engine intake door, windshield heat, and propeller deice are to be turned on before takeoff, and the ref speeds switch is to be

[115] The Q400 AFM contained three reference stall speeds, 1.4, 1.3, and 1.23 V_{SR}, and Colgan used 1.23 V_{SR}.

[116] The Q400 Quick Reference Handbook, dated May 15, 2005, also contained procedures for flight into icing conditions. Quick reference handbooks are intended for flight crew use in the cockpit.

moved to the increase position at 400 feet agl. When airframe ice is detected, the deice boots are to be operated in the fast mode.

- For flight before encountering icing conditions, when ice is first detected, or when a flashing "ice detected" message appears on the engine display, the ref speeds switch is to be moved to the increase position at the same time as the engine intake door switches, the propeller selector, and the windshield heat are selected on. Also, the pilot's side window heat switches are to be turned on if ice is forming on the pilot's side window.
- For climb, cruise, and descent in icing conditions, the minimum airspeed is to be maintained, the deice boots are to be operated, and wing and tail boot advisory lights are to be monitored for normal operation.
- For holding, approach, and landing in icing conditions, the minimum airspeeds for icing are to be maintained, the deice boots are to be operated in fast mode, and a performance weight penalty is to be applied.

The AFM also stated that, when the airplane was no longer in icing conditions, the deice boots should continue to be used in the fast mode until the airplane is aerodynamically clean. At that point, the deice boots and the ref speeds switch are to be turned off, and normal airspeeds are to resume.

In addition, several airplane systems on the Q400, including the ice protection system, required daily checks. The Colgan CFM, section 5, "Expanded Checklist," dated May 20, 2008, explained that the following items were to be checked on the ice protection system: airframe deice pressure indicator, airframe mode select switch, airframe manual select switch, propeller selector, ref speeds switch, engine intake doors, windshield heat, and stall protection system. (A Q400 check airman explained that this 24-hour check was normally accomplished during flight instead of preflight.)[117] Finally, the Q400 AFM and Colgan CFM stated, in the Limitations section, that the autopilot must be disengaged during severe icing.

On February 20, 2009, Colgan issued CFM Operations Bulletin 09-001, Speed Bugs for Landing, Icing Definitions, and Ice Equipment Operations. The bulletin emphasized the importance of setting the proper V_{ref} bugs, especially when icing conditions might be expected; reiterated the proper icing terminology to use with the ACARS system to ensure that the proper ice speeds are received (from AeroData) for V_{ref} and V_{ga}; and introduced three levels of ice protection.[118] The bulletin prohibited selecting the ref speeds switch to the increase position during takeoffs, and changing the position of the ref speeds switch during landings, while the airplane was below 1,000 feet agl. The Colgan POI stated that the company conducted mandatory briefings about the information in the bulletin with its Q400 pilots.

[117] About 2132:13, the first officer detected, while reviewing the airplane's logbooks, that a previous flight crew had not performed the 24-hour ice protection test. The captain responded that he had just performed the test.

[118] Level one was for all flight conditions and on the ground. Level two occurred in flight with a saturated air temperature of 5° C or colder and visible moisture or 1 mile or less visibility in clouds. Level two occurred on the ground with a saturated air temperature of 10° C or colder and visible moisture or 1 mile or less visibility with fog. Level two also occurred on the ground when an airplane was operating on a surface that was contaminated with snow, ice, standing water, or slush. Level three occurred when ice accretion was visible or when the ice detected message appeared on the engine display.

1.17.2.3 Descent, Approach, and Before Landing Checklists

The Q400 CFM, section 5, stated that the pilot flying normally called for the descent checklist when the airplane was descending through an altitude of 18,000 feet or at the top of the descent if the cruise altitude was below 18,000 feet. The CFM indicated that the flying pilot was to call for the approach checklist, with sufficient time to complete the checklist, before (1) crossing the initial approach fix or transitioning to the initial approach phase during an instrument approach or (2) turning onto the base leg on a visual approach. The CFM further stated that the before landing checklist was to be performed 1 nm before the final approach fix.

The Colgan Flight Operations Policies and Procedures Manual, section 5, stated that checklists were to be performed in the challenge-response manner with the monitoring pilot performing and double-checking the action called for by the checklist item (as announced by the captain).[119] The manual also stated that all pilots, while performing checklists, needed to avoid becoming so engrossed in cockpit duties that their outside vigilance would be reduced. Further, the manual indicated that additional information about the company's "checklist philosophy" was included in the Q400 CFM, but the CFM did not contain such information.[120]

Colgan's postaccident CFM Operations Bulletin 09-003 (see section 1.17.2.1) announced that the company's approach checklist had been changed to include a callout for the ref speeds switch, which required a response from both flight crewmembers. The bulletin further indicated that the decision to turn the switch to the increase or off positions during an approach should be made before entering the initial approach phase and prohibited changing the position of the ref speeds switch below 1,000 feet agl. (This information was also communicated in Colgan's postaccident CFM Operations Bulletin 09-001; see section 1.17.2.2.) In addition, CFM Operations Bulletin 09-003 stated that, when the ref speeds switch was set to the increase position, the only speeds that could be set were for $V_{ref\ (ice)}$ and $V_{ga\ (ice)}$ but that, if the ref speeds switch was subsequently turned to the off position, the airspeed targets could be changed to V_{ref} and V_{ga} as long as the airplane was above 1,000 feet agl.

1.17.2.4 Approach Profile and Stabilized Approach Criteria

The Q400 CFM, section 10, dated May 20, 2008, included information for approaches with vertical guidance. According to this information, the monitoring pilot was to advise the flying pilot of airspeed deviations greater than ± 10 knots. The information did not include a reminder to pilots to check the airspeed against the position of the ref speeds switch.

The Colgan Flight Operations Policies and Procedures Manual, section 5, included the company's stabilized approach criteria. Among these criteria was the following: below 1,000

[119] After the accident, Colgan implemented an initiative to train its check airmen to evaluate the performance of the monitoring pilot (in addition to the flying pilot) during checkrides.

[120] In addition, the Flight Operations Policies and Procedures Manual indicated that a statement about "monitoring responsibility" during the required approach briefing was explained in the expanded checklist procedures section of the Q400 CFM, but the CFM did not contain this statement.

feet agl in instrument meteorological conditions or 500 feet agl in VMC, the airplane is to be at an airspeed that is not less than V_{ref} and is not greater than V_{ref} plus 20 knots.

1.17.3 Sterile Cockpit Procedures

Colgan's sterile cockpit procedures are discussed as part of ground school indoctrination training during a review of the subjects covered in the company's Flight Operations Policies and Procedures Manual. The manager of crewmember and dispatcher training stated that ground school instructors referenced applicable policies and pages in the manual. (The slides presented during indoctrination training did not include this information.) Section 3 of the manual, dated December 20, 2007, referenced 14 CFR 121.542, "Flight Crewmember Duties," which discusses the sterile cockpit rule. Sections (a) through (c) of the regulation state the following:

> No flight crewmember may perform any duties during a critical phase of flight not required for the safe operation of the aircraft.
>
> No flight crewmember may engage in, nor may any PIC permit, any activity during a critical phase of flight which could distract any flight crewmember from the performance of his/her duties or which could interfere in any way with the proper conduct of those duties.
>
> Critical phases of flight include all ground operations involving taxi (movement of an airplane under its own power on the surface of an airport), take-off and landing, and all other flight operations conducted below 10,000 feet MSL, except during cruise flight.

The director of crewmember and dispatcher training stated that sterile cockpit procedures were referenced in the flight attendant training program more than the pilot training program because newly hired flight attendants from outside the aviation industry needed to be made aware of the importance of not interrupting the flight crew during critical phases of flight. The director of crewmember and dispatcher training added that pilots were instructed on the critical phases of flight during indoctrination training.

Check airmen stated that, during checkrides, captains were expected to brief sterile cockpit procedures before the flight, and the procedures were expected to be followed during the flight. The company chief pilot stated that he issued a CrewTrac message in summer 2008 about the need to adhere to rules,[121] including the sterile cockpit rule, and avoid complacency, but the company was not able to identify any such message in response to a request from the NTSB.[122]

[121] CrewTrac messages are presented to pilots when they log into the company's computer system. Pilots need to review and acknowledge the information in the CrewTrac messages before they can check in or view their flight schedule.

[122] Colgan was asked to provide CrewTrac messages that addressed sterile cockpit adherence or standard operating procedures and were sent to pilots based at EWR or ORF from January 2008 to the date of the accident. No message on either topic was found.

One first officer indicated that company pilots adhered to sterile cockpit procedures. Another first officer indicated that captains with whom he had flown deviated rarely from sterile cockpit procedures but that, when they did, he would speak up by redirecting them to the tasks at hand. Check airmen and captains indicated that sterile cockpit adherence was good but that, when the sterile cockpit rule was not being followed, they would either remind the pilot about the rule or they would ignore the pilot's statement to convey the message that the pilot should not be talking. The company POI stated that FAA surveillance of Colgan before the accident (as well as the company's own surveillance) did not indicate a problem with crew adherence to sterile cockpit procedures.

According to the company's director of crewmember and dispatcher training, after the accident, he tasked the manager of crewmember and dispatcher training with enhancing the ground school presentations to ensure that pilots were doing their jobs and following procedures. The manager of crewmember and dispatcher training and a ground school instructor added a recurrent training slide that explicitly addressed adherence to sterile cockpit procedures. The slide referenced cockpit decorum, the sterile cockpit concept, maintaining cockpit stations (including airplane control), and preflight procedures (including the captain's briefing and other preflight information).

On February 26, 2009, the company chief pilot issued a CrewTrac message addressing sterile cockpit adherence. The message defined sterile cockpit during the ascent as beginning when the flight attendant closes the cockpit door and ending when the airplane climbs through 10,000 feet. The message defined sterile cockpit during the descent as the time from when the airplane is descending through 10,000 feet to the completion of the parking checklist. The message indicated, "when in sterile cockpit no extraneous conversation of any kind may take place. Remember this also covers non essential activities such as eating."

In October 2009, the company reported that it had added to its checklists an item for the 10,000-foot sterile cockpit period. The company further reported that it also expanded the scope of the sterile cockpit period to include (1) 1,000 feet above or below a level-off altitude and (2) approaching the top of descent on crossing restrictions and pilot-discretion descents.[123]

1.17.4 Commuting Policy

Colgan's Flight Crewmember Policy Handbook, dated March 2008, stated that a commuting pilot was expected to report for duty in a timely manner. Commuting pilots were expected to be listed in an airline reservation system aboard two separate flights that had adequate seat availability and were scheduled to arrive at the pilot's duty station at a reasonable time before the pilot was scheduled to report for duty. If the pilot missed the first flight, then the pilot was required to notify crew scheduling of the estimated time of departure for the second flight so that plans could be made in case the second flight was missed. If the pilot missed the

[123] Colgan's September 20, 2009, revision of its Flight Operations Policies and Procedures Manual incorporated this information.

second flight, then the pilot was to contact crew scheduling and make every effort to report to the location where the pilot was scheduled to begin duty.

The policy recognized that pilots might be unable to report for duty because of unforeseen flight schedule disruptions and, as a result, provided relief from disciplinary actions to pilots twice in any 12-month period for this reason. The policy stated that pilots who demonstrated a pattern of missed trips would no longer be able to use the company's commuting policy, even if the pilot had complied with the above requirements of the policy.

The February 2006 edition of the Flight Crewmember Policy Handbook stated the following information:[124]

> While commuting by Flight Crewmembers is understood and accepted by the Company, in no way will commuting be deemed a mitigating factor in the Flight Crewmember's scheduling, punctuality and demeanor. All Flight Crewmembers will be fully accountable for their timely arrival and appearance at their base. Any and all expenses incurred because of commuting will be borne by the Flight Crewmember. Flight Crewmembers should not attempt to commute to their base on the same day they are scheduled to work.

This statement did not appear in the March 2008 handbook (which was the edition current at the time of the accident).

1.17.4.1 Commuting Status of Pilots Based at Newark

During a February 2009 postaccident interview, the EWR regional chief pilot stated that he did not know the number of commuting pilots at EWR.[125] The regional chief pilot also stated that no restrictions were placed on pilots regarding commuting but that pilots had to meet schedule requirements. An EWR-based first officer thought that most commuting pilots had crash pads or shared apartments. Another EWR-based pilot stated that the reason for the large number of commuting pilots was the high cost of living in the EWR area and the low wages that company pilots received.

In response to an NTSB request for information, Colgan asked its 137 EWR-based pilots, in April 2009, about their commuting status. Of these 137 pilots, 93 (68 percent) identified themselves as commuters. Colgan also responded with address information for its EWR-based pilots, which the NTSB cross-checked against the FAA's airmen certification database between April 9 and 13, 2009. Of the 137 addresses provided by Colgan, 136 were found in the FAA's database. Table 3 shows the geographic distribution for these 136 EWR-based pilots.

[124] Colgan's Employee Handbook, dated February 2005, contained the following similar statement about commuting: "Colgan understands it may be necessary for employees to commute, however, in no way will commuting be deemed a mitigating factor in an employee's schedule, punctuality or demeanor. All employees will be fully accountable for on time appearance at their base (for their shift). Any and all expenses incurred because of commuting will be the responsibility of the employee."

[125] The EWR chief pilot commuted from his home in North Carolina to EWR and had a crash pad in the EWR area.

Table 3. Geographic Distribution of Colgan Air Pilots Based at Newark, New Jersey

Distance from EWR (in statute miles)	Number of pilots	States represented
Less than 100	45	Connecticut, New Jersey, New York, Pennsylvania
100 to 199	13	Maryland, Massachusetts, New York, Pennsylvania, Rhode Island
200 to 399	29	Maine, Massachusetts, New Hampshire, New York, North Carolina, Pennsylvania, Virginia
400 to 999	20	Florida, Georgia, Illinois, Iowa, Michigan, Ohio, South Carolina, Tennessee, West Virginia
1,000 or more	29	California, Colorado, Florida, Louisiana, Minnesota, Nevada, Texas, Utah, Washington

Note: Geographic distances from EWR were determined using the pilots' address on record with the FAA. The number of statute miles was based on straight-line distances between zip codes.

1.17.5 Fatigue Policy

Colgan's fatigue policy for its pilots (and flight attendants) is addressed during basic indoctrination ground school and is included in the Flight Operations Policies and Procedures Manual. The fatigue policy at the time of the accident was as follows:

> Colgan recognizes that there may be occasions and/or circumstances where a Crewmember's ability to accept or complete an assignment is altered by fatigue. While our concerns are oriented to serve safe operations, we need to review all of the known factors which have led to a call of Crewmember fatigue and any resultant operations impact. This information will facilitate the development of fatigue history and identify factors which led to fatigue. We can then evaluate fatigue and [its] relationship to operational considerations which may improve our planning and prevent recurrence.
>
> When a Crewmember is unable to complete an assignment or reassignments because of fatigue, he/she must accomplish the following:
>
> - Immediately notify SOC [Systems Operations Control] and the Operations Duty Officer.
> - Complete the Crewmember Fatigue Form[126] …. Within 24 hours of being released from duty because of declared fatigue, [provide] the completed form to the Chief Pilot or Duty Officer.

The EWR regional chief pilot stated that, between May 2008 and February 2009, only about a dozen pilots had called in fatigued. The regional chief pilot also stated that, if pilots were fatigued, they could call in as such to crew scheduling or use sick leave.[127] In addition, the

[126] Crewmembers were required to include, on the fatigue form, their duty time on the day of the fatigue call and their flight and duty times during the 6 days preceding the fatigue call, including the number of hours of rest before duty.

[127] The Colgan Employee Handbook indicated that pilots earn 0.5 day of sick leave after 90 days of employment with the company and then 0.5 day of sick leave each month, with a maximum carryover of 30 days.

regional chief pilot stated his philosophy about the policy, indicating that, if a pilot's fatigue call was a one-time event, he would only file a report but that, if a pilot were to repetitively call in fatigued, he would talk with that pilot to figure out what was prompting the calls. A check airman stated that he had called in fatigued one or two times and that no followup occurred afterward.

Colgan's September 20, 2009, revision to its Flight Operations Policies and Procedures Manual contained additional information about the company's fatigue policy. According to the manual, Colgan's safety department was the focal point for the company's fatigue policy to gather information to identify fatigue and scheduling issues. As a result, crewmembers were required to submit fatigue forms to the safety department instead of the chief pilot or duty officer. The manual also stated, "managing fatigue is one of the most critical elements of maintaining a safe operation. Recognizing fatigue and its effects on human performance is important, but preventing fatigue is equally essential."

At the time of the accident, Colgan did not provide any information to its pilots about fatigue prevention. The manager of flight safety stated that he had been developing a pamphlet for pilots that provided information on reasons for fatigue and industry fatigue trends. The vice president of safety and regulatory compliance stated that the document developed by the flight safety manager was not implemented because it focused on changing duty times and report periods as a countermeasure to fatigue, which would not have been feasible.

The Colgan POI stated that he was aware of the company's fatigue policy. Although the POI did not have any specific concerns with the policy, he did state, "pilots commute … they get up early … any regional airline tries to be as productive as possible with its folks … I'm always concerned about that." [128]

Colgan's revised CRM course (see section 1.17.1.4) discussed the effects of fatigue on performance, fatigue warning signs, alertness management strategies, and accidents involving flight crew fatigue. Also, on April 29, 2009, Colgan issued Operations Bulletin 09-001 to its Flight Operations Policies and Procedures Manual, which addressed crewmember fatigue.[129] The bulletin discussed the company's fatigue policy, causes of fatigue, the recognition of fatigue and its effects on performance, strategies to combat fatigue by effectively utilizing rest periods, and the procedures to use if a crewmember were unable to complete an assignment because of fatigue. The bulletin stated that any crewmember who conducted a flight when fatigued or otherwise physically incapable of completing a flight safely would be in violation of company policy. The bulletin emphasized, using bold face and capital letters, the following statement: "commuting to arrive at a base with either insufficient rest to prepare for flight duties, or to arrive with minimal time before a duty day begins is inappropriate for your responsibilities as a professional pilot!"

The EWR regional chief pilot explained that no followup would occur after a pilot has called in sick unless the sick leave calls became repetitive, which he defined as four calls within a 12-month period.

[128] Information from Colgan's third quarter 2008 safety department review identified "crew rest challenges" as an issue. The information also indicated that declarations of crew fatigue were increasing.

[129] The information contained in this bulletin was incorporated into the September 20, 2009, revision of the company's Flight Operations Policies and Procedures Manual.

On December 30, 2009, Colgan's director of operations issued read-and-sign memo 09-12, "Interim Fatigue Policy" to all company pilots and flight attendants. The memo stated that, although Colgan's nonpunitive fatigue policy had provided helpful information in understanding scheduling issues that created fatigue among crewmembers and had resulted in crewmembers recognizing and declaring true fatigue situations, abuse of the fatigue policy was increasing. The memo noted the following: "in the last 2 months, the instances of fatigue calls with no valid reason for fatigue have increased to the point where frivolous fatigue calls are now the majority" and "frivolous use of sick policy and fatigue policy at the expense of our customers and our operational reliability is not an acceptable practice."

The memo contained revised fatigue policy information developed by the Colgan vice president of safety and regulatory compliance. This interim policy, which became effective on December 31, 2009, stated that fatigue calls would not be accepted if the crewmember had a rest period of at least 12 hours before the start of the duty day, was returning from days off, or wanted to use the policy for a future flight. The memo noted that the safety department would consider mitigating circumstances preventing a rest period from being fully used when determining whether a fatigue call was acceptable. The memo cautioned, "any further blatant abuse of the fatigue option will be addressed as a disciplinary action, and fatigue resulting from an improper use of rest periods or personal time off duty will be treated as missed trips." In addition, the memo stated that the company was working with pilot and flight attendant unions to establish a comprehensive fatigue program, including a review board process, by February 15, 2010.

1.17.6 Crew Room Policy

The EWR regional chief pilot stated that Colgan had a policy that prohibited crewmembers from using the crew room to sleep overnight. A May 24, 2008, read-and-sign memo from the regional chief pilot addressed sleeping in the crew room and included the following information:[130]

> If a Crew Member is based in EWR [then] you are responsible for your own overnight accommodations. Sleeping in Operations or any crew room in EWR is strictly prohibited and will have severe disciplinary consequences, up to and including termination.

Company records indicated that the accident captain and the accident first officer acknowledged receipt of this policy information.

The EWR regional chief pilot also stated that, even though the crew room was accessible at all times, he did not know of anyone who had stayed in the crew room overnight.[131] He further

[130] A first officer interviewed by the NTSB knew that Colgan had a policy against sleeping overnight in the crew room but did not know if the policy was a written one. A check airman interviewed by the NTSB recalled the read-and-sign memo indicating that it was not permissible to sleep overnight in the crew room.

[131] One check airman stated that he had not seen any pilots sleeping overnight in the crew room. Another check airman stated that he had stayed overnight in the crew room but only when he was traveling home the next day.

stated that Colgan did not get involved with rest issues beyond the FAA regulations for proper crew rest but encouraged pilots to have an appropriate place to stay overnight while in Newark. The Colgan vice president of administration stated that commuting pilots needed to have suitable accommodations because they would not receive adequate rest if they slept in the crew room. She further stated that the company "can't make someone have a crash pad, but we can certainly make them not … sleep in the crew room." In March 2009, the EWR regional chief pilot began requiring that some lights remain on at all times in the crew room to ensure that pilots were not using the room as a crash pad.

1.17.7 Safety Programs

1.17.7.1 Safety Management and Culture

The Colgan vice president of safety and regulatory compliance, who reports directly to the president of the company, is responsible for all safety-related situations. Other Colgan officials who are responsible for safety at the company include the director of safety and the manager of flight safety.[132] The responsibilities of the director of safety were overseeing safety programs, investigating and reviewing occurrences involving safety, and overseeing manual revisions for consistency. The director of safety also attended new-hire indoctrination training to provide an overview of the company's safety programs. During this training, all newly hired employees received information about submitting safety reports, contacting safety personnel, accessing safety information on the company's website, and finding safety information in the company's manuals. The responsibilities of the flight safety manager included overseeing the aviation safety action program (ASAP), providing information for the line operations safety audit (LOSA) program, and developing the flight operational quality assurance (FOQA) program.[133]

Colgan held quarterly safety council meetings, which were chaired by the president of the company and included senior management personnel (at the vice president and director levels) from all of the company's departments. According to the company's Safety Program Manual,[134] the purpose of the safety council meetings was to increase safety awareness, discuss unresolved issues, facilitate group discussions, and develop positive outcomes. Colgan also held quarterly safety review board meetings, which involved personnel at the middle management level. In addition, safety personnel attended the company's daily operations meetings, and safety department reviews occurred quarterly.

[132] An organizational chart in the company's Airline Administrative Guide showed that the manager of flight safety reported directly to this vice president, whereas the Flight Operations Policies and Procedures Manual indicated that the manager of flight safety reported directly to the director of safety, who then reported to the vice president of safety and regulatory compliance.

[133] The ASAP, LOSA, and FOQA programs are discussed in sections 1.17.7.3 through 1.17.7.5, respectively.

[134] Colgan's Safety Program Manual outlined the company's safety policies, procedures, and reporting programs. The manual was issued in June 2001 and was revised in April 2002, December 2005, and June 2007.

Colgan's guiding principle regarding safety was presented in two company manuals. The Employee Manual stated, "Safety – Our primary goal is to provide 100% safe transportation for our customers. Safety is the first priority of Colgan. No other value or goal has priority over safety." The Flight Operations Policies and Procedures Manual stated, "In all aspects of Colgan's operation, safety shall be given primary consideration. Each and every employee is responsible for ensuring safety in his own daily operations and shall promote safety among his fellow employees."

In August 2008, Colgan safety personnel (including the vice president of safety and regulatory compliance) and the company president traveled to all company bases to present a "safety road show" to pilots and other operational personnel. This safety briefing addressed ASAP and LOSA and included a 31-slide presentation that discussed expectations for safety (one of which was to operate the safest airline in the industry), industry accidents involving organizational and management factors, and methods to prevent such accidents by ensuring that a company safety culture existed. The presentation also discussed that a way to change safety culture was by providing top-down guidance that is practiced and reinforced. In addition, the presentation reviewed accidents involving error chains and included a slide that stated that the cause of accidents was "rarely a single event, often a failure of common procedure, and inattention to routine tasks and complacency." The third quarter 2008 safety department review indicated that the presentation had been provided to 525 employees at company headquarters and bases.

After the accident, Colgan announced that it would be increasing the visibility of the company's safety department by having department personnel conduct monthly observations of crew bases and observe flight crews during line operations.

The Colgan manager of flight safety stated that the safety culture at the company was good because of programs, such as ASAP and LOSA, that allowed employees to provide feedback and the corrective actions implemented by the company based on the feedback. This manager added that pilots have also volunteered other information outside of the programs about the company's operations. The Q400 fleet manager also stated that the safety culture at the company was good because of the safety message being conveyed throughout the company by the company president and vice presidents. The manager of flight standards stated that the safety road show helped to improve the company's safety culture because it reinforced the importance of safety and the message that everyone needed to work together. The director of flight standards stated the following regarding the company's safety culture: "the pilots that are out there every day performing the job flying the airplanes around wouldn't dream of doing anything but keeping it a safe operation for themselves and their passengers and their flight attendants."

The POI for Colgan stated that the safety culture at the company was "more reactive than I'd like … not quite as proactive." The POI indicated that the company needed more middle management-level personnel to advance safety programs and conduct additional monitoring. He further stated that Colgan's plans to implement the FAA's air transportation oversight system (ATOS) and a company safety management system (SMS) would facilitate change.[135]

1.17.7.2 Safety Reporting Methods

According to the company's Flight Operations Policies and Procedures Manual, Colgan has a 24-hour safety hotline for employees to anonymously report any safety-related concern. The safety hotline is a voicemail system that is directed to the vice president of safety and regulatory compliance. The director of safety stated that no hotline calls had been received and that the lack of calls was not an issue because employees could raise safety concerns directly rather than anonymously.

The company also has several forms that employees can use to report a safety concern. These forms are available in the company's Flight Operations Policies and Procedures Manual and on the company's website. Once completed, these forms are routed to the vice president of safety and regulatory compliance. One of the forms is the feedback reporting form, which can be used to report manual errors and suggestions for improvements in addition to safety-related concerns. Another form used to report safety concerns is the irregularity event report form. Pilots can use this form, which is routed to the director of safety, to submit reports of events or situations affecting the safe and efficient operation of the airplane while on the ground or during flight. The director of safety stated that the irregularity event report form would be used for reporting an incident or occurrence, whereas an ASAP form (discussed in section 1.17.7.3) would be used when a pilot believed that a company policy or a *Federal Aviation Regulation* had been breached.

The Colgan POI stated that, even though the company's feedback reporting forms were discussed in initial and recurrent ground school, pilots might not be providing enough feedback to the company. The company's APM for the Q400 fleet also stated his concern that pilots might not be providing enough information to Colgan, even with the company reporting forms available in their manuals. He indicated that he had previously told company personnel that either pilots did not know the reporting methods that were available to them or managers were not emphasizing the use of these reporting methods. The APM noted that the EWR regional chief pilot had since placed company reporting forms on the flight crew website and was encouraging their use to effect change.

Colgan's Safety Program Manual stated that disciplinary actions would not be taken against anyone who immediately discloses an occurrence involving safety.

[135] ATOS employs a systems safety approach to air carrier oversight. SMS incorporates proactive safety methods for air carriers to identify hazards, mitigate risk, and monitor the extent that air carriers are meeting their objectives. ATOS and SMS are complementary and are designed to work in an integrated manner.

1.17.7.3 Aviation Safety Action Program

Colgan's ASAP, which began in 2005, involves company pilots, flight attendants, dispatchers, mechanics, and ground personnel. The manager of flight safety, as the ASAP coordinator, participates in event review committee meetings,[136] which also include the manager of flight standards, an FAA representative, and a company pilot representative. The ASAP coordinator manages the submission of ASAP reports, ensures that the findings from the event review committee meetings are disseminated to the appropriate personnel for corrective action, analyzes ASAP data each quarter to identify trends, and prepares quarterly and annual reports that are provided to managers in the flight standards and flight operations departments and are posted on the company's website.

ASAP reporting forms are available on the company's website. The ASAP form includes a box that can be checked if the report should also be sent to NASA's Aviation Safety Reporting System (ASRS),[137] which is a national repository for voluntary reports regarding aviation safety-related issues and events.[138]

The Colgan manager of flight safety stated that about 25 ASAP reports were submitted each month. This manager also recalled that the only deviations of standard operating procedures identified in ASAP data involved overspeeds while descending. He could not recall any reports, during the 12 months before the accident, describing problems with sterile cockpit adherence. The company chief pilot reported that most of the ASAP data he reviewed involved altitude, route, or clearance deviations. Company personnel stated that no ASAP reports had been submitted before the accident regarding stall warning activations,[139] severe icing, or temporary loss of control of an airplane. Also, the fourth quarter 2008 safety department review indicated that ASAP trends and focus areas were runway incursions and altitude and clearance deviations.

After the accident, Colgan announced that an ASAP "reemphasis campaign" for all crew bases would occur during summer and fall 2009. In October 2009, Colgan stated that ASAP was being regularly emphasized to promote the program's use; pilot participation in the program has been "robust"; and program participation by mechanics, dispatchers, and flight attendants was increasing. ASAP was also included as a discussion topic in the company's revised CRM/threat and error management training.

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[136] The director of safety and the vice president of safety and regulatory compliance assumed the role of ASAP coordinator in March 2009 when the manager of flight safety left the company. A new flight safety manager was hired in May 2009. Colgan indicated that he has emphasized the use of ASAP through base meetings and general communications to employees.

[137] Colgan uses an FAA contractor to manage the ASAP forms and the ASAP database. Colgan had asked the contractor to change the default setting on the ASAP form so that it would not automatically be sent to the ASRS. The company made this request after receiving feedback from pilots that the ASAP form was already similar to other company reporting forms and that minor events, such as gate returns, were being included in the ASRS database.

[138] Because ASRS reports are submitted voluntarily, the existence of reports concerning a specific topic in the ASRS database cannot be used to infer the prevalence of that problem within the National Airspace System.

[139] A stall warning activation was reported to the ASAP database in March 2009. This event is discussed in section 1.18.3.

1.17.7.4 Line Operations Safety Audit

Colgan began conducting LOSA observations in 2008. The company's manager of flight safety stated that the purpose of these nonpunitive observations of flight deck procedures was to identify and rectify those performance trends that deviate from standard operating procedures. The manager of flight safety stated that "really nothing" had come up during the LOSA observations; in particular, no problems with sterile cockpit adherence were found.

According to Colgan, company check airmen were initially used as LOSA observers because they were already trained to be observers of operational standards. The manager of flight safety stated that the use of check airmen for LOSA observations might raise concerns among pilots about whether the observations were actually nonpunitive, so the company was taking action to recruit line pilots to be LOSA observers. As of March 2009, two pilots had been trained as LOSA observers, one who conducted observations aboard Q400 airplanes and one who conducted observations aboard Saab 340 airplanes. The flight safety manager explained that 5 to 10 observers were needed to fully implement the LOSA program for the Q400 fleet.

After the accident, Colgan had announced that it would train LOSA observers by July 2009 and that its goal was to conduct 50 LOSA observations by September 2009. The company did not accomplish this goal but now plans to complete a minimum of 100 LOSA observations by the end of the first quarter of 2010.

1.17.7.5 Flight Operational Quality Assurance

FOQA programs collect, deidentify, and analyze flight data to identify and correct possible operational risks at an air carrier. Colgan had initiated actions to establish a FOQA program, but the program was not fully implemented at the time of the accident. After the accident, the company announced plans to equip the Q400 fleet with quick access recorders (QARs) and targeted program implementation for July 1, 2009.[140] The company's director of safety stated that the installation of this equipment required a supplemental type certificate and that the company would finalize the schedule to equip the Q400 fleet with the recorders once the installation was approved.

Other actions that Colgan had taken to initiate a FOQA program included identifying a vendor to support FOQA data analysis and establishing a FOQA steering committee. This committee consisted of personnel from the maintenance, quality control, and safety departments and was planned to be expanded to include the flight operations department and line pilots. Also, in a letter dated May 4, 2009, to the Air Line Pilots Association (ALPA), the Colgan vice president of flight operations proposed including CVR data in the company's FOQA program. This vice president explained that overlaying flight deck communications and other sounds

[140] QARs are recording units installed on aircraft to store data recorded during flight. The recorders provide quick and easy access to a removable medium, such as an optical disk or personal computer memory card, on which the flight information is recorded. According to the FAA, QARs have been developed to record an expanded data frame; some of the recorders support more than 2,000 parameters at higher sample rates than FDRs.

generated within the flight deck from the CVR on the visual representation provided by FDR data would provide additional safety information for accident prevention.

In October 2009, Colgan stated that it received 14 QARs for its Q400 fleet, installed QARs on four Q400 airplanes, and planned to install the remaining 10 QARs on Q400 airplanes by the end of December 2009. The four currently installed QARs were being periodically downloaded to collect data to validate flight information from the recording medium to the ground station. The company expected to receive the FOQA ground station for analysis in November 2009, and user training was scheduled to occur in November and December 2009. Further, a memorandum of understanding between Colgan and ALPA was expected to be signed by December 2009, and analysis of QAR data was expected to begin by the end of January 2010. Colgan reported in early January 2010 that the remaining 10 QARs have been installed on Q400 airplanes and that the memorandum of understanding between Colgan and ALPA was "almost ready" for signature.

1.17.7.6 Additional Postaccident Actions

The safety department review held after the accident included a slide titled, "Flight Ops Actions Since Feb 12." The slide listed actions that the company had taken or planned, which included the following:

- increased the surveillance by check airmen throughout the Q400 fleet as part of a "standardization push";
- increased the presence of flight operations management at crew bases;
- required pilots to ride with a check airman after an infraction;
- required dispatchers to check the icing box on the dispatch release if icing conditions existed in either the departure or the arrival city;
- implemented a zero-tolerance policy that holds pilots accountable for "egregious" mistakes; and
- increased the communications flow to crews with frequent CrewTrac messages and read-and-sign memos for each event or challenge encountered by a crew.

Also, Colgan reported that it was in the process of reviewing the top-of-descent to touchdown phase of flight for its Saab 340 and Q400 fleets. In addition, the company also introduced the "VVM" (verbalize, verify, and monitor) program. The VVM program was presented as part of the company's revised CRM/threat and error management course and was described in the September 20, 2009, revision to the Flight Operations Policies and Procedures Manual. The manual instructed pilots to use the VVM program "during every phase of the flight, beginning when you arrive in the weather room until you leave the flight deck at the end of the flight. It will help you deal effectively with the threats and errors encountered in daily operations – frequency congestion, fatigue, distractions, etc."

1.17.7.7 Safety Communications at the Newark Base

The EWR regional chief pilot stated that one way that safety information was provided to pilots at the base is through the CrewTrac system. Pilots at the EWR base also receive safety information through read-and-sign memos, bulletins, and manual revisions. In addition, a safety bulletin board is posted at EWR, and the company's website for its flight crews contains safety information from the safety department and the flight standards department.

1.18 Additional Information

1.18.1 Previous Safety Recommendations

1.18.1.1 Sterile Cockpit Adherence

On February 7, 2006, the NTSB issued Safety Recommendation A-06-7 as a result of the accident involving Corporate Airlines flight 5966 in Kirksville, Missouri.[141] Safety Recommendation A-06-7 asked the FAA to do the following:

> Direct the principal operations inspectors of all 14 *Code of Federal Regulations* Part 121 and 135 operators to reemphasize the importance of strict compliance with the sterile cockpit rule.

On May 31, 2006, the FAA stated that it would issue a Safety Alert for Operators (SAFO)[142] to address the intent of the recommendation. According to the FAA, the SAFO would call attention to sterile cockpit rules and remind inspectors and Part 121 and 135 operators that strict compliance with those rules was required and that breaches had contributed to at least one recent air carrier accident.

On November 9, 2006, the NTSB acknowledged that SAFO 06004, "Approach and Landing Accident Reduction: Sterile Cockpit, Fatigue," had been issued on April 28, 2006,[143] with a purpose of emphasizing sterile cockpit discipline.[144] As a result, the NTSB classified Safety Recommendation A-06-7 "Closed—Acceptable Action."

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[141] For more information, see National Transportation Safety Board, *Collision with Trees and Crash Short of Runway, Corporate Airlines Flight 5966, British Aerospace BAE-J3201, N875JX, Kirksville, Missouri, October 19, 2004*, Aircraft Accident Report NTSB/AAR-06/01 (Washington, DC: NTSB, 2006).

[142] FAA Order 8000.87A, dated October 24, 2006, stated that a SAFO contained important, often critical, safety information and recommended (nonregulatory) action to be taken voluntarily by the operators identified in the SAFO. (This order replaced FAA Order 8000.87, dated August 29, 2005, which introduced SAFOs.)

[143] The NTSB notes that the issuance date of the SAFO actually preceded the date of the FAA's letter.

[144] SAFO 06004 was also issued in response to Safety Recommendation A-06-11, which is discussed in section 1.18.1.5.

1.18.1.2 Situational Awareness

On October 16, 1996, the NTSB issued Safety Recommendation A-96-106 as a result of the accident involving American Airlines flight 965 near Cali, Colombia.[145] Safety Recommendation A-96-106 asked the FAA to do the following:

> Revise Advisory Circular 120-51B to include specific guidance on methods to effectively train pilots to recognize cues that indicate that they have not obtained situational awareness, and provide effective measures to obtain that awareness.

On December 11, 1998, the FAA stated that it issued Advisory Circular (AC)[146] 120-51C, "Crew Resource Management Training," on October 30, 1998. According to the FAA, appendix 3 of the AC specifically addressed training for pilots in recognizing cues that indicate a lack or loss of situational awareness and training in countermeasures to restore that awareness. The AC also referenced the FAA's February 1998 publication, *Guidelines for Situational Awareness Training*, which included expanded guidance on the subject.

On March 1, 1999, the NTSB stated that the changes to AC 120-51B, which resulted in the issuance of AC 120-51C,[147] met the intent of the recommendation. As a result, the NTSB classified Safety Recommendation A-96-106 "Closed—Acceptable Action."

1.18.1.3 Pilot Professionalism

On January 23, 2007, the NTSB issued Safety Recommendation A-07-8 as a result of the accident involving Pinnacle Airlines flight 3701 in Jefferson City, Missouri.[148] Safety Recommendation A-07-8 asked the FAA to do the following:

> Work with pilot associations to develop a specific program of education for air carrier pilots that addresses professional standards and their role in ensuring safety of flight. The program should include associated guidance information and references to recent accidents involving pilots acting unprofessionally or not following standard operating procedures.

On April 13, 2007, the FAA stated that it meets routinely with training committees from ALPA, the Air Transport Association, the Regional Airline Association, and other groups and

[145] The investigation of this accident was conducted by the Aeronáutica Civil of the Government of Colombia, with assistance from the NTSB, in accordance with the provisions of Annex 13 to the Convention on International Civil Aviation. In September 1996, the Aeronáutica Civil issued its report on this accident and determined that its probable causes included the flight crew's lack of situational awareness regarding vertical navigation, proximity to terrain, and the relative location of critical radio aids.

[146] ACs are advisory and not regulatory in nature.

[147] The most recent version of the AC, 120-51E, was issued on January 22, 2004.

[148] For more information, see National Transportation Safety Board, *Crash of Pinnacle Airlines Flight 3701, Bombardier CL-600-2B19, N8396A, Jefferson City, Missouri, October 14, 2004,* Aircraft Accident Report NTSB/AAR-07/01 (Washington, DC: NTSB, 2007).

that, in future meetings, the FAA would provide a copy of an information for operators (InFO)[149] message to be issued in response to Safety Recommendation A-07-6.[150] The FAA also stated that it would discuss Safety Recommendation A-07-8 with these groups to determine an effective approach for addressing the underlying safety issues.

On January 22, 2008, the NTSB stated that the activities described by the FAA were appropriate actions to take after the development of an educational program that conveys the necessary safety information has been completed. The NTSB also stated that meetings with ALPA, the Air Transport Association, the Regional Airline Association, and other groups would be helpful in distributing program materials or disseminating program information. Safety Recommendation A-07-8 was classified "Open—Acceptable Response" pending completion of these actions.

1.18.1.4 Monitoring Pilot Responsibilities

On February 27, 2007, the NTSB issued Safety Recommendation A-07-13 as a result of the accident involving a Cessna Citation 560 in Pueblo, Colorado.[151] Safety Recommendation A-07-13 asked the FAA to do the following:

> 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.

On May 17, 2007, the FAA stated that the provisions of 14 CFR Part 61 and the practical test standards addressed the requirement for CRM in airman certification and checking. The FAA added that it would consider identifying, in its work program, a list of required inspections that would reemphasize, to regional office and FSDO managers, the need to validate the training that it already required and verify its effectiveness.

On September 10, 2008, the NTSB noted that, even though current CRM regulations addressed the issues in Safety Recommendation A-07-13, the NTSB has investigated accidents and incidents for which improved monitoring and workload management skills might have interrupted the chain of events that led to the accidents and thus prevented their occurrence. The

[149] On October 20, 2006, the FAA issued Order 8000.91 to establish a method of sending information to operators in a timely manner. According to the order, an InFO message contains "valuable information for operators that should help them meet administrative requirements or certain regulatory requirements with relatively low urgency or impact in safety." InFO messages are not mandatory.

[150] Safety Recommendation A-07-6 was also issued as a result of findings from the Pinnacle accident. The recommendation asked the FAA to "require regional air carriers operating under 14 *Code of Federal Regulations* Part 121 to provide specific guidance on expectations for professional conduct to pilots who operate nonrevenue flights." On January 22, 2008, the FAA stated that the InFO would discuss the circumstances of the Pinnacle accident (a repositioning flight) and other accidents involving nonrevenue flights and would emphasize the need for the same high standards of professionalism that are expected for revenue flights. On May 19, 2008, the NTSB classified Safety Recommendation A-07-6 "Open—Acceptable Alternate Response."

[151] For more information, see National Transportation Safety Board, *Crash During Approach to Landing, Circuit City Stores, Inc., Cessna Citation 560, N500AT, Pueblo, Colorado, February 16, 2005*, Aircraft Accident Report NTSB/AAR-07/02 (Washington, DC: NTSB, 2007).

NTSB stated that the FAA's proposal to identify a list of required inspections would be responsive to the intent of the recommendation as long as the list provided a strong emphasis on the monitoring and workload management components of the CRM program. Safety Recommendation A-07-13 was classified "Open—Acceptable Response" pending the development of such a list and its incorporation into FAA work programs for regional offices and FSDOs.

1.18.1.5 Flight Crew Fatigue

On February 7, 2006, the NTSB issued Safety Recommendation A-06-10 as a result of the Corporate Airlines flight 5966 accident (see section 1.18.1.1). Safety Recommendation A-06-10, which is on the NTSB's list of Most Wanted Transportation Safety Improvements, asked the FAA to do the following:[152]

> Modify and simplify the flight crew hours-of-service regulations to take into consideration factors such as length of duty day, starting time, workload, and other factors shown by recent research, scientific evidence, and current industry experience to affect crew alertness.

On September 9, 2009, the FAA stated that, during the past year, it had worked with different groups to develop an operations specification that requires a fatigue risk management approach to mitigating fatigue for flights that exceed 16 hours. According to the FAA, the work highlighted the need for using such an approach in ultra-long-range flights as well as commercial flight operations. The FAA also stated that, in June 2008, it held a 3-day international symposium that presented current scientific knowledge of fatigue in aviation.[153] The FAA further stated that it planned the following actions: publishing the fatigue symposium proceedings, developing ACs to address fatigue in aviation operations and provide guidance for including a fatigue risk management system (FRMS) within an air carrier's SMS, collecting and analyzing crewmember fatigue data during actual flight operations, and providing guidance for determining adequate rest periods.

In addition, the FAA stated that, in July 2009, it established an aviation rulemaking committee on flight and duty time limitations and rest requirements for Part 121 and 135 operations. According to the FAA, the committee developed recommendations to consolidate and replace existing regulations for Parts 121 and 135, apply current fatigue science and information on fatigue, address the development of FRMS, and harmonize with international

[152] Safety Recommendation A-06-10 superseded Safety Recommendation A-99-45, which was issued on June 1, 1999. The recommendation asked the FAA to "establish within 2 years scientifically based hours-of-service regulations that set limits on hours of service, provide predictable work and rest schedules, and consider circadian rhythms and human sleep and rest requirements." Also, Safety Recommendation A-06-10 was reiterated in the NTSB's report on the accident involving Pinnacle Airlines flight 4712. For more information, see *Runway Overrun During Landing, Pinnacle Airlines, Inc., Flight 4712, Bombardier/Canadair Regional Jet CL600-2B19, N8905F, Traverse City, Michigan, April 12, 2007*, Aircraft Accident Report NTSB/AAR-08/02 (Washington, DC: NTSB, 2008).

[153] Staff members from the NTSB gave presentations at the symposium, and Board Member Robert L. Sumwalt was the keynote speaker.

fatigue mitigation initiatives. The FAA stated that it was reviewing the recommendations and that it would publish a notice of proposed rulemaking (NPRM) in December 2009 based on the committee's work.

On December 29, 2009, the NTSB stated that the FAA, after years of inaction, appeared to be on the verge of taking the recommended actions with regard to flight time limitations, duty period limits, and rest requirements for Part 121 and 135 pilots.[154] The NTSB noted that the FAA had proposed publishing the NPRM in early 2010 but stated that the FAA had not informed the NTSB of the specific revisions that the NPRM would include. Thus, the NTSB was not able to determine at that time whether the revisions would fully satisfy the intent of Safety Recommendation A-06-10. As a result, Safety Recommendation A-06-10 remained classified "Open—Unacceptable Response" pending the publication of an NPRM proposing to mandate the recommended actions. (The recommendation first received this classification on November 9, 2006.)

Also, on June 12, 2008, the NTSB issued Safety Recommendations A-08-44 and -45 as a result of previous accidents and incidents that highlighted (1) the dangers of human fatigue within airline operations, (2) the need to address fatigue factors related to company policies and crewmember responsibilities, and (3) the continued need for changes to flight and duty time regulations to effectively mitigate the dangers of fatigue to aviation operations. These recommendations asked the FAA to do the following:[155]

> Develop guidance, based on empirical and scientific evidence, for operators to establish fatigue management systems, including information about the content and implementation of these systems. (A-08-44)
>
> Develop and use a methodology that will continually assess the effectiveness of fatigue management systems implemented by operators, including their ability to improve sleep and alertness, mitigate performance errors, and prevent incidents and accidents. (A-08-45)

On August 11, 2008, the FAA stated that it had hosted a symposium on fatigue in aviation operations to gather and make public the best available knowledge on fatigue and

[154] The NTSB's response also addressed Safety Recommendations A-94-194 and A-95-113. Safety Recommendation A-94-194 asked the FAA to "revise the Federal Aviation Regulations contained in 14 CFR Part 135 to require that pilot flight time accumulated in all company flying conducted after revenue operations—such as training and check flights, ferry flights and repositioning flights—be included in the crewmember's total flight time accrued during revenue operations." Safety Recommendation A-95-113 asked the FAA to "finalize the review of current flight and duty time regulations and revise the regulations, as necessary, within 1 year to ensure that flight and duty time limitations take into consideration research findings in fatigue and sleep issues. The new regulations should prohibit air carriers from assigning flight crews to flights conducted under 14 CFR Part 91 unless the flight crews meet the flight and duty time limitations of 14 CFR Part 121 or other appropriate regulations." Both of these recommendations, which were also on the NTSB's Most Wanted List, had been classified "Open—Unacceptable Response."

[155] Safety Recommendation A-08-44 superseded Safety Recommendation A-06-11, which was issued as a result of the Corporate Airlines flight 5966 accident (see section 1.18.1.1). Safety Recommendation A-06-11 asked the FAA to "require all 14 *Code of Federal Regulations* Part 121 and 135 operators to incorporate fatigue-related information similar to that being developed by the Department of Transportation Operator Fatigue Management Program into their initial and recurrent pilot training programs; such training should address the detrimental effects of fatigue and include strategies for avoiding fatigue and countering its effects."

fatigue mitigations. The FAA also stated that it was developing operations specification guidance for fatigue management for ultra-long-range flights (that is, flights that are greater than 16 hours in duration) but did not identify any such initiatives for shorter duration domestic Part 121 operations.

On February 3, 2009, the NTSB encouraged the FAA to ensure that its planned activities proceed at an appropriate pace and that guidance on fatigue management systems be developed for all components of the aviation industry and not only for ultra-long-range operations. The NTSB asked the FAA to provide a schedule indicating when guidance for other aviation operations would be developed and issued. Safety Recommendations A-08-44 and -45 were classified "Open—Acceptable Response" pending receipt of this schedule and one for the development and implementation of methodologies to continually assess the effectiveness of fatigue management systems.

In addition, on June 27, 2008, the NTSB issued Safety Recommendations A-08-19 and -20 as a result of the accident involving Delta Connection flight 6448 in Cleveland, Ohio.[156] These recommendations asked the FAA to do the following:

> In cooperation with pilot unions, the Regional Airline Association, and the Air Transport Association, develop a specific, standardized policy for 14 *Code of Federal Regulations* Part 121, 135, and Part 91 subpart K operators that would allow flight crewmembers to decline assignments or remove themselves from duty if they were impaired by a lack of sleep. (A-08-19)
>
> Once the fatigue policy described in Safety Recommendation A-08-19 has been developed, require 14 *Code of Federal Regulations* Part 121, 135, and Part 91 subpart K operators to adopt this policy and provide, in writing, details of the policy to their flight crewmembers, including the administrative implications of fatigue calls. (A-08-20)

On September 26, 2008, the FAA stated that its aviation fatigue management symposium addressed air carrier fatigue policies, including crewmembers declining flying assignments as a result of fatigue. The FAA stated that it was actively pursuing a multiyear action plan to address aviation fatigue, including (1) publishing symposium proceedings; (2) developing and distributing an AC that addresses, in general terms, policy guidance in major areas of fatigue mitigation, including crewmember scheduling and duty policies; (3) developing an AC on FRMS that addressed, within an SMS context, all elements of a systematic approach to mitigating aviation fatigue; (4) publishing operations specification guidance for fatigue management in ultra-long-range flight operations; and (5) incorporating fatigue science expertise during data collection and analysis and policy development. The FAA also stated that its plan would include the consideration of operator policies related to crewmembers declining flight and/or duty assignments because of fatigue and would lead to appropriate formal policy guidance.

[156] For more information, see *Runway Overrun During Landing, Shuttle America, Inc., Doing Business as Delta Connection Flight 6448, Embraer ERJ-170, N862RW, Cleveland, Ohio, February 18, 2007,* Aircraft Accident Report NTSB/AAR-08/01 (Washington, DC: NTSB, 2008).

On June 22, 2009, the NTSB stated that the FAA's multiyear action plan to address aviation fatigue was responsive to both recommendations. The NTSB added that a satisfactory response to Safety Recommendation A-08-20 needed to include a requirement for operators to implement an appropriate policy for declining assignments based on fatigue and that the development of guidance by itself would not be sufficient. Safety Recommendations A-08-19 and -20 were classified "Open—Acceptable Response" pending the FAA's completion of the recommended actions.

1.18.1.6 Stall Training

On October 24, 1994, the NTSB issued Safety Recommendation A-94-173 as a result of the accident involving United Express flight 6291 in Columbus, Ohio.[157] Safety Recommendation A-94-173 asked the FAA to do the following:

> Ensure that the training programs for 14 *Code of Federal Regulations* Part 135 pilots place an increased emphasis on stall warning recognition and recovery techniques, to include stick shaker and stick pusher, during training.

On August 7, 1995, the FAA stated that it had issued Flight Standards Information Bulletin 95-10A, "Instrument Approach Procedures and Training," on June 26, 1995. The bulletin directed POIs to ensure that their Part 135 operators emphasized stall warning recognition and recovery techniques, including stick shaker and stick pusher, during training.

On November 14, 1995, the NTSB stated that Flight Standards Information Bulletin 95-10A complied with the intent of the recommendation. As a result, Safety Recommendation A-94-173 was classified "Closed—Acceptable Action."

Also, on July 29, 1997, the NTSB issued Safety Recommendation A-97-47 as a result of the ABX Air accident in Narrows, Virginia.[158] Safety Recommendation A-97-47 asked the FAA to do the following:

> Evaluate the data available on the stall characteristics of airplanes used in air carrier service and, if appropriate, require the manufacturers and operators of flight simulators used in air carrier pilot training to improve the fidelity of these simulators in reproducing the stall characteristics of the airplanes they represent to the maximum extent that is practical; then add training in recovery from stalls with pitch attitudes at or below the horizon to the special events training programs of air carriers.

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[157] For more information, see section 1.18.4 and National Transportation Safety Board, *Stall and Loss of Control on Final Approach, Atlantic Coast Airlines, Inc., United Express Flight 6291, Jetstream 4101, N304UE, Columbus, Ohio, January 7, 1994,* Aircraft Accident Report NTSB/AAR-94/07 (Washington, DC: NTSB, 1994).

[158] For more information, see National Transportation Safety Board, *Uncontrolled Flight Into Terrain, ABX Air (Airborne Express), Douglas DC-8-63, N827AX, Narrows, Virginia, December 22, 1996,* Aircraft Accident Report NTSB/AAR-97/05 (Washington, DC: NTSB, 1997).

On June 9, 1999, the FAA stated that aerodynamic stalls and approaches to stalls are flown during aircraft certification flight testing and that sufficient data are obtained to determine the aircraft's stall speed at an entry rate of 1 knot per second. The FAA also stated that an aircraft in an aerodynamic stall might handle and perform differently than the programming in the simulator might indicate for an identical circumstance. The FAA stated that the acquisition of data in this flight condition would have questionable accuracy and would be costly and dangerous to acquire. The FAA noted that, even if such data existed and were incorporated into simulators, it is unknown whether the simulators would be able to respond accurately to the data, given the limited nature of the motion systems on even the most advanced simulators. The FAA further stated that, to address the recommendation, it would revise the practical test standards to require pilots to adjust pitch, bank, and power to recover from an approach to stall and would add a note indicating, in part, that airspeed and/or altitude loss is critical at low altitudes and must be kept to an absolute minimum.

On November 19, 1999, the NTSB stated that the ability of simulators to faithfully replicate an airplane's actions in some stall and stall recovery regimes could be improved. The NTSB noted that generic simulator modules that were developed for some highly variable events have provided useful and necessary training for pilots. The NTSB pointed out, as an example, microburst and windshear simulator training, which provides realistic and effective training to pilots on specific models, even though an actual encounter is likely to be significantly different. The NTSB stated that it was disappointed that the FAA did not make changes to improve the fidelity of simulators in reproducing stall characteristics to the maximum extent feasible. The NTSB added that airline pilots need to be afforded this type of training so that they are fully prepared to recover stalled aircraft. As a result, Safety Recommendation A-97-47 was classified "Closed—Unacceptable Action."

In addition, on January 23, 2007, the NTSB issued Safety Recommendation A-07-4 as a result of the accident involving the Pinnacle Airlines flight 3701 accident (see section 1.18.1.3). Safety Recommendation A-07-4 asked the FAA to do the following:

> Convene a multidisciplinary panel of operational, training, and human factors specialists to study and submit a report on methods to improve flight crew familiarity with and response to stick pusher systems and, if warranted, establish training requirements for stick pusher-equipped airplanes based on the findings of this panel.

On April 13, 2007, the FAA stated that it would ask the government-industry working group that developed the *Airplane Upset Recovery Training Aid*[159] to reconvene to develop material addressing high-altitude performance issues and high-altitude stall prevention and recovery,[160] including a discussion of stick pusher systems. The FAA also stated that, once these

[159] The *Airplane Upset Recovery Training Aid* was issued in 1998 and was revised in August 2004 and November 2008.

[160] The response to Safety Recommendation A-07-4 also addressed the high-altitude training issues discussed in Safety Recommendations A-07-1 and -2, which were issued as part of the Pinnacle Airlines accident investigation.

materials were developed, it would strongly encourage air carrier managers, trainers, and pilots to include the materials in training programs and pilot operating manuals.

On January 22, 2008, the NTSB acknowledged the FAA's planned actions. The NTSB classified Safety Recommendation A-07-4 "Open—Acceptable Response" pending completion of these actions.

1.18.1.7 Remedial Training and Additional Oversight

On May 31, 2005, the NTSB issued Safety Recommendation A-05-14 as a result of the accident involving Federal Express flight 647 in Memphis, Tennessee.[161] Safety Recommendation A-05-14 asked the FAA to do the following:

> 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.

On April 13, 2007, the FAA stated that it had issued SAFO 06015, "Remedial Training for Part 121 Pilots," on October 27, 2006. The SAFO recommended implementation and incorporation of a voluntary remedial Part 121 pilot training module to supplement an air carrier's approved training program. The FAA indicated that directors of safety at Part 121 air carriers that do not have a voluntary remedial training module for pilots should recommend such a program to top managers at their company.

On December 12, 2007, the NTSB stated that the FAA needed to survey all Part 121 operators to determine whether they had taken the action recommended in SAFO 06015. Safety Recommendation A-05-14 was classified "Open—Acceptable Alternate Response" pending completion of this survey and demonstration that all Part 121 carriers had programs to address pilot performance deficiencies or failures during training.

On April 23, 2009, the FAA issued Notice 8900.71, which discussed verification of remedial training for Part 121 carriers. The purpose of the notice was to provide guidance to POIs about a required inspection to determine whether their Part 121 carriers were voluntarily complying with SAFO 06015. The notice also instructed the POIs to make a Program Tracking and Reporting Subsystem entry within 90 days of the date of the notice for those air carriers that had in place, or had incorporated, the SAFO's recommended actions in the carrier's approved training program.

[161] For more information, see National Transportation Safety Board, *Hard Landing, Gear Collapse, Federal Express Flight 647, Boeing MD-10-10F, N364FE, Memphis, Tennessee, December 18, 2003*, Aircraft Accident Report NTSB/AAR-05/01 (Washington, DC: NTSB, 2005).

On October 30, 2009, the FAA reported that 29 of the 82 Part 121 air carriers had remedial training programs in place. The 82 carriers included 27 regional air carriers, 6 of which had instituted such programs. The FAA did not provide the identities of those carriers with remedial training programs. On December 10, 2009, the FAA Administrator testified before the Subcommittee on Aviation, U.S. Senate Committee on Commerce, Science, and Transportation, and stated that two-thirds of the carriers without advanced qualification programs had systems in place to identify and manage low-time pilots and pilots with persistent performance problems. The administrator also stated that, for those carriers without such systems, additional FAA oversight of their training and qualification programs would be conducted.

On January 27, 2010, the FAA issued a fact sheet regarding its report, *Answering the Call to Action on Airline Safety and Pilot Training.*[162] The fact sheet stated that, between June and September 2009, 85 air carriers without advanced qualification programs were inspected to determine if they had remedial training programs that were consistent with the guidance in SAFO 06015. The review determined that 62 air carriers had programs fully in place to meet the guidance for remedial training programs. The fact sheet also stated that, at the time of the review, 15 carriers had some part of a remedial training program in place and that 9 carriers had not implemented any component of a remedial training program. The fact sheet added that, since the time of the review, these 24 air carriers had developed remedial training programs for pilots.[163]

1.18.1.8 Pilot Records

On November 15, 1995, the NTSB issued Safety Recommendations A-95-116 through -119 as a result of the accident involving American Eagle flight 3379 in Morrisville, North Carolina.[164] These recommendations asked the FAA to do the following:

> Require all airlines operating under 14 CFR Parts 121 and 135 and independent facilities that train pilots for the airlines to maintain pertinent standardized information on the quality of pilot performance in activities that assess skills, abilities, knowledge, and judgment during training, check flights, initial operating experience, and line checks and to use this information in quality assurance of individual performance and of the training program. (A-95-116)

> Require all airlines operating under 14 CFR Parts 121 and 135 and independent facilities that train pilots for the airlines to provide the FAA, for incorporation

[162] The FAA's report stated that, as a result of the information that was learned at the Colgan public hearing and subsequent congressional hearings, the Secretary of Transportation and the FAA Administrator initiated, in June 2009, "a Call to Action on Airline Safety and Pilot Training for FAA, air carriers, and labor organizations to jointly identify and implement safety improvements." For more information, see <http://www.faa.gov/library/reports/media/call_to_action_Jan2010.pdf>.

[163] The NTSB notes that, although the FAA stated that 85 carriers were reviewed, the results presented were for 86 carriers.

[164] For more information, see National Transportation Safety Board, *Uncontrolled Collision With Terrain, Flagship Airlines, Inc., dba American Eagle Flight 3379, BAe Jetstream 3201, N918AE, Morrisville, North Carolina, December 13, 1994*, Aircraft Accident Report NTSB/AAR-95/07 (Washington, DC: NTSB, 1995).

> into a storage and retrieval system, pertinent standardized information on the quality of pilot performance in activities that assess skills, abilities, knowledge, and judgment during training, check flights, initial operating experience, and line checks. (A-95-117)
>
> Maintain a storage and retrieval system that contains pertinent standardized information on the quality of 14 CFR Parts 121 and 135 airline pilot performance during training in activities that assess skills, abilities, knowledge, and judgment during training, check flights, initial operating experience, and line checks. (A-95-118)
>
> Require all airlines operating under 14 CFR Parts 121 and 135 to obtain information, from the FAA's storage and retrieval system that contains pertinent standardized pilot training and performance information, for the purpose of evaluating applicants for pilot positions during the pilot selection and hiring process. The system should have appropriate privacy protections, should require the permission of the applicant before release of the information, and should provide for sufficient access to the records by an applicant to ensure accuracy of the records. (A-95-119)

With regard to Safety Recommendation A-95-116, on April 17, 1998, the FAA stated that the enactment of PRIA in 1996 addressed the NTSB's concerns that led to the recommendation. The FAA pointed out that air carrier training requirements are predicated on training to proficiency and that the current record-keeping requirements thus certify a pilot's proficiency during training. Further, the FAA stated that the inclusion of subjective evaluations by individual instructors, check airmen, or FAA inspectors in a pilot's permanent record might make a training event a punitive experience rather than one in which pilots could learn from mistakes.

On January 3, 2000, the NTSB stated that the FAA had provided a convincing argument about the inappropriateness of subjective information in pilot records and the possibility that pilot training could be negatively affected. As a result, Safety Recommendation A-95-116 was classified "Closed—Reconsidered."

With regard to Safety Recommendations A-95-117 through -119, on February 11, 2007, the FAA stated that the Federal Aviation Reauthorization Act of 1996 required air carriers to obtain, maintain, and share certain specified training records of a prospective employee. The FAA also stated that this legislation eliminated the need for the FAA to maintain a storage and retrieval system for pilot training records.

On June 2, 1997, the NTSB stated that the legislation met the intent of the recommendations. As a result, Safety Recommendations A-95-117 through -119 were classified "Closed—Acceptable Alternate Action."

Also, on January 27, 2005, the NTSB issued Safety Recommendations A-05-1 and -2 as a result of the accident involving Air Sunshine flight 527 in Treasure Cay, Great Abaco Island, Bahamas.[165] These recommendations asked the FAA to do the following:

> 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-05-1)
>
> Conduct a study to determine whether the number of flight checks a pilot can fail should be limited and whether the existing system of providing additional training after a notice of disapproval is adequate for pilots who have failed multiple flight checks. On the basis of the findings of the study, establish a flight check failure limit and modify the recheck training requirements, if necessary. (A-05-2)

With regard to Safety Recommendation A-05-1, on September 9, 2005, the FAA stated that notices of disapproval for flight checks for certificates and ratings are not explicitly required by PRIA. The FAA also stated that requiring all Part 121 and 135 air carriers to obtain these notices would require FAA rulemaking or a change to the PRIA statute. According to the FAA, some air carriers had been asking pilot applicants, as part of their preemployment screening, to sign a consent form that permitted the FAA to release records of notices of disapproval to the air carrier, and the FAA was, in turn, furnishing those records to the air carrier requesting them. The FAA added that, to address the recommendation, it would amend AC 120-68, "Pilot Records Improvement Act of 1996," to indicate that a letter of consent signed by a pilot applicant could be used to authorize the FAA to release records of notices of disapproval for flight checks for certificates and ratings to an air carrier making such a request.

On November 3, 2006, the NTSB stated that the FAA's proposal to amend AC 120-68 might be an acceptable alternate action. The NTSB also stated that, because ACs are advisory only, the FAA should survey all operators (after the AC is revised) to determine how many require, as a condition of employment, a pilot applicant to submit a signed consent form permitting the FAA to release records of notices of disapproval. Safety Recommendation A-05-1 was classified "Open—Acceptable Alternate Response" pending the revision of AC 120-68 and the survey results. (The AC was revised on November 7, 2007; see section 1.18.2.1 for information. The survey has not been completed.)

With regard to Safety Recommendation A-05-2, on September 9, 2005, the FAA stated that it conducted a study in 2004 to determine if a correlation existed between flight test failures and the airmen cited in enforcement actions. The FAA stated that it found the correlation to be "very low … less than one percent." The FAA expressed concern about establishing a flight check failure limit. Specifically, the FAA stated that examiners might be extremely reluctant to find an applicant unsatisfactory as the failure limit is approached, which could result in applicants passing flight checks who would otherwise not pass the checks.

[165] For more information, see National Transportation Safety Board, *In-Flight Engine Failure and Subsequent Ditching, Air Sunshine, Inc., Flight 527, Cessna 402C, N314AB, About 7.35 Nautical Miles West-Northwest of Treasure Cay Airport, Great Abaco Island, Bahamas, July 13, 2003,* Aircraft Accident Report NTSB/AAR-04/03 (Washington, DC: NTSB, 2004).

On November 3, 2006, the NTSB stated that FAA and NTSB staff held teleconferences in January and February 2006 to discuss the type of study that would support the intent of this recommendation. The NTSB also stated that, in March 2006, the FAA examined data from October 1995 to October 2005 for the study. The FAA found that, during this period, almost 164,000 notices of disapproval were issued and almost 4,800 pilots had three or more flight check failures. The NTSB further stated that it understood the FAA's concern about imposing a flight check failure limit. Safety Recommendation A-05-2 was classified "Open—Acceptable Response" pending a formal written report on the study, including a description of the data analyzed and the results found.

1.18.1.9 Air Carrier Safety Programs

On January 23, 2007, the NTSB issued Safety Recommendations A-07-9 through -11 as a result of the accident involving Pinnacle Airlines flight 3701 (see section 1.18.1.3). These recommendations asked the FAA to do the following:

> Require that all 14 *Code of Federal Regulations* Part 121 operators incorporate into their oversight programs periodic Line Operations Safety Audit observations and methods to address and correct findings resulting from these observations. (A-07-9)
>
> Require that all 14 *Code of Federal Regulations* Part 121 operators establish Safety Management System programs. (A-07-10)
>
> Strongly encourage and assist all regional air carriers operating under 14 *Code of Federal Regulations* Part 121 to implement an approved Aviation Safety Action Program and an approved Flight Operational Quality Assurance program. (A-07-11)

With regard to Safety Recommendation A-07-9, on April 13, 2007, the FAA stated that it encouraged operators to voluntarily conduct LOSA observations and issued AC 120-90, "Line Operations Safety Audits," to describe the steps, resources, and procedures for conducting the audits. The FAA noted that LOSA was not the only way for an operator to accomplish oversight of the safety of its operations and indicated, as an example, the advanced qualification program, which allowed most major carriers to conduct random flight checks on their flight crews. The FAA also stated that the most effective approach for addressing this recommendation was the effective implementation of SMS, which would include safety audits as a key element. The FAA indicated that it had initiated a rulemaking project for SMS.

On January 22, 2008, the NTSB stated that air carriers should establish and operate a LOSA program because of its benefits and that the program could be part of an SMS. The NTSB also stated that the intent of the recommendation would be met if the FAA's rulemaking project for SMS included a requirement for LOSA programs. Safety Recommendation A-07-9 was classified "Open—Acceptable Response" pending completion of these actions. (Additional information on LOSA programs appears in section 1.18.2.2.)

With regard to Safety Recommendation A-07-10, on April 13, 2007, the FAA noted that the recommendation was similar to a recent amendment to Annex 6 of the International Civil Aviation Organization (ICAO) treaty that required SMS implementation by January 1, 2009. The FAA stated that its rulemaking project for SMS would meet the ICAO deadline and that it planned to impose SMS requirements on Part 121 and 135 air carriers and Part 145 repair stations. The FAA further stated that pilot project trials related to SMS implementation were scheduled to begin in 2007.

On January 22, 2008, the NTSB acknowledged the FAA's planned actions. Safety Recommendation A-07-10 was classified "Open—Acceptable Response" pending a requirement for all Part 121 air carriers to establish SMS programs. The NTSB notes that pilot project trials related to SMS implementation began in 2007 as scheduled and that the FAA has yet to finalize requirements and rulemaking for Part 121 and 135 air carriers and Part 145 repair stations.

With regard to Safety Recommendation A-07-11, on April 13, 2007, the FAA stated that it encouraged all Part 121 air carriers to voluntarily implement ASAP and FOQA. The FAA also stated that there was significant participation by regional airlines in ASAP but that few regional airlines participated in FOQA. To encourage further participation, the FAA stated that it would (1) make available, at no cost, a comprehensive Web-based ASAP report submission and database management system that could be housed at the air carrier or managed by an FAA contractor and (2) participate, during fiscal years 2007 and 2008, in conferences and seminars sponsored by the Regional Airline Association to increase awareness of ASAP and FOQA in the regional airline community. The FAA also stated that AC 120-92, "Introduction to Safety Management Systems for Air Operators,"[166] identified FOQA as one of the recommended tools that could contribute to the required safety assurance function of an SMS. The FAA further stated that it was engaged in rulemaking that would mandate SMS and that the expected SMS requirement, as well as the high level of industry support for SMS, could offer an increased incentive for regional airlines to participate in FOQA.

On January 22, 2008, the NTSB stated that the programs and initiatives that the FAA described met the intention of the recommendation. As a result, Safety Recommendation A-07-11 was classified "Closed—Acceptable Action." (Additional information on FOQA programs appears in section 1.18.2.3.)

1.18.1.10 Air Carrier Oversight

On December 20, 1996, the NTSB issued Safety Recommendation A-96-163 as a result of its investigation of the December 1995 Tower Air flight 41 accident in Jamaica, New York.[167] Safety Recommendation A-96-163 asked the FAA to do the following:

[166] AC 120-92 was issued on June 22, 2006, to provide guidance for SMS program development for air carriers and others in the aviation industry. The guidance was based on the FAA's review of existing worldwide SMS programs, its own internal SMS programs, and other system safety approaches.

[167] For more information, see National Transportation Safety Board, *Runway Departure During Attempted Takeoff, Tower Air Flight 41, Boeing 747-136, N605FF, JFK International Airport, New York, December 20, 1995*, Aircraft Accident Report NTSB/AAR-96/04 (Washington, DC: NTSB, 1996).

> Develop, by December 31, 1997, standards for enhanced surveillance of air carriers based on rapid growth, change, complexity, and accident/incident history; then revise national flight standards surveillance methods, work programs, staffing standards, and inspector staffing to accomplish the enhanced surveillance that is identified by the new standards.

On November 24, 2004, the NTSB stated that the FAA briefed NTSB staff in March 2004 about programs related to oversight and surveillance of air carriers, including ATOS and the Surveillance and Evaluation Program. The NTSB indicated that, during this briefing, the FAA stated that the risk indicators used by the Surveillance and Evaluation Program for targeting surveillance resources included rapid growth or expansion, new or major program changes, complexity of aircraft or new aircraft types, and accident and incident history. Because the FAA had developed these surveillance standards, the NTSB classified Safety Recommendation A-96-163 "Closed—Acceptable Action."

1.18.1.11 Low-Airspeed Alerting System

On December 2, 2003, the NTSB issued Safety Recommendations A-03-53 and A-03-54 as a result of the accident involving a King Air A100 in Eveleth, Minnesota.[168] These recommendations asked the FAA to do the following:

> Convene a panel of aircraft design, aviation operations, and aviation human factors specialists, including representatives from the National Aeronautics and Space Administration, to determine whether a requirement for the installation of low-airspeed alert systems in airplanes engaged in commercial operations under 14 *Code of Federal Regulations* Parts 121 and 135 would be feasible, and submit a report of the panel's findings. (A-03-53)

> If the panel requested in Safety Recommendation A-03-53 determines that a requirement for the installation of low-airspeed alert systems in airplanes engaged in commercial operations under 14 *Code of Federal Regulations* Parts 121 and 135 is feasible, establish requirements for low-airspeed alert systems, based on the findings of this panel. (A-03-54)

Although these recommendations resulted from a stall accident that did not involve icing conditions, the NTSB reiterated the recommendations on July 10, 2006, based on preliminary findings of an incident involving a Saab 340 airplane (operated as American Eagle flight 3008) that experienced a loss of control during icing conditions.[169]

[168] For more information, see National Transportation Safety Board, *Loss of Control and Impact With Terrain, Aviation Charter, Inc., Raytheon (Beechcraft) King Air A100, N41BE, Eveleth, Minnesota, October 25, 2002*, Aircraft Accident Report NTSB/AAR-03/03 (Washington, DC: NTSB, 2003).

[169] The safety recommendation letter in which the recommendations were reiterated also addressed three similar Saab 340 incidents investigated by the Australian Transport Safety Bureau. The letter stated, "if the flight crews had been alerted to the rapid airspeed decrease in a timely fashion, they may have been able to take corrective action and perhaps avoid the stall."

On October 3, 2006, the FAA stated that it formed an internal team of experts to assess the feasibility of a new low-airspeed alerting system. The FAA indicated that it would provide a status update in November 2006.

On April 3, 2007, the NTSB stated that it was encouraged that the FAA had formed a team to begin addressing the recommendations and noted that the FAA's status update was planned to occur in July 2007. As a result, Safety Recommendations A-03-53 and -54 were classified "Open—Acceptable Response." (The FAA's status update did not occur as planned.)

1.18.1.12 Airplane Icing

On November 30, 1998, the NTSB issued Safety Recommendations A-98-90 and -107 to the FAA and NASA, respectively, as a result of the accident involving Comair flight 3272 in Monroe, Michigan.[170] These recommendations asked the FAA and NASA to take the following actions along with each other as well as other interested aviation organizations:

> Organize and implement an industry-wide training effort to educate manufacturers, operators, and pilots of air carrier and general aviation turbopropeller driven airplanes regarding the hazards of thin, possibly imperceptible, rough ice accumulations, the importance of activating the leading edge deicing boots as soon as the airplane enters icing conditions (for those airplanes in which ice bridging is not a concern), and the importance of maintaining minimum airspeeds in icing conditions.

With regard to Safety Recommendation A-98-90, on August 2, 2001, the FAA stated that it sponsored an icing conference in February 1999 and that, as a result of the conference, NASA, in cooperation with the FAA, produced two videos, "Tailplane Icing" and "Icing for Regional and Corporate Pilots."[171] According to the FAA, the tailplane icing video provided information about ice-contaminated horizontal stabilizers, described symptoms of tailplane ice contamination, and suggested recovery procedures. The FAA also stated that the other icing video, which was intended for pilots of turboprop aircraft, discussed ice protection systems, ice accretion on aircraft, the effects of ice on performance degradation and handling qualities, and recovery techniques from a roll or pitch upset. The FAA further stated that it distributed the videos to its regional offices and FSDOs and that it would distribute additional videos, once they became available, to aircraft manufacturers for use in air carrier and general aviation flight training programs.

On January 3, 2002, the NTSB stated that the production and distribution of these icing videos met the intent of the recommendation. As a result, Safety Recommendation A-98-90 was classified "Closed—Acceptable Action."

[170] For more information, see National Transportation Safety Board, *In-Flight Icing Encounter and Uncontrolled Collision With Terrain, Comair Flight 3272, Embraer EMB-120RT, N265CA, Monroe, Michigan, January 9, 1997,* Aircraft Accident Report NTSB/AAR-98/04 (Washington, DC: NTSB, 1998).

[171] After this date, NASA produced a third icing video, as detailed in the response to Safety Recommendation A-98-107.

With regard to Safety Recommendation A-98-107, on March 3, 2004, NASA stated that it completed a computer-based training module for general aviation pilots titled "A Pilots Guide to In-Flight Icing" and three training videos for pilots titled "Icing for General Aviation Pilots," "Icing for Regional and Corporate Pilots," and "Tailplane Icing." NASA also stated that the purpose of the training module and videos, which were developed in cooperation with the FAA, was to educate pilots on how to operate in and avoid icing conditions.

On August 19, 2004, the NTSB stated that NASA's work to provide training about the hazards associated with in-flight icing conditions met the intent of the recommendation. As a result, Safety Recommendation A-98-107 was classified "Closed—Acceptable Action."

1.18.1.13 Weather Information for Pilots

On August 15, 1996, the NTSB issued Safety Recommendation A-96-48 as a result of its investigation of the American Eagle flight 4184 accident in Roselawn, Indiana.[172] Safety Recommendation A-96-48 asked the FAA to do the following:

> Direct principal operations inspectors (POIs) to ensure that all 14 *Code of Federal Regulations* (CFR) Part 121 air carriers require their dispatchers to provide all pertinent information, including airman's meteorological information (AIRMETs) and Center Weather Advisories (CWAs), to flightcrews for preflight and in-flight planning purposes.

On April 24, 1997, the FAA stated that it issued Flight Standards Information Bulletin for Air Transportation 97-03 on March 17, 1997, which directed POIs to ensure that air carriers require dispatchers to provide pertinent information, including AIRMETs and CWAs, when appropriate, for preflight and in-flight planning purposes. The FAA also stated that the information in the bulletin would be incorporated into FAA Order 8400.10, "Air Transportation Operations Inspector's Handbook."[173] On August 20, 1997, the NTSB stated that the flight standards information bulletin addressed the intent of the Safety Recommendation A-96-48 and classified it "Closed—Acceptable Action."

[172] For more information, see National Transportation Safety Board, *In-flight Icing Encounter and Loss of Control, Simmons Airlines, d.b.a. American Eagle Flight 4184, Avions de Transport Regional (ATR) Model 72-212, N401AM, Roselawn, Indiana, October 31, 1994,* Aircraft Accident Report NTSB/AAR-96/01 (Washington, DC: NTSB, 1996).

[173] FAA Order 8400.10 has been superseded by FAA Order 8900.1, "Flight Standards Information Management System."

1.18.2 Federal Aviation Administration Guidance

1.18.2.1 Pilot Records Improvement Act

On November 7, 2007, the FAA issued AC 120-68D, "Pilot Records Improvement Act of 1996." The AC noted that PRIA (49 *United States Code* 44703) was enacted to ensure that air carriers adequately investigated a pilot's background before allowing that pilot to conduct commercial air carrier flights. The AC also noted that a hiring employer could not place a pilot into service until the employer obtained and reviewed the last 5 years of the pilot's background and other safety-related records.

The AC included information for three different audiences: the pilot applicant, hiring employers that must request PRIA records (any Part 121, 125, or 135 operator), and former employers that must respond to PRIA record requests (any Part 121, 125, or 135 operator or any person that employed the applicant as a civil or public aircraft pilot). Also, the AC indicated that it contained expanded information to address operational situations that could affect a hiring employer's PRIA records request compared with the previous version (AC 120-68C, dated January 28, 2004). In addition, the AC stated that a letter of consent signed by a pilot job applicant could be used to authorize the FAA to release records of notices of disapproval for flight checks for certificates and ratings to an air carrier making such a request.

1.18.2.2 Line Operations Safety Audits

On April 27, 2006, the FAA issued AC 120-90, "Line Operations Safety Audits." The AC provided the rationale and procedures for conducting a LOSA program at an air carrier. The AC stated that a LOSA program included the confidential collection of safety-related operational data by expert and highly trained observers riding in the jumpseat during regularly scheduled flights. These data are used to assess the carrier's strengths and weaknesses to proactively improve safety margins and prevent degradation.

The AC explained that a LOSA program is distinct from, but complementary to, a FOQA program and an ASAP. According to the AC, FOQA and ASAP rely on outcomes to generate data (flight parameter exceedances and adverse crew-reported events, respectively), but LOSA samples all activities in normal operations, including successful flights, near events, and reportable events, and notes how flight crews manage the problems they encounter. The AC also stated that LOSA is more project-based than FOQA and ASAP (which are continuous programs) because the full LOSA process, including advance planning, observer selection and training, data collection, analyses, and the final report, can take between 6 and 12 months. The AC further stated that data from any of these safety programs can be cross-referenced to guide data collection in another one of the programs.

The AC recommended that air carriers conduct a LOSA every 3 years. The AC stated that the data collected during a LOSA could impact almost every department at an air carrier because the data could help (1) identify threats in the carrier's operating environment, (2) identify threats from within the carrier's operations, (3) assess any areas of training that are not successfully transferring to line operations, (4) check the quality and usability of procedures, (5) identify airplane design problems, (6) understand pilot shortcuts and workarounds, (7) assess the prevalence and management of incident and accident precursors (that is, vertical and lateral deviations and unstable approaches), (8) provide a baseline for organizational change, and (9) provide a rationale for resource allocation. The LOSA program also includes briefing management and line pilots on the audit findings detailed in the final report and implementing and monitoring a safety change process to address the findings.

1.18.2.3 Flight Operational Quality Assurance

On April 12, 2004, the FAA issued AC 120-82, "Flight Operational Quality Assurance," to provide guidance for developing, implementing, and operating a FOQA program. The AC stated that FOQA was a voluntary safety program that was designed to make commercial aviation safer by allowing air carrier operators and their pilots to share unidentified aggregate data with the FAA so that it could monitor industry trends in aircraft operations and target resources to address operational risk issues. The AC advised that FOQA programs could provide objective safety information that would not otherwise be obtainable.

The AC explained that the basis of any FOQA program was the understanding among the FAA, air carriers, and pilots that data provided to the FAA would be kept confidential so that the identity of reporting pilots or air carriers would remain anonymous.[174] The AC also stated that operator FOQA programs included provisions for the identification of safety issues and the development and implementation of corrective actions.

According to the AC, in a FOQA program, data are periodically collected from an aircraft using a QAR or an FDR. The retrieved data are then sent to the air carrier's FOQA office for validation and analysis. The data can be used to evaluate or effect change in the following areas: operational safety, aircraft performance, aircraft systems performance, flight crew performance, company procedures, training programs, training effectiveness, aircraft design, ATC system operation, airport operational issues, and meteorological issues. The data can also be shared with the FAA, other air carriers, and the aviation industry.

1.18.2.4 Standard Operating Procedures

On February 27, 2003, the FAA issued AC 120-71A, "Standard Operating Procedures for Flight Deck Crewmembers." The AC provided advice and recommendations about developing, implementing, and updating standard operating procedures, which, according to the AC, "are universally recognized as basic to safe aviation operations."

[174] Specifically, data submitted to the FAA as part of a FOQA program would be protected as "voluntarily submitted safety related data" under 14 CFR Part 193.

The AC included an appendix addressing standard operating procedures for flight crew monitoring and cross-checking. The appendix provided examples of standard operating procedures that emphasized that monitoring was a primary responsibility of both flight crewmembers. The appendix also provided examples of standard operating procedures to support improved monitoring during vertical segments of flight (that is, climb, descent, and approach).[175] In addition, the appendix addressed standard operating procedures to support improved monitoring of airport surface operations and automation.

1.18.3 Interview with Colgan Air Flight Crew of Burlington, Vermont, Stick Shaker Event

On March 10, 2009, a Colgan Q400 airplane, N188WQ, was en route from EWR to Burlington International Airport (BTV), South Burlington, Vermont, during night VMC. While descending into BTV, the stick shaker activated, a recovery followed, and the airplane landed at BTV without further incident. After the event, the NTSB interviewed the flight crew and the check airman who was administering the captain's 1-year line check at the time.[176]

The captain reported that, before the event, she had been manually flying the airplane, and her attention had been mostly focused outside of the airplane. She also reported that she asked the first officer for the no-ice and en route ice speeds and that the deice system (level two) had been selected.[177] The captain reported that she and the first officer (the monitoring pilot) had programmed the no-ice speeds because she observed no indications of ice on the wings during the descent.

The captain stated that the last airspeed she noticed before the event was about 140 knots and that the stick shaker had activated at an airspeed of about 135 knots and an altitude of about 1,800 feet. The first officer reported that, while performing the before landing checklist, he heard a noise, looked up, and saw that the numbers on the IAS display had turned red. The first officer further reported that he immediately called out "airspeed" and that the captain (the flying pilot) immediately responded by increasing power. The captain reported that she had lowered the airplane's nose and added full engine power (but did not reach the detent) in response. The first officer reported that he did not notice any significant change in the airplane's pitch when the captain applied full power, describing the airplane as being in a "gentle descent" at the time.

[175] The AC referenced a study on crew monitoring by NASA's ASRS, which found that 75 percent of the monitoring errors included in the study occurred while the aircraft was in a vertical phase of flight.

[176] At the time of the event, the captain had been with Colgan for more than 3 years and had been flying the Q400 for 1 year, accumulating between 800 and 1,000 hours in the airplane. The first officer had been with Colgan about 1 year and had been flying the Q400 for about 10 months, accumulating between 450 and 500 hours in the airplane. The check airman had flown the Q400 for 1 year and had been a check airman for 3 1/2 years.

[177] The check airman reported that the captain had selected the deice system to level two when the airplane was at an altitude of about 13,000 feet, even though the airplane was not in icing conditions at the time. (During postaccident interviews, the captain stated that the airplane had been in icing conditions at the time and that she planned to turn off the equipment before landing, and the first officer stated that the airplane had been in icing conditions earlier in the flight but that icing conditions were not occurring as the airplane was maneuvering toward the airport.) The check airman stated that selecting the deice system to level two with no icing conditions was not standard company procedure.

The captain stated that the low-speed cue did not come into view until the event occurred. She also stated that, at the onset of the event, she realized that the ref speeds switch was selected to the increase position. The first officer stated that he then pointed out the status of the ref speeds switch. The captain reported that she asked the first officer for the ice speeds, and he told her that V_{ref} was 140 knots. She then reportedly flew the airplane at that airspeed.

The captain indicated that, after recovering the airplane, she did not execute a missed approach because she was in control of the airplane. The first officer reported that he did not call for a go-around because the stick shaker activation was “a very quick thing” (lasting less than 5 seconds) and the airplane had already captured the glideslope and was stable.

The check airman stated that the stick shaker had momentarily engaged just before the airplane intercepted the glidepath. The captain added power, gaining about 150 to 200 feet, and reestablished a stabilized approach. The flight then continued uneventfully to a landing. The check airman stated that the last speed before the event that he recalled with certainty was 165 knots. He also stated that the airspeed was about 130 knots when the stick shaker activated and that the low-speed cue was visible at the time.[178] He further stated that the event was “minute” and that he did not observe the airplane in an actual stall.

The check airman indicated that the recovery appeared normal and that the remainder of the approach was flown at airspeeds between 150 and 155 knots. The check airman stated that, if he had been flying, he would have executed a missed approach but noted that the approach was stabilized and that the airplane was not in an unsafe condition after the recovery.

1.18.4 Previous Related Accident

On January 7, 1994, United Express flight 6291, a Jetstream 4101, N304UE, operated by Atlantic Coast Airlines, crashed into a storage warehouse while on an ILS final approach to Port Columbus International Airport, Columbus, Ohio. The flight crew, the flight attendant, and two passengers were killed, two passengers received minor injuries, and one passenger was not injured. The airplane was destroyed.

In its final report on this accident, the NTSB made the following conclusions:

- The airplane’s autopilot maintained the airplane on the glideslope and localizer, but the flight crew was not monitoring or maintaining airspeed.
- The first officer failed to alert the captain of the deteriorating airspeed, which was below the minimum specified for the approach, and the operator had no specified callouts for airspeed deviations during instrument approaches.

[178] The check airman stated that, after landing, he discussed the stick shaker activation with the captain and told her that it would have to be reported. He also informed the captain that the checkride was unsatisfactory. The check airman stated that, besides the stick shaker event, the captain’s performance had been satisfactory with no other airspeed control issues.

- The stall warning system operated properly, but the captain failed to apply full power and properly configure the airplane in a timely manner.
- The operator did not give proper consideration to the possible consequences of pairing a newly upgraded captain with a first officer who had no experience (before being hired by the airline 3 months before the accident) with air carrier operations.

The NTSB determined that the probable causes of the accident included (1) an aerodynamic stall that occurred when the flight crew allowed the airspeed to decay to stall speed and (2) an improper pilot response to the stall warning, including failing to advance the power levers to maximum and inappropriately raising the flaps.[179] Although light-to-moderate mixed icing conditions occurred during the approach, the NTSB concluded that airframe icing was not a cause of the accident.

1.18.5 Gulfstream Training Academy Information

The captain attended Gulfstream Training Academy from August 2004 to April 2005. According to its director, the academy is a comprehensive program for professional pilots who want to gain flight time without becoming a certified flight instructor. The academy is also directly associated with GIA.[180] Pilots entering the academy's program are required to have completed their instrument, commercial, and multiengine ratings and possess a current FAA medical certificate. The academy conducts complete applicant background checks. The director stated that some applicants enter the academy with only 200 flight hours, whereas others have accumulated between 1,000 and 1,500 flight hours. The program duration is from 6 to 8 months.

The program begins with a 5-day IFR refresher course during which the academy assesses the pilots' readiness. Those pilots that do not require additional training and experience progress through systems training, cockpit procedures training, verbal exams, and six to eight simulator sessions in a FlightSafety BE-1900D simulator in Orlando, Florida. This training culminates in a checkride in both the simulator and the airplane. After passing the checkrides, the pilot is qualified to be an SIC in the BE-1900D and then transitions to initial training and IOE. After accomplishing IOE and a line check, pilots fly with GIA for 250 hours and are assigned reserve status or scheduled line duty as probationary pilots. Once pilots complete the 250 flight hours, they are hired by the company as full-time first officers, are placed on furlough, or are released from the company.

GIA's initial training program was structured to teach pilots how to operate the BE-1900 in a Part 121 environment. As a result, the training focused on systems and procedures and not basic flying skills, which should have been learned while pilots were completing their instrument rating and commercial certificate.

[179] Safety Recommendation A-94-173, which was issued as a result of this accident, is discussed in section 1.18.1.6.

[180] According to Gulfstream Training Academy's website, GIA is a regional air carrier with more than 200 scheduled daily flights within Florida and to the Bahamas.

The captain completed initial training and, in December 2004, began flying the BE-1900 for GIA as a fully qualified first officer. GIA maintained comprehensive training records for the captain. His training records showed that, even though he completed all entry, training, and operating phases without a failure, the captain had experienced continuing difficulties with aircraft control. For example, during simulator periods 3 and 4, the captain was graded unsatisfactory in "approach to stall – landing configuration," although he received a satisfactory grade in later sessions. During simulator period 7, the captain's altitude and airspeed control was unacceptable, and comments included, "airspeed more than 10 knots below Vref + 10. Fly correct airspeed!" "airspeed 10 knots below Vref crossing threshold," "gear remains up during entire approach," and "repeated deviation from altitude 200-300 feet."

During simulator period 8, the instructor noted, "basic attitude flying cause of repeated deviations," "constant deviations up to full scale on glide slope," and "additional training required." All maneuvers were graded satisfactory the next day (by the same instructor as the day before) during an extra ninth simulator period, and the simulator checkride was completed that same day.

The captain completed his IOE at GIA in 34.8 hours, and training captains made several positive remarks, such as "good progress," "getting better," and "good job, signed off from IOE." No further comments appeared in the captain's GIA file about his performance while flying as a first officer.

When the captain completed his 250 flight hours in April 2005, GIA was not hiring pilots. According to GIA's director of operations, the captain would have been eligible for hiring based on his record. However, the director pointed out that, to be hired, pilots must have at least three letters of recommendation from captains in their file, and no such letters were found for the captain.

2. Analysis

2.1 General

The pilots were properly certificated and qualified in accordance with applicable Federal regulations. The airplane was properly certified, equipped, and maintained in accordance with Federal regulations. The recovered components showed no evidence of any preimpact structural, engine, or system failures, including no indications of any problems with the airplane's ice protection system.

The air traffic controllers who were responsible for the flight during its approach to BUF performed their duties properly and responded immediately and appropriately to the loss of radio and radar contact with the flight. Although PIREPs before the time of the accident could have provided additional real-time information of the flight conditions on approach to BUF, no evidence showed that the icing conditions that existed were abnormal for wintertime operations in the BUF area. Also, the NTSB's postaccident survey of pilots operating into BUF about the time of the accident indicated that they were not surprised by the icing conditions and did not consider the conditions to be significant.

This accident was not survivable.

This analysis discusses the following information:

- the accident sequence, including the minimal effect of icing on the airplane's performance, the flight crew's failure to monitor airspeed in relation to the rising position of the low-speed cue, and the captain's incorrect actions in response to the stall warning;
- strategies to prevent flight crew monitoring failures, including explicit pilot training for monitoring and standard operating procedures that promote effective monitoring;
- pilot professionalism, including captain leadership skills and adherence to sterile cockpit and standard operating procedures;
- fatigue, including commuting pilots' use of company crew rooms as rest facilities and industry efforts to mitigate fatigue;
- remedial training for poor-performing pilots, the need for detailed documentation of pilot training and checking events and retention of such records, and the information to be included in an air carrier's assessment of a pilot applicant;
- flight crew procedures and training to ensure that selected airspeeds are matched to the position of a ref speeds switch or similar device;

- stall training that involves fully developed stall profiles (in addition to the approach-to-stall profiles that are currently required) and a demonstration of the stick pusher system;
- the FAA's oversight of Colgan, including the surveillance provided at the time that the company incorporated the Q400 into its fleet;
- flight operational quality assurance programs, including the use of downloaded safety information to identify deviations from established norms and procedures;
- the use of personal portable electronic devices on the flight deck;
- the FAA's use of SAFOs, which are advisory in nature, to transmit safety-critical information; and
- preflight weather documents provided to flight crews and icing terminology presented in an FAA publication used by pilots for basic flight information.

2.2 Accident Sequence

2.2.1 Overview

The FDR recorded the activation of the airframe and propeller deice equipment while the airplane was climbing to its assigned cruise altitude of 16,000 feet. At that time, the captain would have turned the ref speeds switch (on the ice protection panel above his seat) to the increase position. According to the Bombardier Q400 AFM, the ref speeds switch was to be set to the increase position before an airplane entered icing conditions (or upon initial detection of icing) and was to be set to the off position when the airplane was aerodynamically clean (that is, all ice was removed from the visible leading edges of the wing and wing tips).

For the accident airplane, turning the ref speeds switch from the off to the increase position lowered the AOA reference for stick shaker activation and raised the position of the low-speed cue on the pilots' IAS displays by about 15 knots. As a result, the airplane would have the same (or greater) performance margins relative to the stall speed during operations in icing conditions as it would have with a clean configuration as long as the landing airspeeds were appropriately increased to remain above the stall warning threshold.[181]

The first officer had received the BUF ATIS by 2150:42 and had entered planned landing information, including the intended runway and the airplane's landing weight, into ACARS for transmittal to AeroData (see section 1.6.1) for landing performance data. However, she did not enter the keywords "icing" or "eice," despite the icing conditions at the time, the deicing equipment in use, the ref speeds switch in the increase position, and the expected landing conditions (based on the ATIS information). ACARS returned the AeroData landing

[181] The performance margins for operations in icing conditions were based on the worst-case ice accretions examined during icing certification. Ice accretions with less severe performance penalties than the worst-case ice accretions would result in a greater margin to stall.

performance data to the airplane at 2153:00, showing a V_{ref} of 118 knots and a V_{ga} of 114 knots, but these speeds were not appropriate for an airplane configured for flight in icing conditions. (If the first officer had entered either "icing" or "eice," then the V_{ref} would have been 138 knots, which would have included a 20-knot icing increment.) The first officer provided the speeds to the captain, and he did not challenge them.

Variable periods of snow and light-to-moderate icing were present during the accident airplane's approach to BUF, and some ice accumulation was likely present on the airplane. However, FDR data and airplane performance models showed that the airplane responded to control inputs as expected, given the calculated ice accretion at the time, until the wing stalled.

The CVR recorded the activation of the stick shaker about 2216:27, and FDR data showed that the activation occurred at an AOA of about 8°, a load factor of 1 G, and an airspeed of 131 knots, which was consistent with the AOA, airspeed, and low-speed cue during normal operations when the ref speeds switch was selected to the increase position. The airplane was not close to stalling at the time. However, because the ref speeds switch was selected to the increase (icing conditions) position, the stall warning occurred at an airspeed that was 15 knots higher than would be expected for a Q400 in a clean (no ice accretion) configuration. Stick shakers generally provide pilots with a 5- to 7-knot warning of an impending stall; thus, as a result of the 15-knot increase from the ref speeds switch, the accident flight crew had a 20- to 22-knot warning of a potential stall.[182]

CVR and FDR data indicated that, when the stick shaker activated, the autopilot disconnected automatically. The captain responded by applying a 37-pound pull force to the control column, which resulted in an airplane-nose-up elevator deflection, and adding power. In response to the aft control column movement, the AOA increased to 13°, pitch attitude increased to about 18°, load factor increased from 1.0 to about 1.4 Gs, and airspeed slowed to 125 knots. In addition, the speed at which a stall would occur increased.[183] The airflow over the wing separated as the stall AOA was exceeded, leading to an aerodynamic stall and a left-wing-down roll that eventually reached 45°, despite opposing flight control inputs. Thus, the NTSB concludes that the captain's inappropriate aft control column inputs in response to the stick shaker caused the airplane's wing to stall.

The airplane experienced several roll oscillations during the wing aerodynamic stall. FDR data showed that, after the roll angle had reached 45° left wing down, the airplane rolled back to the right through wings level. After the first stick pusher activation, the captain applied a 41-pound pull force to the control column, and the roll angle reached 105° right wing down. After the second stick pusher activation, the captain applied a 90-pound pull force, and the roll angle reached about 35° left wing down and then 100° right wing down. After the third stick pusher activation, the captain applied a 160-pound pull force. The final roll angle position

[182] The airspeed at which an airplane would stall can be increased if the airplane experiences measurable loads (that is, variation from a 1 G load) because of, for example, maneuvering or external forces. The increased stall speed with loads greater than 1 G would erode the stall warning margin.

[183] Numerous combinations of airspeed and load factor can result in the stall AOA being exceeded. The stall warning margin that existed at the time of stick shaker activation was consumed by the increase in load factor during the pull-up maneuver, leading to the stall AOA being exceeded at an airspeed that was much higher than the 1 G stall speed.

recorded on the FDR was about 25° right wing down. At that time, the airplane was pitched about 25° airplane nose down.

The airplane performance study and simulations showed that the airplane experienced minimal performance degradation because of ice accretion.[184] Specifically, the AOA at the time of the wing stall was about 1° above the expected AOA for a clean wing (no ice accretion) stall warning. Thus, the airplane could have been operated in normal flight, at the non-icing V_{ref}, and with a substantial margin remaining above the actual point of stall. As a result, the NTSB concludes that the minimal aircraft performance degradation resulting from ice accumulation did not affect the flight crew's ability to fly and control the airplane. The flight crew's actions during the accident sequence are further discussed in sections 2.2.2 through 2.2.4.

2.2.2 Approach to Airport

The approach phase of flight is dynamic and requires heightened vigilance because it typically involves changes in the airplane's altitude, heading, speed, and configuration. The captain, as the flying pilot, had the primary responsibility to monitor the instruments, and the first officer, as the monitoring pilot, was responsible for providing backup and corrective input to the captain's efforts.

About 2215:14, the controller informed the flight crew that the airplane was 3 miles from the outer marker and cleared the flight for the ILS runway 23 approach. The glideslope intercept point, as shown on the approach chart, was outside the outer marker. According to Colgan's guidance, the airspeed at the time (184 knots) was too fast for the airplane's position relative to the glideslope;[185] as a result, the captain needed to initiate a rapid slowdown less than 3 miles from the outer marker. ATC requirements at busy airports, such as EWR (where both pilots were based), often necessitate such a maneuver. However, in this case, it is likely that the captain had to slow the airplane quickly because he was distracted by his conversation with the first officer and had lost positional awareness.[186] A rapid slowdown is not unusual and is not unsafe if it is flown properly.[187] The captain slowed the airplane by extending flaps to 5°, reducing power to near idle,[188] extending the landing gear, and moving the condition levers to maximum rpm.[189]

[184] The aircraft performance simulation study results for constant pitch attitude and constant altitude (see section 1.16.2) provide specific evidence showing that the airplane had more-than-adequate performance capability to return to a safe flight condition.

[185] The 184-knot airspeed was 46 knots faster than Colgan's maximum allowable approach speed on the glideslope, which is V_{ref} plus 20 knots (in this case, 138 knots).

[186] Air traffic was reported to be light at BUF at the time of the accident flight, and ATC had not issued any speed restrictions for the flight.

[187] Several of the 13 previous flights recorded by the FDR had involved rapid slowdowns. The Colgan Q400 APM stated that a good technique for slowing an airplane rapidly is to increase the propeller rpm.

[188] The primary power indication, torque, was displayed at the top of the engine display, which would have been in the direct view of the pilots. The power levers, which were being manipulated by the captain, were located on the center console.

Airspeed indications were displayed on the pilots' PFDs, as shown previously in figure 1. A vertical scale on the left side of each PFD showed the current airspeed (depicted in the center of the scale) and a range of ± 42 knots from the actual airspeed, and an airspeed trend vector predicted the airspeed at which the airplane would be flying in 10 seconds. The low-speed cue, consisting of alternating red and black bars, appeared on the bottom right of this scale to warn pilots of the calculated airspeed at which the stick shaker would activate. The cue's red color is consistent with a warning indication requiring immediate recognition and corrective action by either pilot. The ref speeds switch, when set to increase, adjusts the position of the low-speed cue to account for the increased stall protection margin.

About 2216:09, the low-speed cue began to rise from the bottom of the airspeed display as the airspeed slowed. However, the flight crew made no remarks and took no actions that were consistent with the recognition of this cue. Also, because the autopilot altitude hold mode was engaged when the airplane leveled off at 2,300 feet, the autopilot continued to add nose-up pitch trim to maintain altitude as the airspeed slowed. During the time that the low-speed cue was in view, the airplane's pitch trim increased from 1° to 7° nose up, and the pitch attitude of the airplane increased from 3° to 9° nose up. Neither pilot remarked about the increasing pitch attitude, even though it was a cue indicating that airspeed was slowing. In addition, the numbers on the airplane's IAS display changed from white to red as the airplane reached the calculated stick shaker activation speed. About 2216:27, the stick shaker activated at an airspeed of 131 knots, which was 13 knots higher than the V_{ref} that the flight crew had set but 7 knots lower than the V_{ref} icing speed.

It is not unusual for a flight crew to see the low-speed cue appear during an approach given the airspeed range displayed on the PFDs. When the cue does appear, however, increased vigilance is necessary to ensure that the airspeed does not slow into the low-speed cue region, which would result in stick shaker activation. Pilots can accomplish such vigilance by using cues from the airspeed (actual IAS versus desired IAS), airplane configuration, pitch attitude, and power, all of which are part of a normal instrument scan. In this accident, the rise of the low-speed cue toward the decreasing IAS during an 18-second period should have been a salient cue to elicit action from either pilot. The NTSB concludes that explicit cues associated with the impending stick shaker onset, including the decreasing margin between indicated airspeed and the low-speed cue, the airspeed trend vector pointing downward into the low-speed cue, the changing color of the numbers on the airplane's IAS display, and the airplane's excessive nose-up pitch attitude, were presented on the flight instruments with adequate time for the pilots to initiate corrective action, but neither pilot responded to the presence of these cues.

2.2.2.1 Possible Reasons for Failed Detection of Impending Stick Shaker Onset

To identify possible reasons the pilots failed to detect and correct the impending stick shaker onset, the NTSB examined how the pilots' attention was directed and what their workload

[189] Even though the autopilot had been on throughout most of the flight, power was controlled manually by the captain because the airplane was not equipped with autothrottles. Both pilots recognized, as a result of their training, that the airplane did not have an autothrottle system and that power had to be applied manually.

had been during the seconds preceding the event. As the flying pilot, the captain should have been alerted to the rising low-speed cue and should have taken corrective actions during the 18 seconds between the first appearance of the cue and the onset of the stick shaker. Although the CVR contained statements and actions that were consistent with the captain referencing the PFD,[190] the NTSB could not precisely determine when he was, or was not, looking at the airspeed indicator or where else he might have been focusing his attention during this period.[191]

As the monitoring pilot, the first officer should have been the primary backup to the captain and noticed his monitoring error. However, during the time between the first appearance of the low-speed cue and the onset of the stick shaker, the first officer was performing tasks that directed her attention toward the center pedestal and the center of the instrument panel and away from the PFD. About 2216:06, in response to the captain's "gear down" callout, the first officer lowered the landing gear and adjusted the condition levers.[192] About 6 seconds later, the first officer acknowledged a change to the ATCT frequency, and about 3 seconds afterward made a double chime notification to the flight attendant. About 2216:21, the first officer confirmed that the gear was down. About 2 seconds later, the captain requested that the flaps be set to 15° and that the before landing checklist be accomplished. About 5 seconds afterward, and about 1 second before the stick shaker activated, the first officer moved the flap handle to the 10° position in response to the captain's callout for flaps 15. (The flap handle had previously been in the 5° position.)[193]

The NTSB concludes that the reason the captain did not recognize the impending onset of the stick shaker could not be determined from the available evidence but that the first officer's tasks at the time the low-speed cue was visible would have likely reduced opportunities for her timely recognition of the impending event; the failure of both pilots to detect this situation was the result of a significant breakdown in their monitoring responsibilities and workload management.

The NTSB also considered the possibility that the pilots were unaware of the effect that the ref speeds switch position had on the stick shaker activation speed. However, both pilots were familiar with the airplane's ice protection system, and the Bombardier Q400 AFM cautioned that a stall warning might occur if airspeed was not increased before the ref speeds switch was selected to the increase position. As a result, it is unlikely that the pilots were unaware of the switch's effect.

[190] These statements included "approach is armed" about 2215:32, "gear down loc's [localizer is] alive" about 2216:04, and "flaps fifteen before landing checklist" about 2216:24. In addition, a sound similar to a decrease in engine power was recorded about 2216:00.

[191] The captain could have possibly been referencing the approach chart. It is also possible that he was inspecting the condition of the wings or the ice protection system because an ice detect message appeared on the engine display about 2216:25. It is important to note that no correlation existed between the timing of the message and the activation of the stick shaker 2 seconds later.

[192] Colgan procedures indicated that these tasks were to be performed by the monitoring pilot.

[193] Less than 1 second before the stick shaker activated, the first officer stated, "uhhh." This statement could have indicated her recognition of the position of the low-speed cue on the PFD, or it could have been associated with the start of the before landing checklist. The available information was not sufficient to attribute the meaning of this statement.

The CVR did not record the captain, during the climb to cruise altitude, stating that he had changed the position of the ref speeds switch from off to increase. However, the CVR did record the captain and the first officer referring to the 24-hour ice protection check, which included turning the ref speeds switch to the increase position and then back to the off position.[194] Also, neither the captain nor the first officer mentioned the status of the switch during the flight, even with the "INCR REF SPEED" indication that would have appeared on the engine display.[195] Further, if the ref speeds switch had been turned to the off position after stick shaker activation, the shaker would have stopped. As a result, the NTSB concludes that the flight crew did not consider the position of the ref speeds switch when the stick shaker activated.

As indicated in section 1.18.3, after the accident, another Colgan flight crew experienced the activation of the stick shaker during a night VMC approach to BTV after losing awareness of the position of the ref speeds switch (which had been set to increase) and failing to recognize the impending stick shaker onset.[196] The BUF accident, the BTV event, and postaccident interviews with company pilots demonstrated that Colgan's approach procedures for setting airspeed bugs did not reinforce awareness of the ref speeds switch position, which created an opportunity for confusion. Specifically, pilots were not provided with specified airspeed targets beyond V_{ref}, and no procedures were in place to ensure that the selected airspeeds were above the top of the low-speed cue. For example, if the captain and the first officer had recalled that the switch was set to the increase position, then they should have recognized that the airspeed for the approach needed to increase by 20 knots. Additional information on Colgan's airspeed selection procedures is discussed in section 2.8, along with the company's postaccident changes to these procedures.

2.2.3 Response to Stick Shaker Activation

After the stick shaker activated, the autopilot disconnected automatically, as designed. The airplane was not in an aerodynamic stall at that time. The stick shaker activated with enough airspeed available to correct the situation because the wings were level and the load factor was 1 G. However, as stated previously, the captain's inappropriate aft control column inputs in response to the stick shaker led to an aerodynamic stall.

CVR and FDR data showed that the captain made an initial aft control column input after stick shaker onset and before the application of power. The stick forces at the time of autopilot disconnect were likely less than 2 pounds and would not account for his control input, which was

[194] The CVR recorded the captain stating that the 24-hour ice protection check had been accomplished. The first officer subsequently confirmed that the check had been performed after she noticed in the airplane's logbooks that a previous flight crew had not completed the daily check.

[195] In addition, if the ref speeds switch was in the off position, the ice detected message on the engine display would appear in flashing yellow letters, which would have provided the pilots with information about the mismatch between the position of the ref speeds switch and the airspeed bugs.

[196] When the event occurred, the airplane was not under autopilot control. The captain, who was the flying pilot, reported that she had been looking outside for the runway when the stick shaker activated, and the first officer reported that he had been performing a checklist at the time. The captain successfully recovered the airplane, and the flight continued to a landing without further incident.

abrupt and inappropriate.[197] The aft control column input occurred within 1 second of the stick shaker activation, which suggested that the captain's hands were close to or resting on the control column. However, it was not possible to determine whether the captain's hands were lightly placed on the control wheel before the onset of the stick shaker and the initial aft input was the result of a rough grab in response to being startled by the activation of the stick shaker.[198]

The aft control column movement was relaxed momentarily, but no evidence showed that the control column was pushed forward enough to prevent or recover from a stall. (The control column did not move forward of its neutral position any time after stick shaker activation.) NTSB postaccident observations in a Q400 flight simulator (with no simulated ice) showed that Colgan's recovery procedures after initial stick shaker activation did not require exceptional piloting skills or aggressive inputs on the flight controls, even when full power was applied during the recovery effort.

The captain's subsequent control inputs were also not appropriate because he pulled back on the column rather than pushed forward to reduce AOA. As a result, the airplane's pitch attitude and AOA increased and its airspeed decreased. After the stall, the AOA oscillated between 10° and 27°, the airspeed remained below the low-speed cue value, and the stick shaker remained active.

According to Colgan's procedures for a stall recovery, the captain, as the flying pilot, was to call "stall," increase power to the rating detent, and call "check power," but he did not follow these procedures. Even though the captain added power in response to the stall warning, he did not add full power as required.[199] Also, the first officer did not call "stall" when the captain failed to do so, inform him that power had not been increased to the rating detent (she would have been able to observe the position of the power levers), or advance the power to the rating detent when the captain failed to do so. The next steps in the stall recovery procedure would have been for (1) the first officer, as the monitoring pilot, to call "positive rate" as an indication that the airplane was climbing; (2) the captain to call "gear up"; (3) the first officer to raise the gear and call "V_{fri}" when the airspeed had accelerated to 125 knots; and (4) the captain to call for flaps 0.

In addition, the captain had not yet called for the landing gear to be raised or for the flaps to be retracted. However, about 7 seconds after the stick shaker activated, the first officer raised the flaps and then told the captain about the action she had just taken. All of Colgan's procedures

[197] The NTSB considered the possibility that the captain's initial aft input was the result of unrecognized spatial disorientation. Accelerations and decelerations can be misinterpreted by pilots as pitch cues, which is a condition known as the somatogravic illusion. However, for this event, the deceleration would not have provided perceived nose-down pitch cues of sufficient magnitude to explain the captain's action.

[198] To facilitate pilot corrective action in the event of an unexpected autopilot disconnect and minimize the potential for errant flight as the pilot takes manual control, it is good technique for a pilot to lightly follow along with the flight controls during approaches flown with the autopilot engaged.

[199] FDR data showed that the captain advanced the power levers to about 70°, but the rating detent was 80°. The rating detent was not a physical stop and required tactile feedback to positively identify its location as the power levers were advanced. It is possible that the captain missed this feedback as he advanced the throttles.

pertaining to flap movement required a command from the flying pilot and acknowledgment from the monitoring pilot before the flaps could be moved.

The stick pusher activated when the airplane's airspeed had decreased to about 100 knots and its AOA was about 18° (which was about 10° higher than the AOA at the time of stick shaker onset). FDR data showed that the control column moved forward temporarily after stick pusher activation and then moved aft. The stick pusher activated a second time when the AOA was about 21° and a third time when the AOA was about 22°, but the control column continued to remain aft of its neutral position. The NTSB is concerned that the captain pulled against the stick pusher three separate times during the stall event and that his control inputs fought the stall protection system's attempts to decrease the AOA and reduce the severity of the situation.[200]

Before transitioning to the Q400, the captain had previously flown the Saab 340, which had a stick pusher. It is possible that he had seen a demonstration of the stick pusher during simulator training for that airplane.[201] However, it could not be determined whether the captain had seen a stick pusher demonstration on the Q400. Even if the captain had seen this demonstration, his actions in pulling against the pusher were not consistent with any trained procedure or the basic requirements for recovery from an aerodynamic stall.

If the captain had not overridden the stick pusher's action to decrease AOA, then the pusher would have forced the nose of the airplane downward. Also, if the captain would have responded properly to this nose-down input, then the airplane might have recovered flying speed in sufficient time to avoid the impact. However, the raising of the flaps, in addition to the vertical loading at the time, increased the stall speed and reduced the lift being produced by the wings at a time when the airplane was already stalled.

About 7 seconds after notifying the captain about the status of the flaps, the first officer asked him whether she should raise the gear, and he consented. The raising of the gear was not appropriate but had minimal effect on the attempted stall recovery.

In general, the captain's performance suggests that he was surprised by the stick shaker's activation, and he responded by making control inputs that were inappropriate for the situation. The captain's failure to make a standard callout or even a declarative statement associated with a recovery attempt and his failure to silence the autopilot disconnect horn (which continued for the remainder of the flight and could have been silenced using a button on the control wheel) further suggest that he was not responding to the situation using a well-learned habit pattern. The first officer was not providing guidance consistent with an understanding of the situation, suggestions for corrective input, or standard callouts. In addition, neither flight crewmember made reference to the airplane's airspeed at any time after the activation of the stick shaker. During the public hearing for this accident, the NASA-Ames Research Center chief scientist for aerospace human factors stated that people under stress might not respond appropriately to events in their

[200] Overriding the stick pusher required an 80-pound opposite breakout force and then 66 pounds of continued aft force. FDR and stall protection system data showed that the stick pusher activated a second time about 2216:40, and the CVR recorded the captain making a grunting sound about 2216:42.

[201] The syllabus for Saab 340 simulator training showed "demonstration to pusher" as an instructor's discretion item listed under stalls.

environment. In this case, the airplane was in a low-speed, nose-high attitude and was aerodynamically stalled, and neither pilot responded appropriately to the situation.

The captain's response to the stick shaker should not have required cognitive effort to make the correct inputs or standard callouts. Although the conditions under which the captain had practiced stall recoveries—which should have formed the sequence of actions used in his response—did not involve an autopilot disconnect or an element of surprise, the captain's experience should still have allowed him to quickly adapt to the situation and perform correctly, as demonstrated by the pilot response during the Colgan BTV event.[202]

The accident captain's history of training failures (previously discussed in section 1.5.1.2 and analyzed in section 2.7) showed that he had demonstrated weaknesses throughout his career with instrument flying skills and had relied heavily on the autopilot to help him stabilize the airplane, which might have contributed to his deficient performance during the accident flight. However, research has shown that it could be difficult for pilots to recognize and recover from unusual attitudes that were unexpected. In addition, the night and poor visibility conditions at the time precluded the use of external visual cues for reliable attitude reference, and the airplane's G loads and proximity to the ground would have increased the stress associated with the event. The NTSB concludes that the captain's response to stick shaker activation should have been automatic, but his improper flight control inputs were inconsistent with his training and were instead consistent with startle and confusion. The NTSB further concludes that the captain did not recognize the stick pusher's action to decrease AOA as a proper step in a stall recovery, and his improper flight control inputs to override the stick pusher exacerbated the situation.

2.2.3.1 Possible Reasons for Failed Recovery Procedures

The captain and the first officer had performed approach-to-stall recoveries multiple times during training at Colgan, with no documented or reported deficiencies. As a result, the NTSB considered possible reasons for the captain's and the first officer's actions during the attempted recovery.

The NTSB evaluated whether the captain responded incorrectly to the stick shaker onset because he was applying corrective techniques that would have been more appropriate for a tailplane stall event. The captain (as well as the first officer) had seen, during initial and recurrent ground school, a NASA-produced icing video that discussed tailplane stalls and recovery techniques.[203] The video indicated that tailplane stalls were most likely to occur with regional and corporate turboprop airplanes[204] and during flight in icing conditions with ice

[202] During the BTV event, the captain's response to the stick shaker was consistent with the company's stall recovery procedures. The captain applied forward pressure on the control column and full power. The airspeed immediately increased, and the stick shaker discontinued.

[203] Colgan personnel did not specify the total number of times that the flight crew would have seen the video during training, but the NTSB estimates that the captain and the first officer would have most likely seen the video four and two times, respectively.

[204] The Q400 was not specifically mentioned as an example of a regional turboprop airplane that was prone to tailplane stalls; the video was produced before the airplane entered service.

present on the horizontal stabilizer. Bombardier, Transport Canada, and the FAA stated during public hearing testimony that the Q400 was not susceptible to tailplane stalls.[205] In addition, Colgan had no written procedure for tailplane stalls and did not include tailplane stall training for the Q400.

The tailplane stall recovery procedure presented in the video called for pulling back on the control column and reducing flaps, which the accident flight crew did. However, the video also stated that tailplane icing symptoms were lightening of the controls, pitch excursions, difficulty in pitch trim, control buffeting, and sudden nose-down pitch, none of which occurred before the stick shaker activation during the accident flight. Further, the activation of the stick shaker was a clear warning of an impending conventional aerodynamic stall and not a tailplane stall, and the change in the IAS numbers to red (which occurred after the airspeed was equal to or below that of the low-speed cue) was a conspicuous signal that was not consistent with a tailplane stall. Also, indications of a tailplane stall, for those airplanes determined to be susceptible, would likely occur at higher airspeeds and/or higher flap deflections.

For a tailplane stall recovery, the captain would have had to interpret the situation, identify the tailplane stall, and apply a recovery procedure that he had never practiced. The CVR showed that he did not verbally identify a tailplane stall, and the FDR showed that he did not fully apply the tailplane stall recovery procedure described in the video. The NTSB concludes that it is unlikely that the captain was deliberately attempting to perform a tailplane stall recovery. The NTSB further concludes that no evidence indicated that the Q400 was susceptible to a tailplane stall. (Tailplane stall training is discussed further in section 2.9.3.)

The NTSB also evaluated why the first officer had raised the flaps without being so directed by the captain. The stick shaker activated within 1 second of the first officer moving the flap handle from 5° to 10°. It is possible that, because of the close timing of these events, the first officer's retraction of the flaps was an attempt to undo her last action. However, after returning the handle to the 5° position, the first officer continued moving the handle to the 0° position.[206] It is also possible that she misinterpreted the event as a tailplane stall, and retracting the flaps to the last position before a tailplane stall was a recommended technique that she had been exposed to while watching the NASA icing video during recurrent ground school less than 1 month before the accident. Also, the absence of standard callouts from the captain impeded the first officer's abilities to coordinate actions to support him. Further, it is possible that she raised the flaps as part of the steps associated with a landing stall recovery profile. However, if that were the case, the first officer failed to make the "positive rate" or "V_{fri}" callouts or confirm that power was set, which were required before raising the flaps. Finally, it is possible that the first officer raised the flaps because she had reverted to her previous general aviation experience; as a certified flight instructor, stall recoveries were not crew-coordinated maneuvers, and the flying pilot raised the flaps incrementally during the recovery.[207]

[205] The testing that was performed to make this determination is described in section 1.17.1.2.

[206] Although each flap handle position has a detent, it is possible to traverse a particular detent quickly (in about 1 second). The FDR flap handle position parameter is sampled every 2 seconds, so the actual time between the positioning of the flap handle in the detents for 5° and 0° is not known.

[207] Section 1.5.2.2 describes the first officer's previous approach-to-stall training.

In addition, the NTSB evaluated why the first officer suggested raising the landing gear. Her suggestion could have been in response to the ambiguous statement made by the captain following his grunting sound about 2216:42 (*ther bear).[208] However, her suggestion occurred about 4 seconds later and not immediately afterward. Another possibility is that the first officer was attempting to provide support to the captain because raising the gear is one of the steps in the stall recovery procedure, but the "gear up" callout was the responsibility of the flying pilot, and the steps that preceded that callout had not been accomplished.

The NTSB concludes that, although the reasons the first officer retracted the flaps and suggested raising the gear could not be determined from the available information, these actions were inconsistent with company stall recovery procedures and training.

2.2.4 Captain's Management of Flight

The captain was responsible for the management of the flight. However, he and the first officer engaged in conversations for much of the flight,[209] starting about 6 minutes 40 seconds after takeoff as the airplane was climbing to 12,000 feet during the ascent to its cruise altitude. (The airplane had reached an altitude of 10,000 feet about 2 minutes before the conversations began.) Although the conversations during cruise flight did not conflict with Federal regulations or company policy, their depth and duration likely contributed to the delayed performance of callouts and checklists.[210] For example, Colgan's Q400 CFM indicated that the cruise checklist should be performed after the airplane attained its assigned cruising altitude,[211] as the flying pilot leveled the airplane and allowed it to accelerate to the maximum operating limit speed minus 10 knots. However, the captain called for the cruise checklist about 2138:47, which was about 2.5 minutes after the airplane had accelerated to cruise speed.

The airplane began descending from its 16,000-foot cruise altitude about 2157:20. Although Colgan's Flight Operations Policies and Procedures Manual stated that approach briefings should generally be accomplished before the top of the descent (when the crew's workload was expected to be minimal), the captain did not start this briefing until 2204:16, as the airplane descended below 12,000 feet.[212] The manual also required a callout by the flying pilot when the airplane was descending through 10,000 feet, but the captain was conducting the approach briefing at that time and omitted the callout.

[208] The asterisk denotes an unintelligible word.

[209] Between the time that the airplane left the gate at EWR and the time that it was cleared for takeoff, 1 hour 33 minutes had elapsed. During the ground time at EWR that was captured by the CVR, the flight crew engaged in lengthy conversations that were not directly related to the operation, which set the tone for the flight.

[210] The captain was also late with a checklist callout earlier in the flight. Colgan's Q400 CFM indicated that the taxi checklist should begin after an airplane leaves the ramp area. However, the captain called for the checklist about 2115:51, which was 45 minutes after the airplane left the ramp area.

[211] The 24-hour ice protection check was performed as part of the cruise checklist.

[212] The captain conducted a complete and accurate approach briefing in accordance with Colgan procedures with the exception of one briefing item. A flight data center notice to airmen had been issued to modify the ILS runway 23 missed approach procedure. Even though the captain should have briefed this information, the flight crew would have received instructions from ATC for the missed approach procedure.

Once the airplane had descended through 10,000 feet (about 2206:37), sterile cockpit procedures, prohibiting nonpertinent conversations within the cockpit, were required. However, the flight crewmembers engaged in a nonpertinent conversation during the final minutes of the descent, which distracted them from their flying duties.[213]

About 2210:23, the first officer asked whether ice was present on the windshield. After a brief exchange between the pilots as they inspected the ice, the captain stated that it was the most ice he had seen on the leading edges in a long time. About 2210:58, the first officer initiated a nonpertinent conversation about her experience flying in icing conditions. The captain participated in this conversation, which continued for a period of about 80 seconds, until it was interrupted by an ATC clearance to descend to 2,300 feet. About 2212:33, after the pilots confirmed the altitude entry in the autopilot and had a brief discussion about the autopilot mode, they resumed their conversation until ATC called 11 seconds later with a heading instruction.

About 2213:01, the captain and the first officer again resumed the conversation for another 15 seconds until the altitude alerter sounded to indicate that the airplane was descending through 3,300 feet. At that point, the captain called for the descent checklist, but Colgan's Q400 CFM stated that the descent checklist was to begin at the top of the descent if the cruise altitude was below 18,000 feet. The captain called for the approach checklist about 11 seconds later, immediately after completion of the descent checklist. However, the CFM stated that this checklist was to be completed before an airplane on an instrument approach transitioned to the initial approach phase, but the accident airplane was at a point inside the initial approach fix at the time of the captain's callout. After the descent and approach checklists were completed, the first officer resumed the conversation until about 2214:09, when another ATC call was received.

The pilots were responsible for performing operational tasks during their 3-minute 11-second nonpertinent conversation. In addition, the conversation followed the first officer's identification of a possible threat to the airplane (ice), but neither pilot took appropriate actions, such as confirming the ice protection system's status or the airspeed targets, to ensure that the threat was mitigated.

As previously stated in section 2.2.2, the captain had the primary responsibility to monitor the instruments, and the first officer was responsible for providing backup to the captain. However, as part of his overall workload management responsibilities, the captain should have been cognizant of the tasks that he requested the first officer to perform and their effect on her ability to reliably provide the expected monitoring and cross-check. As a result, he should have been especially focused on the flight instruments during these periods. However, he did not notice the rising low-speed cue on the IAS display (especially during the 18 seconds before stick shaker activation, when the first officer would have been configuring the airplane for landing), even though the pilots' nonpertinent conversation had ended about 2 minutes before the appearance of the low-speed cue.

[213] About 2207:22, the first officer made the "in-range" call to Colgan operations at BUF. However, according to the company's Flight Operations Policies and Procedures Manual, this call should have been made before leaving cruise flight.

Because of their conversation, the flight crewmembers squandered time and their attention, which were limited resources that should have been used for attending to operational tasks, monitoring, maintaining situational awareness, managing possible threats, and preventing potential errors. As a result, the NTSB concludes that the captain's failure to effectively manage the flight (1) enabled conversation that delayed checklist completion and conflicted with sterile cockpit procedures and (2) created an environment that impeded timely error detection. Additional information on captain leadership and sterile cockpit procedures appears in sections 2.4.1 and 2.4.2, respectively.

2.3 Strategies to Prevent Monitoring Failures

The flight crewmembers failed to monitor the airplane's pitch attitude, power, and especially its airspeed and failed to notice, as part of their monitoring responsibilities, the rising low-speed cue on the IAS display. Multiple strategies can be used to protect against catastrophic outcomes resulting from these and other monitoring failures, including flight crew training, flight deck procedures, and low-airspeed alert systems, which are discussed in sections 2.3.1 through 2.3.3, respectively.

2.3.1 Flight Crew Monitoring Training

The NTSB has long recognized the importance of flight crew monitoring skills in accident prevention. In its 1994 safety study of 37 flight crew-involved major accidents, the NTSB found that, for 31 of these accidents, inadequate monitoring and/or cross-checking had occurred.[214] The study also found that flight crewmembers frequently failed to recognize and effectively draw attention to critical cues that led to the accident sequence, which was further demonstrated by the circumstances of this accident.

As part of its safety study, the NTSB issued Safety Recommendations A-94-3 and -4 to the FAA concerning the need for enhanced training of pilot monitoring skills. The recommendations stated, in part, that the FAA should require Part 121 air carriers to provide line operational simulation training that "allows flightcrews to practice, under realistic conditions, non-flying pilot functions, including monitoring and challenging errors made by other crewmembers" and that the carriers' IOE should include training and experience for check airmen and pilots "in enhancing the monitoring and challenging functions." On January 16, 1996, the NTSB classified these recommendations "Closed—Acceptable Alternate Action" based on the FAA's revised training guidance (AC 120-51B), which emphasized the importance of monitoring.

Another accident involving monitoring failures occurred in February 2005 when a Cessna Citation crashed on approach to Pueblo, Colorado. In its report on the accident (see

[214] For additional information, see National Transportation Safety Board, *A Review of Flightcrew-Involved, Major Accidents of U.S. Carriers, 1978 through 1990*, Safety Study NTSB/SS-94/01 (Washington, DC: NTSB, 1994).

section 1.18.1.4), the NTSB cited the flight crew's "failure to effectively monitor and maintain airspeed" as part of the probable cause and issued Safety Recommendation A-07-13, which asked the FAA to do the following:

> 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.

On May 17, 2007, the FAA stated that it would consider identifying, in its work program, a list of required inspections that would reemphasize, to regional office and FSDO managers, the need to validate the training that was already required and verify its effectiveness. On September 10, 2008, the NTSB stated that such a list would be responsive to the intent of the recommendation as long as the list provided a strong emphasis on the monitoring and workload management components of a CRM program. The NTSB classified the recommendation "Open—Acceptable Response."

The importance of monitoring was referenced in some of Colgan's guidance to its pilots[215] and was discussed and evaluated during simulator training and IOE. However, the company did not provide specific pilot training that emphasized the monitoring function. Further, the company's CRM training did not explicitly address monitoring or provide pilots with techniques and training for improving their monitoring skills.[216]

During public hearing testimony, the NASA-Ames Research Center chief scientist for aerospace human factors stated that people have limited attention and must select from among those features in their environment to direct their attention. Also, distractions and interruptions can increase workload and redirect attention, thus complicating the monitoring task. As a result, effective monitoring requires active effort.

To improve monitoring skills, pilots must proactively seek information and ask questions. The NASA chief scientist testified that current pilot training programs do not typically train these skills in a systematic manner. The NTSB concludes that the monitoring errors made by the accident flight crew demonstrate the continuing need for specific pilot training on active monitoring skills. Almost 3 years have passed since Safety Recommendation A-07-13 was issued, and more than 2.5 years have passed since the FAA described to the NTSB the planned actions to address the recommendation. Since that time, the FAA has reported no further action on this recommendation, even after receiving the NTSB's September 2008 response letter. Therefore, the NTSB reiterates Safety Recommendation A-07-13 and reclassifies it "Open—Unacceptable Response."

[215] The CFM made only minimal reference to the responsibilities of the monitoring pilot during approach profiles.

[216] The company's current training for CRM/threat and error management presents information on the importance of monitoring as a strategy to detect and prevent errors.

2.3.2 Flight Deck Procedures

The FAA has developed guidance on the design of procedures to facilitate pilot monitoring and cross-checking. These procedures are contained in an appendix to AC 120-71A, "Standard Operating Procedures for Flight Deck Crewmembers." The guidance provides examples of and supporting rationale for standard operating procedures that promote monitoring. The guidance also recommends establishing standard operating procedures to support improved monitoring during climb, descent, and approach.

Colgan's standard operating procedures did not include speed targets during approaches; these targets would have facilitated the detection of speed deviations by the monitoring pilot. Colgan also lacked standardized procedures for setting airspeeds and using the ref speeds switch, which did not promote effective cross-checking between airspeeds and the switch's status. (These issues are discussed in section 2.8.) If such procedures had been in place, then the flight crew might have detected the inconsistency between the 118-knot V_{ref} (a non-icing speed) and the position of the ref speeds switch (icing conditions assumed) and ensured that a V_{ref} of 138 knots (an icing speed) was selected. Further, although company procedures required the flying pilot to make a 1,000-foot callout when changing altitudes, the director of flight standards stated that the callout was not required before the altitude alerter sounded. Such a practice can impede monitoring because flight crews may become passive and wait for an automated backup system to prompt their required callout.[217] After the accident, the company introduced the "VVM" (verbalize, verify, and monitor) program to improve flight crew monitoring.[218]

The NTSB concludes that Colgan Air's standard operating procedures at the time of the accident did not promote effective monitoring behavior. The NTSB is concerned that other air carriers' standard operating procedures may also be deficient in this area. Therefore, the NTSB recommends that the FAA require Part 121, 135, and 91K[219] operators to review their standard operating procedures to verify that they are consistent with the flight crew monitoring techniques described in AC 120-71A; if the procedures are found not to be consistent, revise the procedures according to the AC guidance to promote effective monitoring.

2.3.3 Low-Airspeed Alert Systems

The low-speed cue and the stick shaker on the Q400 were intended to warn the pilots of an impending stall. In this case, even though both systems functioned as designed, neither pilot responded appropriately to prevent the stall. Features on the airspeed display, including the indicated airspeed, trend vector, and low-speed cue, should have provided the pilots with adequate time to detect the rising low-speed cue and respond appropriately. However, distraction

[217] This practice, known as primary backup reversion, is characterized by a human operator using an automated backup system as the primary signal to be monitored.

[218] Colgan also discussed the importance of monitoring in its revised CRM/threat and error management course. Also, the company's revised Flight Operations Policies and Procedures Manual reinforced this training by stating that all pilots were expected to "actively demonstrate monitoring and challenging" as a CRM skill during line operations.

[219] Title 14 CFR 91 Subpart K applies to fractional ownership operations.

and workload considerations may have made it difficult for the pilots to visually detect features on the airspeed display depicting the development of this condition (including the trend vector and the low-speed cue), so a redundant aural alert might have provided them with an effective warning about the decreasing airspeed in relation to the rising position of the low-speed cue.

In its report on the October 2002 King Air A100 accident in Eveleth, Minnesota, the NTSB found that the pilots had allowed the airspeed to decrease to dangerously low levels while attempting to execute a nonprecision instrument approach during instrument meteorological conditions. As a result, the airplane entered an aerodynamic stall from which the flight crew did not recover. Because the flight crew failed to recognize that the stall was imminent, the NTSB concluded that the development of and requirement for the installation of a low-airspeed alert system could substantially reduce the number of accidents and incidents involving a flight crew's failure to maintain airspeed.

On December 2, 2003 the NTSB issued Safety Recommendations A-03-53 and -54, which asked the FAA to do the following:

> Convene a panel of aircraft design, aviation operations, and aviation human factors specialists, including representatives from the National Aeronautics and Space Administration, to determine whether a requirement for the installation of low-airspeed alert systems in airplanes engaged in commercial operations under 14 *Code of Federal Regulations* Parts 121 and 135 would be feasible, and submit a report of the panel's findings. (A-03-53)
>
> If the panel requested in Safety Recommendation A-03-53 determines that a requirement for the installation of low-airspeed alert systems in airplanes engaged in commercial operations under 14 *Code of Federal Regulations* Parts 121 and 135 is feasible, establish requirements for low-airspeed alert systems, based on the findings of this panel. (A-03-54)

On October 3, 2006, the FAA stated that it had formed a team to assess the feasibility of low-airspeed alert systems. On April 3, 2007, the NTSB stated it was encouraged that the FAA had formed the team and would begin addressing the recommendation. As a result, the recommendation was classified "Open—Acceptable Response."

During the almost 6 years since the NTSB issued Safety Recommendations A-03-53 and -54, (which were reiterated in July 2006 after another event involving decreasing airspeed and loss of control),[220] accidents and incidents involving a lack of flight crew awareness of decreasing airspeed have continued, indicating that existing stall warnings are not a reliable method for preventing inadvertent hazardous low-speed conditions. The NTSB notes that human

[220] The recommendations were reiterated in a safety recommendation letter addressing an incident involving American Eagle flight 3008, a Saab 340 airplane that experienced a loss of control during icing conditions. The letter also addressed three similar Saab 340 incidents investigated by the Australian Transport Safety Bureau and stated, "if the flight crews had been alerted to the rapid airspeed decrease in a timely fashion, they may have been able to take corrective action and perhaps avoid the stall."

factors concerns associated with a low-airspeed alert do not require more than 6 years of study for a solution to be implemented.[221]

The NTSB notes that several other airplanes certificated under 14 CFR Part 25, including the Boeing 747-400 and 777, provide pilots with an amber band on the airspeed display above the low-speed cue. This amber band typically represents the airspeed between the stall warning speed and the minimum maneuvering speed. Operations are not normally conducted with airspeeds in the amber band, which, in effect, provides pilots with a visual indication of a developing low-speed condition before the onset of the stall warning.

AC 25-11A, "Electronic Flight Displays," discusses the visual design of low-speed awareness cues and states, "the preferred colors to be used are amber or yellow to indicate that the airspeed has decreased below a reference speed that provides adequate maneuver margin, changing to red at the stall warning speed. The speeds at which the low speed awareness bands should start should be chosen as appropriate to the airplane configuration and operational flight regime. For example, low speed awareness cues for approach and landing should be shown starting at V_{ref} with a tolerance of +0 and -5 knots."

The NTSB concludes that the Q400 airspeed indicator lacked low-speed awareness features, such as an amber band above the low-speed cue or airspeed indications that changed to amber as speed decrease toward the low-speed cue, which would have facilitated the flight crew's detection of the developing low-speed situation. Therefore, the NTSB recommends that the FAA require that airspeed indicator display systems on all aircraft certified under 14 CFR Part 25 and equipped with electronic flight instrument systems depict a yellow/amber cautionary band above the low-speed cue or airspeed indicator digits that change from white to yellow/amber as the airspeed approaches the low-speed cue, consistent with AC 25-11A, "Electronic Flight Displays."

At the public hearing for this accident, an FAA certification specialist testified that current certification rules under 14 CFR 25.1329 indicate that there should be speed protection and/or alerting within the normal speed range while under flight guidance system (autopilot) control. The certification specialist stated, "there should be low speed alerting occurring prior to stall warning, if you're under flight guidance system or autopilot control. And that low speed alerting can take many forms, but it needs to be aural and visual."[222]

On July 9, 2009, the FAA issued an NPRM for flight crew alerting, which included a requirement that alerts necessitating immediate crew awareness be presented using two sensory modalities. For example, a visual alert accompanied by an aural alert can help to capture and

[221] After the March 19, 2001, incident involving Comair flight 5054, a low-airspeed alert system was developed for Embraer EMB-120 airplanes. The system was designed to provide pilots with an aural and a visual alert of low airspeed while operating in icing conditions. FAA Airworthiness Directive 2001-20-17, effective October 22, 2001, mandated installation of the system on the EMB-120.

[222] The Q400 was certificated before the amendment to Section 25.1329. AC 25.1329-1B, "Approval of Flight Guidance Systems," states, "standard stall warning and high-speed alerts are not always timely enough for the flight crew to intervene to prevent unacceptable speed excursions during FGS [flight guidance system] operation." The AC also states, "a low speed alert and a transition to the speed protection mode at approximately 1.13 Vsr for the landing flap configuration has been found to be acceptable." In addition, the AC states, "low speed protection alerts should include both an aural and visual component."

focus a pilot's attention in the event that the pilot is not looking at the alerting cue. In this accident, the pilots did not likely see the rising low-speed cue on the IAS display, the downward-pointing trend vector, or the airspeed indications change to red. As a result, the NTSB concludes that an aural warning in advance of the stick shaker would have provided a redundant cue of the visual indication of the rising low-speed cue and might have elicited a timely response from the pilots before the onset of the stick shaker. Therefore, the NTSB recommends that, for all airplanes engaged in commercial operations under 14 CFR Parts 121, 135, and 91K, the FAA require the installation of low-airspeed alert systems that provide pilots with redundant aural and visual warnings of an impending hazardous low-speed condition. Because of the FAA's inactivity with regard to Safety Recommendations A-03-53 and -54, the NTSB classifies the recommendations "Closed—Unacceptable Action/Superseded" and classifies Safety Recommendation A-10-12 "Open—Unacceptable Response."

2.4 Pilot Professionalism

2.4.1 Leadership Training

The captain was responsible for setting the appropriate tone in the cockpit and managing communications and workload in a manner that promoted professionalism and adherence to standard operating procedures. On the basis of his actions during the flight, including the late performance of checklists and callouts because of an ongoing conversation, the captain showed inadequate leadership. His failure to establish the appropriate cockpit tone during the initial stages of the operation and show strong command authority during the flight is disconcerting, especially because he had been a captain for more than 2 years.

In March 1998, the FAA mandated CRM training for all Part 121 operators. CRM training helps facilitate effective crew communication and coordination and the use of available resources to protect against error. The concepts associated with CRM training have been expanded to include techniques for threat and error detection, management, and mitigation. Many operators integrate CRM concepts in their training programs and evaluate CRM skills during simulator training and line observations. Colgan's CRM training included 5 slides (of 45 slides total) that addressed command, leadership, and leadership styles. (Colgan's CRM training is further discussed in section 2.4.3.)

In contrast, Part 121 operators are not required to provide upgrading captains with specific training on the leadership skills necessary to make the transition from SIC to PIC. For many new captains, including the accident captain, the initial upgrade represents the first time in which they are held responsible for leading and managing multiple crewmembers during air carrier operations. Because of the PIC's critical role in establishing and maintaining safe operating conditions, upgrading captains would greatly benefit from specific training on command and leadership skills.

The captain upgraded in October 2007; at that time, Colgan provided to its upgrading captains a 1-day training course on duties and responsibilities. Although the director of crewmember and dispatcher training stated that the course was designed to help a new captain make the transition to the new role, the NTSB's review of the course content showed that it focused on the administrative duties associated with becoming a captain. The upgrade training course did not contain significant content applicable to developing leadership skills, management oversight, and command authority.

Some air carriers provide leadership training to their upgrading captains. For example, one regional air carrier expanded its leadership training, from 2 to 8 hours, so that additional information on leadership skills could be presented. This change was made in response to an unacceptable level of training failures (primarily because of leadership and judgment factors) for upgrading captains.[223] The expanded course contained modules on leadership, authority, and responsibility; briefing and debriefing scenarios; decision-making processes, including those during an emergency; dry-run line-oriented flight scenarios; and risk management and resource utilization.

Industry changes (including two-pilot cockpits and the advent of regional carriers) have resulted in opportunities for pilots to upgrade to captain without having accumulated significant experience as a first officer in a Part 121 operation. Without these important opportunities for mentoring and observational learning, which characterize time spent in journeyman pilot positions, it may be difficult for a pilot to acquire effective leadership skills to manage a multicrew airplane. In addition, airlines must instill their leadership values and safety culture in their captains because they are the ones who are ultimately responsible for the safety of each flight.

At the public hearing for this accident, ALPA's safety committee chairman discussed the need for companies to provide leadership skills to upgrading captains and for captains to set the proper tone in the cockpit. The POI for Colgan stated, during a postaccident interview, that training in this area was important and should be required.

The NTSB concludes that specific leadership training for upgrading captains would help standardize and reinforce the critical command authority skills needed by a PIC during air carrier operations. Some operators are already providing this training, but others are not. Therefore, the NTSB recommends that the FAA issue an AC with guidance on leadership training for upgrading captains at Part 121, 135, and 91K operators, including methods and techniques for effective leadership; professional standards of conduct; strategies for briefing and debriefing; reinforcement and correction skills; and other knowledge, skills, and abilities that are critical for air carrier operations. The NTSB further recommends that the FAA require all Part 121, 135, and 91K operators to provide a specific course on leadership training to their upgrading captains that is consistent with the AC requested in Safety Recommendation A-10-13.

[223] The company's captain upgrade first-time failure rate had reached 22 percent when the target was 10 percent. The company's POI stated that the failures had involved "captain thinking skills" and not "stick and rudder skills." For more information, see the NTSB's report on the Pinnacle Airlines flight 3701 accident (referenced in section 1.18.1.3).

2.4.2 Sterile Cockpit and Standard Operating Procedures

The pilots were involved in nonpertinent conversation during all phases of flight, including those that are defined as critical by the sterile cockpit rule. For example, the pilots' nonpertinent conversation during the final minutes of the descent (which included a discussion of their previous experiences flying in icing conditions) distracted them from their operational tasks. In addition, the pilots deviated from standard operating procedures with the timing of checklists during the descent (as previously discussed in section 2.2.4).

Colgan expected sterile cockpit procedures to be included in a captain's briefing and adhered to during training, checkrides, and line operations. Most company pilots interviewed after the accident stated that sterile cockpit adherence was good and that pilots deviated rarely from sterile cockpit procedures. Company and FAA oversight before the accident did not identify any problems with sterile cockpit adherence, but some deviations were identified after the accident.

Colgan stated that it had provided pilots with information on sterile cockpit procedures during ground school indoctrination training, but a review of all slides presented during the training at the time of the accident found none that specifically addressed sterile cockpit procedures. After the accident, the company revised its training program, and recurrent training now addresses the importance of sterile cockpit procedures. Also, the company's chief pilot issued guidance on sterile cockpit adherence, including a reminder that no extraneous conversation of any kind could take place when sterile cockpit procedures were in effect.[224]

The NTSB is concerned that, during the accident flight, neither pilot seemed hesitant to engage in nonpertinent conversation or demonstrated correcting behavior when the other pilot deviated from sterile cockpit procedures. These facts suggest that nonpertinent conversation among company pilots during critical phases of flight was not unusual.

The primary reason for 14 CFR 121.542, otherwise known as the sterile cockpit rule, is to ensure that a pilot's attention is directed to operational concerns during critical phases of flight and is not redirected or degraded because of nonessential activities or conversation. The NTSB has investigated accidents demonstrating the catastrophic effects of pilot deviations from Section 121.542 and standard operating procedures. For example, in August 2006, the flight crew of Comair flight 5191 attempted to depart from the wrong runway, which resulted in an accident that killed 49 of the 50 people on board. The NTSB determined that the flight crew's nonpertinent conversation during taxi, which resulted in a loss of positional awareness, was a contributing factor to the accident. The NTSB also found that the flight crew's noncompliance with standard operating procedures had most likely created an atmosphere in the cockpit that enabled the crew's errors.[225] Nonpertinent conversation during a critical phase of flight and

[224] In addition to these changes, Colgan incorporated a discussion of accidents and incidents involving sterile cockpit breakdowns to its CRM/threat and error management training. Also, Colgan procedures contained an expanded definition of sterile cockpit periods, including ± 1,000 feet of level-off altitude when making altitude changes and when approaching the top of descent on crossing restrictions and pilot-discretion descents.

[225] For more information, see *Attempted Takeoff From Wrong Runway, Comair Flight 5191, Bombardier CL-600-2B19, N431CA, Lexington, Kentucky, August 27, 2006*, Aircraft Accident Report NTSB/AAR-07-05 (Washington, DC: NTSB, 2007).

noncompliance with standard operating procedures were also issues found during the investigation of the Colgan accident.

Other recent accidents have identified similar issues involving a breakdown in cockpit discipline and noncompliance with the sterile cockpit rule.[226] Although it is difficult to identify a specific reason for this behavior, industry data have shown that pilots who had intentionally deviated from standard operating procedures were three times more likely to make other types of errors, mismanage more errors, and find themselves in more undesirable situations compared with those flight crewmembers who had not intentionally deviated from procedures.[227] Nevertheless, most airline and FAA personnel have stated, after accidents, that no precursors to such deviations were identified during their previous oversight activities. The Q400 APM for Colgan acknowledged that an inspector's observations of flight crew performance might not be representative of the crew's usual performance.

On February 7, 2006, the NTSB issued Safety Recommendation A-06-7, which asked the FAA to direct the POIs of all Part 121 and 135 operators to reemphasize the importance of strict compliance with the sterile cockpit rule. In response to this recommendation, the FAA issued SAFO 06004 on April 28, 2006, to emphasize the importance of sterile cockpit discipline. As a result of the FAA's action, the NTSB classified Safety Recommendation A-06-7 "Closed—Acceptable Action" on November 9, 2006. However, the lasting effect of this SAFO is questionable given that the Comair flight 5191 accident occurred only 4 months after the SAFO was issued and the Colgan accident happened less than 3 years after the SAFO's issuance.

At the public hearing for this accident, an FAA manager stated that the agency has been addressing sterile cockpit issues through, among other actions, published guidance and oversight activities by inspection personnel.[228] The NTSB identified only one FAA AC or handbook—the Instrument Procedures Handbook (FAA-H-8261-1A)—that references an accident involving the lack of sterile cockpit discipline.[229] In addition, this publication does not include information that outlines the origin of the sterile cockpit rule, its rationale, and an explicit discussion of the safety consequences associated with the failure to adhere to sterile cockpit procedures during critical phases of flight.

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[226] These accidents include the Corporate Airlines flight 5966 accident (see section 1.18.1.1) and the Pinnacle Airlines flight 3701 accident (see section 1.18.1.3).

[227] These data are from the LOSA Collaborative, which is a network of researchers, safety professionals, pilots, and airline representatives who collaborate to provide, among other things, oversight and implementation of LOSA and a forum for information exchange regarding LOSA. Deviations from sterile cockpit procedures are among the types of intentional noncompliance that can be detected through LOSA observations. In January 2007, the NTSB issued Safety Recommendation A-07-9 to require Part 121 operators to incorporate LOSA observations into their oversight programs. This recommendation and its status are discussed in section 1.18.1.9. Colgan has begun to implement a LOSA program, as discussed in section 1.17.7.4.

[228] These publications include AC 120-71A, "Standard Operating Procedures for Flight Deck Crewmembers"; AC 120-74A, "Parts 91, 121, 125, and 135 Flightcrew Procedures During Taxi Operations"; AC 120-51E, "Crew Resource Management Training"; and AC 91-73A, "Part 91 and Part 135 Single-Pilot Procedures During Taxi Operations."

[229] The handbook references the September 1974 Eastern Air Lines flight 212 accident, which was caused by the flight crew's lack of altitude awareness at critical points during the approach as a result of poor cockpit discipline. For more information, see National Transportation Safety Board, *Eastern Air Lines, Inc., Douglas DC-9-31, N8984E, Charlotte, North Carolina, September 11, 1974,* Aircraft Accident Report NTSB/AAR-75/09 (Washington, DC: NTSB, 1975).

Also at the public hearing, the Colgan director of flight standards testified that postaccident observations of company pilots revealed only "minor" sterile cockpit deviations, such as an individual pilot remark about something either heard on the radio or seen. The flight standards director stated that, in such instances, the other pilot would not respond to the comment. However, the NTSB recognizes that any nonpertinent remark during critical phases of flight has the potential to be distracting. Multiple opportunities exist during noncritical phases of flight to allow flight crewmembers to communicate, establish trust, and build rapport, but, during critical phases of flight, all conversations need to relate solely to the operation of the flight. These conversations should follow standard operating procedures and include the use of standard phraseology, which are proven tools for safely operating aircraft.

Even though the responsibility for sterile cockpit adherence is ultimately a matter of a pilot's own professional integrity, the NTSB notes that pilots work within a context of professionalism created through the mutual efforts of the FAA, operators, and pilot groups. These stakeholders need to work together to provide clear and unwavering guidance that helps to instill sound principles of professionalism and adherence to standard operating and sterile cockpit procedures. The stakeholders also need to provide detailed guidance on these topics to new commercial pilots as well as instruction and reinforcement on the topics to pilots throughout their career.

On January 23, 2007, the NTSB issued Safety Recommendation A-07-8, which asked the FAA to do the following:

> Work with pilot associations to develop a specific program of education for air carrier pilots that addresses professional standards and their role in ensuring safety of flight. The program should include associated guidance information and references to recent accidents involving pilots acting unprofessionally or not following standard operating procedures.

On April 13, 2007, the FAA stated that it would meet with ALPA, the Air Transport Association, the Regional Airline Association, and other groups to determine an effective approach for addressing these issues. On January 22, 2008, the NTSB stated that the FAA's planned action would be appropriate after the development of an educational program that conveyed the necessary safety information and classified the recommendation "Open—Acceptable Response." However, in the 3 years since the issuance of Safety Recommendation A-07-8, the FAA has not produced guidance material or developed a program that meets the intent of the recommendation.[230]

The NTSB recognizes that most pilots strive to fly professionally and adhere to standard operating and sterile cockpit procedures. However, the continuing failure of some pilots to

[230] In contrast, the FAA has created instructional materials on other aviation safety-related issues. For example, to address the increasing problem of runway incursions, the FAA distributed to all pilots a multimedia presentation and printed guidance on the issue. The presentation addressed runway safety, discussed accidents and operating rules, and offered best practices and techniques. Such an approach could be effective in addressing breakdowns in pilot professionalism and sterile cockpit discipline, especially if examples of accidents are included with standard operating procedures and best practices to help focus attention on the reasons for the standards and the potential results of not following them.

refrain from nonpertinent conversation during critical phases of flight erodes proven margins of safety provided by the strict adherence to standard operating procedures, as demonstrated by the circumstances of this accident.

More than 28 years have elapsed since sterile cockpit rulemaking was enacted based on the NTSB's investigation of the Eastern Air Lines accident and the professional conduct recommendations that resulted from the investigation.[231] However, industry action is still needed to provide all pilots with guidance discussing (1) the importance of following standard operating procedures, adhering to sterile cockpit procedures, and maintaining professionalism during aircraft operations and (2) the costs to safety when pilots do not operate according to these standards.

The NTSB concludes that, because of the continuing number of accidents involving a breakdown in sterile cockpit discipline, collaborative action by the FAA and the aviation industry to promptly address this issue is warranted. Therefore, the NTSB recommends that the FAA (1) develop, and distribute to all pilots, multimedia guidance materials on professionalism in aircraft operations that contain standards of performance for professionalism; best practices for sterile cockpit adherence; techniques for assessing and correcting pilot deviations; examples and scenarios; and a detailed review of accidents involving breakdowns in sterile cockpit and other procedures, including this accident and (2) obtain the input of operators and air carrier and general aviation pilot groups in the development and distribution of these guidance materials. As a result of this new recommendation, and because the FAA has not taken any action in 3 years to address Safety Recommendation A-07-8, the recommendation is reclassified "Closed—Unacceptable Action/Superseded."

2.4.3 Crew Resource Management

Colgan provided CRM training to its pilots during initial and recurrent ground school. The training addressed topics such as command, leadership and leadership styles, communication, and decision-making. The training also included information on the importance of maintaining situational awareness, employing checklist discipline, and adhering to standard operating procedures. A CRM training instructor stated that the course also addressed the relationship between flight crewmembers and the need to indicate when pilots were not observing sterile cockpit procedures. The Colgan POI stated that the company's training was consistent with the guidance discussed in AC 120-51E, "Crew Resource Management Training."

[231] Safety Recommendation A-74-85 asked the FAA to "initiate a movement among the pilots associations to form new professional standards committees and to regenerate old ones. These committees should: a) monitor their ranks for any unprofessional performance, b) alert those pilots who exhibit unprofessionalism to its dangers and try, by example and constructive criticism of performance required, to instill in them the high standards of the pilot group, c) strengthen the copilot's sense of responsibility in adhering to prescribed procedures and safe practices, and d) circulate the pertinent information contained in accident reports to pilots through professional publications so that members can learn from the experience of others." Safety Recommendation A-74-86 asked the FAA to "develop an air carrier pilot program, similar to the general aviation accident prevention program (FAA Order 8000.8A), that will emphasize the dangers of unprofessional performance in all phases of flight. The program could be presented in seminar form, using audio/visual teaching aids, to call to the pilots' attention all facets of the problem." Both recommendations were classified "Closed—Acceptable Action" on March 10, 1977.

Colgan's CRM training should have provided the captain with the communication, coordination, and resource management skills that were important to his role as PIC.[232] However, the captain did not effectively use all of the resources available to him to ensure safety of flight. CRM training should also have provided the first officer with the skills to challenge the captain's deviations from standard operating procedures. The first officer was characterized during postaccident interviews as being assertive, which was consistent with the CRM training that she received. On the basis of the first officer's level of involvement in conversations with the captain, and the apparent ease with which they were communicating, it is unlikely that the first officer's failure to challenge the captain was because of a lack of assertiveness. It is possible that she did not challenge the captain because she did not consider his deviations from standard operating procedures to be remarkable. The NTSB concludes that the flight crewmembers' performance during the flight, including the captain's deviations from standard operating procedures and the first officer's failure to challenge these deviations, was not consistent with the CRM training that they had received or the concepts in the FAA's CRM guidance.

In late 2008, Colgan began the process of revising its CRM training. Even though the training was consistent with the FAA's CRM guidance, the Colgan POI and the company's director of flight operations, vice president of safety and regulatory compliance, and director of crewmember and dispatcher training wanted to expand the program. In developing the revised training, Colgan obtained guidance from Pinnacle Airlines and Continental Airlines.

The expanded CRM training program now spans 2 days (compared with the previous initial and recurrent training programs, which lasted 8 and 2 hours, respectively). The revised CRM program includes techniques for threat and error detection, management, and mitigation and additional discussion of decision-making, leading and following, positively communicating, and setting expectations. In addition, to facilitate discussion, the course is taught by line pilots instead of ground instructors or management. During the summer of 2009, Colgan began providing the revised recurrent CRM training to pilots, dispatchers, flight attendants, and managers at its bases at EWR and IAH.

2.5 Fatigue

Although both pilots had flown during the week before the accident, their schedules were within flight and duty time requirements and were not excessive in terms of accumulated flight time or duty periods worked. However, each pilot made an inappropriate decision to use the crew room to obtain rest before the accident flight, as discussed further in section 2.5.2.

According to his wife, the captain would typically sleep from about 2200 to 0900 and would normally receive between 8 and 10 hours of sleep. (The captain's wife explained that he would awake earlier than 0900 for family activities.) From February 3 to 5, 2009, the captain was working and had a duty period that started about 0500 and ended between 1200 and 1800 each day. The significantly earlier awakening time required for the report times, as well as being

[232] As indicated in section 2.4.1, the NTSB has recommended the implementation of specific leadership training for upgrading captains.

away from home, would have produced some chronic sleep loss. However, the captain would likely have been able to make up for this sleep loss while he was off duty and at home from February 6 to 9.

On February 9, 2009, the captain commuted from his home in the Tampa area to EWR, arriving about 2005 for a 2-day trip to begin the next day. His last known activity on February 9 ended about 2247. The captain was reported to have stayed overnight in the crew room at EWR.

On February 10 and 11, 2009, the captain had a report time of 0530, and his last known activities those days ended between 2130 and 2200. As with his schedule 1 week before, the captain's earlier awakening time required for the report times, and his rest away from home, would have produced some chronic sleep loss.

On the day of the accident, the captain was scheduled to report to EWR at 1330. Because his duty period on February 11, 2009, had ended about 1544, he had a 21-hour, 16-minute scheduled rest period before his report time. However, at 0310 on February 12, the captain logged into Colgan's CrewTrac computer system. This activity would have meant that he had, at a minimum, a 5-hour opportunity for sleep followed by another sleep opportunity of about 4 hours. (The captain had logged into the CrewTrac system again at 0726.) The captain's actual sleep during this period is unknown. However, his sleep would have been further interrupted and would likely have been of poor quality because he was again staying in the crew room.[233] As a result, the captain would not have had an opportunity to restore his sleep loss from the previous 2 days. Also, it would have been difficult for the captain to nap in the crew room during the day based on observations of his activities before the flight (which included office work, watching television, and talking on the telephone or with other company pilots).[234]

According to her husband, the first officer would go to sleep between 2000 and 2200 PST and would awake between 0700 and 1000 PST. On February 4, 2009, the first officer commuted from SEA to EWR because of the 5-day trip that she would be starting later that day. The duty periods during the trip started between 1140 and 1235 (except for the first and last days, which started at 1800 and 0825, respectively) and ended between 2049 and 0032 (except for the last day, which ended at 1455).[235] The times of the trip (shown in eastern standard time) were mostly consistent with the first officer's PST home time zone.[236] However, it was possible that she had accumulated some chronic sleep loss during this period because of the early awakenings required for the report times on both the first day (as a result of her commute) and the last day of the trip, as well as from being away from home.

[233] This investigation found no evidence that the captain had stayed elsewhere that night.

[234] According to Colgan's Flight Operations Policies and Procedures Manual, the company's dispatch release requires each captain to confirm that he or she is "physically qualified for this flight." The manual also stated that, in signing this release, the captain was certifying that he or she is not fatigued and is physically capable of completing the flight safely. The manual further indicated that, although other crewmembers, including first officers, do not sign the dispatch release, it is a violation of company policy for any crewmember to conduct a flight when fatigued or otherwise physically incapable of completing the flight safely.

[235] The 0032 end time occurred in the middle of the trip and not before the 0825 start on the last day of the first officer's trip.

[236] The first officer had moved from ORF (in the eastern time zone) to SEA 1 week before the trip but was likely acclimated to the PST time zone.

The first officer was home from February 9 to the morning of February 11. Her activities each day began between about 0900 and 1000 PST and ended about 2230 PST, which would have facilitated restoration of any sleep debt that she might have been experiencing. From about 1951 to about 2330 PST (0230 eastern standard time), the first officer traveled as a jumpseat passenger on a cargo airplane from SEA to MEM and was reported to have slept 90 minutes during the flight.

On February 12, 2009, from about 0418 to about 0623, the first officer traveled as a jumpseat passenger on a cargo airplane from MEM to EWR and was reported to have slept the entire flight. She was observed awake, and electronic records (telephone, text, and computer) showed activity from the time of her arrival at EWR to about 0732. Afterward, no activities on the part of the first officer were recorded until a text message she sent at 1305.[237]

During the 24 hours that preceded the accident, the first officer was reported to have slept 3.5 hours on flights and 5.5 hours in the crew room. Although the opportunity for sleep approached the first officer's normal needs, her actual amount of sleep obtained is not known. However, even if the first officer did obtain her normal amount of sleep, its quality would have been diminished because of the manner in which it was obtained (on airplanes and in the crew room). It is not known whether she received additional sleep by napping later in the day.[238]

At the time of the accident, the captain would have been awake for at least 15 hours if he had awakened about 0700 and for a longer period if he had awakened earlier. The accident occurred about the same time that the captain's sleep opportunities during the previous days had begun and the time at which he normally went to sleep. The first officer had been awake for about 9 hours at the time of the accident, which was about 3 hours before her normal bedtime. The captain had experienced chronic sleep loss, and both he and the first officer had experienced interrupted and poor-quality sleep during the 24 hours before the accident.

2.5.1 Role of Fatigue in Flight Crew Performance

For fatigue to be considered a factor in the flight crew's performance, deficiencies need to be clearly discernable and consistent with the known effects of fatigue, and any evidence supporting alternative explanations for such deficiencies needs to be considered. Scientific research and accident investigations have demonstrated the negative effects of fatigue on human performance,[239] including reduced alertness and degraded mental and physical performance. For

[237] The content of this text message indicated that the first officer had awakened from 6 hours of sleep.

[238] The first officer's opportunities for sleep at that time were reduced because of the recorded telephone, text, and computer activity throughout the afternoon (see section 1.5.2.1).

[239] For the scientific research, see J.A. Caldwell, "Fatigue in the Aviation Environment: An Overview of the Causes and Effects as Well as Recommended Countermeasures," *Aviation, Space, and Environmental Medicine*, vol. 68, pages 932-938, 1997; D.R. Haslam, "The Military Performance of Soldiers in Sustained Operations," *Aviation, Space, and Environmental Medicine*, vol. 55, pages 216-221, 1984; and G.P. Kruger, "Sustained Work, Fatigue, Sleep Loss, and Performance: A Review of the Issues," *Work and Stress*, vol. 3, pages 129-141, 1989. For the accident investigations, see, for example, the NTSB's 1994 safety study on flight crew-involved major accidents (referenced in section 2.3.1) and its report on the Corporate Airlines flight 5966 accident (referenced in section 1.18.1.1).

example, breakdowns in vigilance can occur, response time can slow and become inaccurate, decision-making and risk assessment can degrade, and motivation can decrease. In addition, task management and prioritization can be affected by fatigue, and some reports have indicated a reduction in leadership behavior with increased fatigue.

The pilots' failure to detect the impending onset of the stick shaker and their improper response to the stick shaker could be consistent with the known effects of fatigue. Workload management issues, as well as some minor errors that occurred during the flight (for example, a delayed response to an altitude alert about 2213:21) could also be consistent with fatigue. However, the research and accident data have shown that the errors made by the flight crewmembers, including their failure to monitor airspeed in relation to the position of the low-speed cue, adhere to standard operating and sterile cockpit procedures, and respond appropriately to the stick shaker, have also been observed in other pilots who were not fatigued.

It is important to note that, throughout the flight, the pilots were conversational and engaged. Neither pilot acted withdrawn or lethargic or made any statements about being tired or receiving inadequate sleep.[240] Also, the pilots demonstrated good performance during the flight by following sterile cockpit procedures during the takeoff and initial climb. Other examples of good performance by the flight crew include (1) the first officer's detection, during her review of the airplane's logbooks, that a previous flight crew had not completed the 24-hour ice protection check (the captain had just completed the check); (2) the captain's interruption of his own conversation to point out crossing traffic; and (3) his continuation of the approach briefing after it was interrupted 50 seconds earlier by an ATC call.

Company pilots had reported that both accident pilots were competent in their positions and adept with procedures and checklists. Also, the first officer had been described as being assertive and ahead of the airplane as a monitoring pilot. Thus, both pilots' performance failures were inconsistent with these reports of their past performance, and, as stated in section 2.5, evidence suggests that both pilots were likely experiencing some degree of fatigue at the time of the accident. However, the errors and decisions made by the pilots cannot be solely attributed to fatigue because of other explanations for their performance. For example, the fundamental monitoring error made by the flight crew (the failure to recognize cues indicating the impending stick shaker onset) was also made 1 month after the accident by another Colgan flight crew. Also, the captain's errors during the flight could be consistent with his pattern of performance failures during testing, which he had experienced throughout his flying career. In addition, research indicates that errors occur routinely during flight regardless of whether fatigue is present and that errors are typically caught and mitigated by existing systems without serious consequences.[241]

[240] Two yawns were recorded on the CVR during a 2-hour period. One was attributed to the captain about 2149:18; the other was attributed to the first officer about 2207:14.

[241] J.R. Klinect, J.A. Wilhelm, and R.L. Helmreich, "Threat and Error Management: Data From Line Operations Safety Audits," *Proceedings of the Tenth International Symposium on Aviation Psychology*, Columbus, Ohio: The Ohio State University, pages 683-688, 1999. M.I. Nikolic and N.B. Sarter, "Flight Deck Disturbance Management: A Simulator Study of Diagnosis and Recovery From Breakdowns in Pilot-Automation Coordination," *Human Factors*, vol. 49, pages 553-563, 2007.

Because the effects of fatigue can exacerbate performance failures, its role in the pilots' performance during the flight cannot be ruled out. The NTSB concludes that the pilots' performance was likely impaired because of fatigue, but the extent of their impairment and the degree to which it contributed to the performance deficiencies that occurred during the flight cannot be conclusively determined.

2.5.2 Industry Fatigue Mitigation Efforts

The NTSB has had a long-standing concern about the need to mitigate the effects of fatigue in aviation. Reducing accidents and incidents caused by human fatigue has been on the NTSB's Most Wanted List since 1990. Also, the NTSB has issued numerous safety recommendations addressing fatigue, including Safety Recommendation A-06-10, which was issued on February 7, 2006, as part of the investigation of the Corporate Airlines flight 5966 accident. Safety Recommendation A-06-10 asked the FAA to do the following:

> Modify and simplify the flight crew hours-of-service regulations to take into consideration factors such as length of duty day, starting time, workload, and other factors shown by recent research, scientific evidence, and current industry experience to affect crew alertness.

On September 9, 2009, the FAA stated that an aviation rulemaking committee had developed recommendations on flight and duty time limitations and rest requirements for Part 121 and 135 operators. The FAA indicated that it was reviewing the recommendations (which have not been publicly released) and that it had planned to publish a science-based fatigue NPRM in December 2009.[242]

On December 10, 2009, in testimony before the Subcommittee on Aviation, U.S. Senate Committee on Commerce, Science, and Transportation, the FAA Administrator stated that the FAA was reviewing the aviation rulemaking committee's recommendations on flight and duty time limitations and rest requirements but that additional analysis needed to be completed, precluding the NPRM from being issued by the end of December 2009. The administrator also stated that the NRPM would be published as soon as possible.

On December 29, 2009, the NTSB stated that the FAA, after years of inaction, appeared to be on the verge of taking the recommended actions with regard to flight time limitations, duty period limits, and rest requirements for Part 121 and 135 pilots. The NTSB noted that the FAA had proposed publishing the NPRM in early 2010 but stated that the FAA had not informed the NTSB of the specific revisions that the NPRM would include. Because the NTSB was not able to determine at that time whether the revisions would fully satisfy the intent of Safety

[242] The FAA's last fatigue-based NPRM was 95-18, "Flight Crewmember Duty Period Limitations, Flight Time Limitations, and Rest Requirements," which was issued on December 20, 1995. The NTSB provided comments on the NPRM, indicating that the proposed rule did not (1) include effective mechanisms to address flight operations during the circadian night and circadian trough and (2) recognize the fatigue associated with multiple takeoffs and landings. No changes in the rules regarding flight time and rest requirements were made after the issuance of the NPRM. On November 23, 2009, the FAA officially withdrew the NPRM.

Recommendation A-06-10, the recommendation remained classified "Open—Unacceptable Response."

One of the stated purposes of SAFO 06004 (previously discussed in sections 1.18.1.1 and 2.4.2) was to "call attention to fatigue as one of the most important elements to be addressed in CRM training." Even though the SAFO recommended that Part 121 directors of safety become familiar with the document's contents, a review of Colgan's CRM course material at the time of the accident showed only a minimal mention of fatigue. The company's director of crewmember and dispatcher training stated that fatigue was discussed as part of a review of situational awareness. Also, Colgan personnel were not able to describe how the company had incorporated the fatigue-related information in the SAFO.

Colgan had a nonpunitive fatigue policy in effect at the time of the accident[243] but did not have a formal fatigue management program in place at the time. (Such a program was still not in place as of January 2010.) After the accident, the company revised its CRM course material to include a specific discussion of fatigue management and the hazards associated with fatigue. Also, in April 2009, Colgan issued an operations bulletin to its pilots addressing the company's fatigue policy, causes of fatigue, recognition of fatigue and its effects on performance, and prevention of fatigue by effectively using rest.[244]

In December 2009, Colgan issued a read-and-sign memo to its pilots and flight attendants, which stated that the company's nonpunitive fatigue policy was being increasingly abused. (As stated in section 1.17.5, the company indicated that crewmembers had been calling in fatigued without a valid reason.) The memo also detailed interim changes to Colgan's fatigue policy. The memo stated that, effective December 31, 2009, fatigue calls would not be accepted if a crewmember was returning from rest periods or personal time off duty (and did not properly use the time off). The memo indicated that the safety department would consider mitigating circumstances preventing a rest period from being fully utilized when evaluating a fatigue call. In addition, the memo stated that the company was working with its pilot and flight attendant unions to establish a comprehensive fatigue program, including a review board process, by February 15, 2010.

At the public hearing for this accident, the FAA manager of air carrier operations stated that fatigue mitigation in aviation was a joint responsibility between the operator and the pilot. He also stated that company fatigue information can help pilots better manage their time off from work. The accident pilots did not wisely manage their time off from work, which contributed to the development of fatigue. In particular, the pilots chose to use the crew room during their rest

[243] The policy allowed pilots to remove themselves from flight status without reprisals if they were too tired to fly. Pilots calling in fatigued would not be paid for that flight segment if it were over their 75-hour monthly guarantee. The company's chief pilot indicated that the company tracked fatigue calls to identify trends but that no consistent factors had been identified. Also, the Colgan POI had not received any complaints about the company's administration of the fatigue policy.

[244] This information has also been incorporated into the Flight Operations Policies and Procedures Manual revision, dated September 20, 2009. In addition, the NTSB notes that ALPA has developed resources for pilots on preventing fatigue, recognizing fatigue symptoms, and mitigating the effects of fatigue.

period, and their quality of sleep was affected by this decision.[245] Although the crew room was supposed to be a quiet area with couches and recliners, it was not isolated and was subject to interruptions, sporadic noise and activity, lights, and other factors that prevent quality rest. As a result, neither pilot made use of the opportunity to obtain quality sleep and be as rested as possible before the flight.

Company personnel stated that sleeping overnight in the crew room was against policy because the room was not an adequate rest facility.[246] However, the captain used the crew room for overnight sleeping on February 9 and 11, which indicates that the company was not effectively enforcing its policy.

In addition, the first officer's decision to begin a transcontinental commute about 15 hours before her scheduled report time without having an adequate rest facility affected her ability to begin the trip as rested as possible. The commute from SEA to MEM and then from MEM to EWR did not afford her an opportunity for an uninterrupted sleep period. Even though the first officer arrived at EWR about 7 hours before her scheduled report time, this time period was less than her normal sleep period, and evidence indicates that she could not have used all of that time for sleep. Company guidance at the time of the accident, however, did not discourage pilots from commuting on the same day that a trip was scheduled to begin.[247]

The company's commuting policy addressed ways to ensure that pilots were able to arrive at their base and report for duty on time (see section 1.17.4), but the policy did not reference ways to mitigate fatigue resulting from commuting. Testimony at the public hearing by ALPA's air safety chairman indicated that Colgan's commuting policy was consistent with industry practices.

Commuting is considered a privilege for air carrier pilots because they are not required to live within a certain distance of their assigned base. Commuting may also be considered a necessity for air carrier pilots because of possible changes in the industry, including base closures, and the cost of living at some bases.[248] To accommodate the need for rest areas when commuting, pilots often have "crash pads" (shared rooms or apartments) at their base if their operator does not provide crew rest facilities for uninterrupted sleep. However, Colgan did not have such a facility at EWR (or its other bases), and neither the captain nor the first officer had a crash pad.[249]

[245] The NTSB notes that strategic napping in crew rooms during breaks is an effective countermeasure for pilot fatigue and that this type of rest would be appropriate use of a crew room. However, the accident captain used the EWR crew room for all of his sleep opportunity before the flight, and the first officer used the crew room for most of her sleep opportunity.

[246] The EWR regional chief pilot issued policy guidance in May 2008 stating that crewmembers were responsible for their own overnight accommodations and that sleeping in the crew room was prohibited and would have disciplinary consequences.

[247] The previous edition of the Colgan Flight Crewmember Policy Handbook (dated February 2006) stated that pilots should not commute to their base on the same day that they are scheduled to work. The handbook version current at the time of the accident was dated March 2008 and did not include this guidance.

[248] Colgan did not have locality pay for its pilots, but its management personnel received locality pay. In 2008, the average salary of a company Q400 captain and first officer was $67,000 and $24,000, respectively.

[249] Colgan does not require such an arrangement for its commuting pilots.

Pilots who commute have a significant responsibility to make sure that they arrive fit for duty and are able to maintain this fitness throughout the duration of their assigned duty period.[250] However, pilots who do not commute also have a responsibility to be fit for duty, and certain circumstances can affect a noncommuting pilot's ability to obtain adequate rest. For example, in its investigation of the Federal Express flight 1478 accident in Tallahassee, Florida, the NTSB found that the captain (who lived close to MEM, the departure airport) had received interrupted sleep[251] during the two nights that preceded the accident because he had been taking care of the family dog, whose health was deteriorating. The captain described his sleep during that time as "marginal" and "not really good." The captain reported that he had received 3.5 hours of "pretty good" sleep before reporting about 0200 for the accident flight. The NTSB concluded that the captain was likely impaired by fatigue and that the impairment contributed to his degraded performance, especially in the areas of crew coordination and monitoring, during the approach to the airport.[252]

The NTSB notes that most pilots are cognizant of their personal responsibility to report to work fit for duty, including having received the proper amount of rest. However, the performance failures that occurred in the Tallahassee accident and this accident demonstrate the negative outcomes that can occur when a pilot fails to obtain adequate rest before a flight. The NTSB concludes that all pilots, including those who commute to their home base of operations, have a personal responsibility to wisely manage their off-duty time and effectively use available rest periods so that they can arrive for work fit for duty; the accident pilots did not do so by using an inappropriate facility during their last rest period before the accident flight.

Companies can take actions to help mitigate fatigue in commuting pilots. Such actions include providing rest facilities, providing assistance to pilots in identifying affordable accommodations, planning flight schedules that support commuting without extended times of wakefulness, and considering ways to evaluate and account for the effect of commuting on subsequent duty periods. With regard to providing rest facilities, the FAA's SAFO 09014, "Concepts for Fatigue Countermeasures in Part 121 and 135 Short-Haul Operations," issued on September 11, 2009, stated that operators "should consider providing crew rest facilities that have rooms away from the general traffic for quiet, comfortable and uninterrupted sleep."[253]

Most of Colgan's EWR-based pilots (93 of 137 pilots) identified themselves as commuters. However, the EWR regional chief pilot stated that he did not know the number of commuting pilots at EWR. This lack of awareness is inconsistent with available information stressing the importance of mitigating hazards associated with crewmember fatigue, including SAFOs 06004 and 09014. The NTSB notes that, although many of the major accidents it has

[250] Air transportation is one mode of transportation that pilots use to commute to their home base. Commuting pilots can also use surface transportation to arrive at their base.

[251] That captain had been released from duty on July 23, 2002, at 2353 and learned of the flight 1478 assignment on July 25 between 1800 and 1830.

[252] For more information, see *Collision With Trees on Final Approach, Federal Express Flight 1478, Boeing 727-232, N497FE, Tallahassee, Florida, July 26, 2002,* Aircraft Accident Report NTSB/AAR-04/02 (Washington, DC: NTSB, 2004).

[253] SAFO 09014 also stated that pilots "should understand their responsibility with regard to ensuring that they achieve the required rest so they are properly rested and fit for each assigned or scheduled flight."

investigated during the last decade involved pilots who commuted, this accident is the first one in which the pilots' rest location has been an issue. Operators have a fundamental responsibility to support their pilots' efforts to mitigate fatigue. However, Colgan did not (1) enforce the policy prohibiting sleeping overnight in the crew room, which was an inappropriate rest facility for uninterrupted sleep, and (2) have in place a formal fatigue management program. The NTSB concludes that Colgan Air did not proactively address the pilot fatigue hazards associated with operations at a predominantly commuter base.

On June 12, 2008, the NTSB issued Safety Recommendations A-08-44 and -45, which asked the FAA to do the following:

> Develop guidance, based on empirical and scientific evidence, for operators to establish fatigue management systems, including information about the content and implementation of these systems. (A-08-44)
>
> Develop and use a methodology that will continually assess the effectiveness of fatigue management systems implemented by operators, including their ability to improve sleep and alertness, mitigate performance errors, and prevent incidents and accidents. (A-08-45)

On August 11, 2008, the FAA noted that, in June 2008, it had hosted an international symposium on fatigue in aviation operations to gather and make public the best available knowledge on fatigue and fatigue mitigations. The FAA also stated that it was developing operations specification guidance for fatigue management for ultra-long-range flights and that lessons learned could likely benefit other flight profiles. On February 3, 2009, the NTSB encouraged the FAA to ensure that guidance on fatigue management systems be developed for all components of the aviation industry and not only for ultra-long-range operations. Safety Recommendations A-08-44 and -45 were classified "Open—Acceptable Response" pending such guidance.

A fatigue management system, also known as an FRMS, incorporates various components and strategies to mitigate the hazards of fatigue in aviation operations. Components of an FRMS include scheduling policies and practices, attendance policies, education, medical screening and treatment, personal responsibility during nonwork periods, task and workload issues, rest environments, commuting policies, and napping policies. An organizational plan for implementing an FRMS and measuring its ability to mitigate fatigue is important to the success of the system.

Many operators are beginning to implement components of an FRMS, and countermeasures to address issues associated with commuting are expected to be part of an FRMS. However, some operators have not adopted an FRMS, and neither FAA guidance nor rulemaking currently exists in this area. As a result, the NTSB concludes that operators have a responsibility to identify risks associated with commuting, implement strategies to mitigate these risks, and ensure that their commuting pilots are fit for duty. Therefore, the NTSB recommends that the FAA require all Part 121, 135, and 91K operators to address fatigue risks associated with commuting, including identifying 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.

2.6 First Officer's Illness Symptoms

According to the first officer's husband and mother, the first officer was not sick when she left home for her commute to EWR. In addition, pilots who spoke with and observed the first officer during her commute and on the ground at EWR reported that she was not showing any symptoms that were consistent with being sick. However, some of the accident pilots' remarks suggest that the first officer was experiencing symptoms associated with congestion or the onset of a head cold. Also, the CVR recorded the first officer sniffling and sneezing multiple times during the flight.[254]

During the ground delay, the first officer stated, "I'm ready to be in the hotel room," to which the captain replied, "I feel bad for you." The first officer continued, "this is one of those times that if I felt like this when I was at home there's no way I would have come all the way out here." She also stated, "if I call in sick now I've got to put myself in a hotel until I feel better … we'll see how … it feels flying. If the pressure's just too much … I could always call in tomorrow at least I'm in a hotel on the company's buck but we'll see. I'm pretty tough."

During the descent, the pilots made some additional remarks regarding the first officer's symptoms. For example, the first officer stated, "might be easier on my ears if we start going down sooner" Afterward, the captain asked the first officer about her ears, and she replied that they were stuffy and popping.

Captains are responsible, as part of their initial crew briefing, for assessing the fitness for duty of other crewmembers and for removing crewmembers from flight status if necessary. The captain did not remove the first officer from flight status or question her remarks, so it is possible that he did not think that her symptoms would affect her performance during the flight.[255] Postaccident toxicology testing on the first officer did not identify the presence of any prescription or over-the-counter medications.

The NTSB attempted to determine whether the first officer's symptoms would have affected her performance during the flight. The sneezing, sniffles, and ear congestion could have directly affected the first officer's performance by interfering with communication. However, the mistakes made during the accident sequence cannot be attributed to her symptoms. It is also difficult to determine the extent of the first officer's symptoms or their indirect effect on her performance. In addition, the NTSB was not able to determine whether the first officer's symptoms contributed to her fatigued condition. Even with her comments about how she was feeling, the first officer did state that she was "pretty tough," and she was conversational and

[254] The first officer's husband stated that she would get sniffles from the cold air but that these sniffles were not symptoms of a cold.

[255] The CVR recorded the captain stating that the first officer could try an over-the-counter herbal supplement, drink orange juice, or take vitamin C.

engaged throughout the flight. As a result, the NTSB concludes that the first officer's illness symptoms did not likely affect her performance directly during the flight.

The NTSB, however, is concerned about the first officer's reluctance to use Colgan's sick policy before the start of the trip. Company pilots were allowed to remove themselves from flight status, without penalty, if they were sick.[256] If the illness began before the beginning of a duty period, then the pilots would be responsible for their own accommodations. (In the first officer's case, she would have needed to pay for a hotel room until she felt well enough to return to duty.) This situation illustrates the need for all commuting pilots to have adequate accommodations, such as shared rooms or apartments, for obtaining rest (or recovering from the onset of an illness) while at their home base and for operators to develop or identify rest facilities for commuting pilots, as stated in Safety Recommendation A-10-16.

2.7 Captain's Disapprovals and Training Problems

The captain had received several disapprovals and had experienced training problems throughout his flying career.[257] In October 1991, the captain was disapproved for his initial instrument airplane rating. The tasks disapproved were partial panel VOR approach, NDB approach, and holding. During training for the instrument rating, a pilot is introduced to the concept of attitude instrument flying (that is, the control of an aircraft's spatial position using instruments inside the cockpit rather than visual references outside the airplane). Instrument training also teaches pilots to use a method known as cross-checking to continuously assess and interpret the performance, control, and navigation of aircraft instruments. This training establishes the foundation, skills, and habits a pilot uses for instrument flying.

All pilots must pass a checkride before a certificate or rating can be issued. Checkride failures are not uncommon and are not necessarily an indication of incompetence.[258] Because the captain's initial instrument rating disapproval happened more than 17 years before the accident, when he had only 125 hours total flight time, this failure was not especially significant. He successfully completed the checkride 3.5 weeks later.

[256] Colgan's sick leave policy, which was adopted in June 2008, requested that pilots notify crew scheduling of a sick call 2 hours before a flight. The vice president of administration stated that, if that were not possible, pilots should not fly but cautioned that repeated events could be counted as a missed trip. Also, if pilots had not accumulated sick time, then they would lose pay for the flight if it would put them over the 75-hour monthly guarantee. (Section 1.17.5 discusses the sick leave earned by company pilots.) In addition, some commuting pilots had been using sick leave when they were bumped from a flight and could not get to work. No evidence indicated that this factor entered into the first officer's decision-making, especially because the company had increased the number of times that a pilot could receive relief from disciplinary actions under the commuting policy.

[257] Even though the first officer was disapproved for her initial flight instructor certificate, the areas that needed to be reexamined pertained to her instructional methods and abilities and not her flying skills. She passed the test and was issued her certificate 5 days later.

[258] FAA statistics for 2008 showed that 10.3 percent of all tested applicants for an additional rating were disapproved, 28.5 percent of all tested applicants for an original commercial certificate were disapproved, and 9.4 percent of all tested applicants for an additional rating on a commercial certificate were disapproved. The 2008 overall failure rate for an original-issue FAA airline transport pilot certificate was 13.1 percent.

In May 2002, the captain was disapproved for his initial commercial single-engine land certificate.[259] The tasks disapproved were takeoffs, landings, go-arounds, and performance maneuvers. The performance maneuvers required skillful control of altitude, heading, bank angle, and airspeed. Failure to pass these tasks on a checkride could indicate poor control of the airplane. After additional training, the captain passed the checkride 5 weeks later. At that time, the captain had accumulated 296 hours total flight time.

In March 2004, the captain was disapproved for his initial commercial multiengine land airplane certificate. The entire checkride needed to be repeated because the captain did not perform enough maneuvers properly to get credit for them on a subsequent checkride. He successfully completed the checkride on his next attempt 3 weeks later. The total number of flight hours that the captain had accrued at that time was not recorded,[260] but his certificate application for the rating showed that he had received 7.1 hours of flight instruction before the test, which is minimal training for a multiengine certificate.

The captain's disapproval for a commercial multiengine land airplane certificate was his third successive failure to pass an initial attempt for an FAA certificate or rating, and it appeared that his performance was not improving as he gained experience. In its September 9, 2005, response to Safety Recommendation A-05-2 (see section 1.18.1.8), the FAA stated that multiple checkride failures showed no correlation with pilots' accident and incident records. However, the captain's established pattern of first-attempt failures might have indicated that he was slow to absorb information, develop skills, and gain mastery or that the training he received was not adequate. This pattern might also have indicated that the captain had difficulty performing required skills while under the stress conditions associated with a checkride.

The captain attended Gulfstream Training Academy from August 2004 to April 2005 and completed initial training at GIA (which was directly associated with the academy) in December 2004. Details from his training records, however, revealed his continuing difficulties with aircraft control. During two simulator periods, he was graded unsatisfactory in "approach to stall – landing configuration." During a later simulator period, he demonstrated unacceptable altitude and airspeed control. During the final planned simulator session, the instructor noted basic attitude flying problems and repeated deviations. Because additional training was required, an extra simulator session occurred the next day. All maneuvers were graded satisfactory at that time. The simulator checkride occurred the same day as the additional training.

The captain's GIA training records clearly showed that his flying skills needed improvement, but he had apparently met the minimum standards required for completion of the training. Thus, he began flying the BE-1900D as a fully qualified first officer. However, the captain's GIA training records should have raised concerns about his suitability for employment at a Part 121 air carrier.

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[259] Standards of execution are higher for a commercial pilot certificate than for a private pilot certificate.

[260] FAA medical records showed the captain reported 300 hours total flight time (with no hours during the previous 6 months) on his medical certificate application dated January 16, 2004. He reported 325 flight hours (with 25 hours accrued during the previous 6 months) on his medical certificate application dated July 27, 2004.

The captain applied to Colgan in August 2005 and was hired the next month. At that time, the captain had 618 total flight hours, 290 of which were accumulated while at GIA in a multiengine airplane. His total number of flight hours met the company's internal policy requirements at the time, which were a minimum of 600 hours total time, including 100 hours of multiengine time.[261] This minimum was typical for new hires at regional airlines at that time.

The Colgan employment application asked the question, "have you ever failed any proficiency check, FAA check ride, IOE or line check?" The captain responded, "yes, FAA check ride for instrument rating. I missed the NDB approach, received additional instruction, then repeated the approach and passed." He did not disclose the two other certificate disapprovals that he had received. At the public hearing for this accident, the company's vice president of administration stated that, if the captain's incomplete answer had previously been known, it would have resulted in his dismissal from the company.[262]

The captain's initial proficiency check at Colgan, as a first officer on the Saab 340, occurred in October 2005. The captain was graded "train to proficiency" for normal and abnormal procedures. This grade indicated that the captain had completed the checkride but needed additional training on normal and abnormal procedures before he would be considered fully successful. Colgan could not provide any further details about this event.

In October 2006, the captain received an unsatisfactory grade on his next flight check, which was his first recurrent proficiency check as a first officer in the Saab 340. The unsatisfactory tasks were rejected takeoffs, general judgment, landings from a circling approach, oral exam, and nonprecision approach. According to company records, the captain attended recurrent training and then completed requalification proficiency training the next month. However, no evidence showed that Colgan considered the captain's performance (as a Saab 340 first officer) to be a concern, even with the problems he demonstrated during the initial and recurrent proficiency checks.

The captain began upgrade training on the Saab 340 in October 2007 and attempted a checkride for an FAA airline transport pilot certificate and type rating later in the month, but he was initially disapproved. The check airman indicated that the captain's airspeed was too slow on a second missed approach while attempting to complete a single-engine ILS approach. After another check airman provided further training for the captain, the original check airman conducted the recheck and approved the captain for the certificate and type rating 3 days later.

Even though the captain had demonstrated problems with the three checkrides he had performed, Colgan was not proactively addressing his training and proficiency issues. For example, the company's director of flight standards stated that he had not tracked the captain in terms of his performance. Also, the company's chief pilot stated that he could not recall talking to anyone at the company about the captain's training record. The chief pilot further stated that

[261] On April 30, 2009, Colgan began requiring newly hired pilots to have a minimum of 1,000 hours total flight time and 100 hours in multiengine aircraft.

[262] The company stated that its current employment policy does not consider pilots with more than one failed checkride.

he was aware of the captain's initial upgrade failure in the Saab 340 and that he told the captain that his next proficiency check needed to be "right on."

The captain had satisfactorily completed recurrent proficiency training in April 2008 and a line check in September 2008, indicating that his mastery of the Saab 340 was improving. The chief pilot approved the captain for Q400 transition training,[263] which he began in October 2008. The captain had satisfactorily completed his line-oriented flight training, IOE, line check, and type rating.[264] However, at the time of the accident, the captain had been flying the Q400 for just over 2 months and thus was still new to the airplane.

Interviews with Colgan instructors revealed that, even though the captain had progressed significantly in terms of his confidence, crew management, and execution of procedures, some of his problems with aircraft control remained. For example, the Q400 simulator instructor stated that, during unusual attitude training, the captain was "very rough" on the controls and had somewhat overcontrolled the roll axis.

The basic concept of attitude instrument flying involves making the proper adjustments to flight and power controls to control aircraft attitude. The NTSB concludes that the captain had not established a good foundation of attitude instrument flying skills early in his career and that his continued weaknesses in basic aircraft control and instrument flying were not identified and adequately addressed.

2.7.1 Remedial Training and Additional Oversight

Because of his continued weaknesses in basic aircraft control and attitude instrument flying, the captain would have been a candidate for remedial training. However, at the time of the accident, the company did not have a formal program for pilots who demonstrated ongoing weaknesses. The company's director of flight standards stated that pilots who were found to be unsatisfactory because of a failed checkride could retrain on the specific failure item and that no further followup would occur if the pilot were found to be satisfactory on the subsequent checkride. This director also stated that, for pilots with multiple unsatisfactory checkrides, he or the flight standards manager would coordinate with the director of crewmember and dispatcher training to assign additional training. (As stated in section 1.17.1.3, Colgan began a formal pilot monitoring program in August 2009.)

Even though the captain had failed two checkrides since beginning work for Colgan (and was graded "train to proficiency" on another checkride), he had received retraining on the specific failure items and then subsequently passed the checkrides. As a result, no additional training or overall review of his skills as a pilot occurred.

[263] The chief pilot stated that the captain's record did not show anything significant that would have prevented him from successfully transitioning to the Q400.

[264] The check airman who conducted the captain's initial proficiency check on the Q400 indicated that he did well on the oral portion of the check and was "well above average" in the simulator. The check airman further stated that the captain completed his transition IOE without difficulty, except that he was somewhat slow in adapting to the flight management system.

During its investigation of the Federal Express flight 647 accident, the NTSB found that the company had an oversight program that identified flight crewmembers with demonstrated performance deficiencies or training failures and provided them with additional oversight and training. The NTSB's report on the accident (see section 1.18.1.7) concluded that such a proactive program would benefit flight safety at other Part 121 carriers. As a result, on May 31, 2005, the NTSB issued Safety Recommendation A-05-14, which asked the FAA to do the following:

> 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.

On April 13, 2007, the FAA stated that it had issued SAFO 06015, "Remedial Training for Part 121 Pilots," on October 27, 2006. The purpose of the SAFO was to promote voluntary implementation of remedial training for pilots with persistent performance deficiencies. The SAFO recognized that many air carriers had voluntarily incorporated remedial training to supplement their approved training programs and that these remedial training programs were effective in addressing and correcting below-standard pilot performance. For air carriers without a voluntary remedial training program, the SAFO recommended implementing a process to identify pilots with persistent performance deficiencies and/or multiple failures during training and checking. The SAFO advised that this process should (1) review the entire performance history of any pilot in question, (2) provide additional remedial training as necessary, and (3) provide additional oversight by the air carrier to ensure that performance deficiencies were effectively addressed and corrected.

On December 12, 2007, the NTSB stated that the FAA needed to survey all Part 121 operators to determine whether they had taken the action recommended in SAFO 06015. Safety Recommendation A-05-14 was classified "Open—Acceptable Alternate Response" pending completion of this survey and demonstration that all Part 121 carriers had programs to address pilot performance deficiencies or failures during training.

On April 23, 2009, the FAA issued Notice 8900.71, which discussed verification of remedial training for Part 121 carriers. The purpose of the notice was to provide guidance to POIs about a required inspection to determine whether their Part 121 carriers were voluntarily complying with SAFO 06015. The notice also instructed the POIs to complete the inspection within 90 days of the date of the notice. During the public hearing for this accident, the POI for Colgan stated that he was not aware of SAFO 06015.

By definition, SAFOs are advisory only, and the decision to implement a SAFO rests with an operator. The NTSB notes that SAFO guidance may be an acceptable alternate response to a safety recommendation if an FAA survey finds that all of the operators have implemented the recommended actions. However, during public hearing testimony, the FAA's manager of air carrier training indicated that he did not know which carriers had complied with SAFO 06015.

On October 30, 2009, the FAA indicated that 29 of the 82 Part 121 carriers and 2 of the 24 Part 121/135 carriers had implemented the actions recommended in SAFO 06015. The total number of Part 121 carriers included 27 regional carriers, 6 of which had implemented the SAFO's recommended actions. On December 10, 2009, the FAA Administrator stated, during his testimony before the U.S. Senate, that two-thirds of the air carriers without advanced qualification programs[265] had systems in place to identify and manage low-time pilots and pilots with persistent performance problems. The administrator also stated that, for those carriers without such systems, additional FAA oversight of their training and qualification programs would be conducted. The FAA's January 27, 2010, fact sheet regarding its "Call to Action" report stated that all air carriers (including the 14 carriers that had advanced qualification programs) had developed remedial training programs for pilots that were consistent with the guidance in SAFO 06015.

The NTSB concludes that 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. Because the NTSB has not determined the extent that air carrier remedial training programs address pilot performance deficiencies and failures during training, the NTSB reiterates Safety Recommendation A-05-14.

2.7.2 Pilot Training Records

During the investigation of this accident, the NTSB found discrepancies between the dates entered into Colgan's electronic training record system and those in the FAA's certificate records. Specifically, the company's records showed that the captain had failed his initial upgrade proficiency check on the Saab 340 on October 3, 2007, received upgrade line-oriented flight training and upgrade simulator training on October 14, received additional simulator training on October 15, and passed his upgrade proficiency check on that same day. However, FAA certificate records showed that the captain failed his initial Saab 340 upgrade proficiency check on October 15 and passed the check on October 18.

Because Colgan used an electronic record-keeping system to maintain training records for pilots, detailed paper training records were destroyed once the information was entered into the system.[266] As a result, the NTSB was not able to reconstruct the actual sequence of events concerning the captain's Saab 340 upgrade proficiency check. Colgan's director of crewmember and dispatcher training stated that the discrepancy between the company's and the FAA's dates was the result of a clerical error. However, a discrepancy also existed within the company. Specifically, the check airman who conducted the captain's two upgrade proficiency checks

[265] An advanced qualification program is a voluntary alternative to the traditional regulatory requirements under Parts 121 and 135 for pilot training and checking.

[266] The NTSB's investigation of a May 2003 accident involving Colgan showed that the company was retaining detailed paper records at that time. (The accident involved a Colgan Saab 340B, N277MJ, and a Dassault DA-50, N664B, at LaGuardia Airport, Flushing, New York. The NTSB determined that the probable cause of the accident was the inadequate visual lookout and inadequate crew coordination of the Dassault DA-50 flight crew while taxiing, which resulted in a ground collision with the taxiing Saab 340B.) Additional information about this accident, NTSB case number NYC03LA114A, is available on the NTSB's website at <http://www.ntsb.gov/ntsb/query.asp>.

stated that the second check was conducted the day after he failed the first check, but the company's electronic records indicated that the second check was conducted 12 days after the failure. These discrepancies in the captain's training records were notable because he had demonstrated previous training difficulties at the company and the events surrounding his upgrade proficiency check warranted further scrutiny.

The company's electronic training record system contained only a basic description of each training event, along with codes for specific items, including the type of airplane, crew position, and instructor name, and a brief statement of any maneuver that was performed unsatisfactorily. If a company manager wanted to reconstruct events from a pilot's training, the manager would need to contact the instructor or check airman who conducted that training. However, interviews with instructors and check airmen who had trained the accident flight crew revealed that some of them could not remember specific details about training events, including the check airman who graded the captain as train to proficiency on his 2005 initial Saab 340 proficiency check and as unsatisfactory on his 2006 recurrent Saab 340 proficiency training. Thus, an air carrier cannot depend solely on the memory of instructors and check airman to identify trends in a pilot's performance.

Colgan's Crewmember and Dispatcher Training Program Manual specified a grading legend to indicate a pilot's performance on each training maneuver.[267] The electronic training record system did not include these grades, even though this information could help company managers determine a pilot's progress during training or events that needed repetitive training. Instructor comments at the time of the training are another source of valuable information regarding a pilot's performance, but such comments were also not included in the company's electronic training record system.

During its investigation of the American Eagle flight 3379 accident, the NTSB was unable to locate instructor comments about the quality of the captain's performance during activities that trained or assessed pilot skills and found that the air carrier's management was unaware of critical aspects of the captain's performance. As a result, on November 15, 1995, the NTSB issued Safety Recommendation A-95-116, which asked the FAA to require all air carriers and their training facilities to maintain pertinent information on the quality of pilot performance. On April 17, 1998, the FAA stated that the inclusion of subjective evaluations by individual instructors, check airmen, or FAA inspectors in a pilot's permanent record might make a training event a punitive experience rather than one in which a pilot could learn from mistakes. On January 3, 2000, the NTSB stated that the FAA had provided a convincing argument about the inappropriateness of subjective information in pilot records and the possibility that pilot training could be negatively affected and classified the recommendation "Closed—Reconsidered."

Detailed paper records of the captain's performance at his previous airline, GIA, were obtained during the investigation. These records provided greater insight into the captain's

[267] Grading was done on a scale of one through four. Grades of one and two indicated that the pilot understood the maneuver and completed it successfully; a grade of one was given when no further training was necessary, and a grade of two was given if further training for retention was necessary. A grade of three indicated that the pilot understood the maneuver but did not complete it satisfactorily and that further training was necessary. A grade of four indicated that the pilot did not understand the maneuver or complete it satisfactorily and that further instruction and explanation was needed before further flight or simulator training.

performance than the records maintained by Colgan. For example, remarks in the captain's training record at GIA included "airspeed 10 knots below Vref," "repeated deviation from altitude 200-300 feet," and "constant deviations up to full scale on glide slope." It is important to note that these remarks were not subjective evaluations (about which the FAA expressed concern in its response to Safety Recommendation A-95-116); rather, these remarks were criteria-based observations that provided an explanation for the captain's unsatisfactory performance and his need for further training in attitude instrument flying.

At the public hearing for this accident, the POI for Colgan stated that, although the company's training records met regulatory requirements, he was concerned about the lack of detailed information in the system. The FAA's manager of air carrier training stated that electronic record-keeping systems, such as the one used by Colgan, were approved individually for each air carrier by its POI and that his branch, which sets FAA policy on training, does not approve "software of that nature as a standalone item." The FAA manager also indicated that the agency did not require training records to be verified or validated but stated that there should be a way to audit and amend records before they appeared in their final format.

The NTSB notes that the use of electronic pilot training records is acceptable as long as the records contain detailed information from which a pilot's performance during training and checking events can be fully determined. However, the NTSB concludes that Colgan Air's electronic pilot training records did not contain sufficient detail for the company or its POI to properly analyze the captain's trend of unsatisfactory performance. Therefore, the NTSB recommends that the FAA require Part 121, 135, and 91K operators to document and retain electronic and/or paper records of pilot training and checking events in sufficient detail so that the carrier and its POI can fully assess a pilot's entire training performance. The NTSB also recommends that the FAA require Part 121, 135, and 91K operators to include the training records requested in Safety Recommendation A-10-17 as part of the remedial training program requested in Safety Recommendation A-05-14. The NTSB further recommends that the FAA require Part 121, 135, and 91K operators to provide the training records requested in Safety Recommendation A-10-17 to hiring employers to fulfill their requirement under PRIA. In addition, the NTSB recommends that the FAA develop a process for verifying, validating, auditing, and amending pilot training records at Part 121, 135, and 91K operators to guarantee the accuracy and completeness of the records.

2.7.3 Pilot Records Improvement Act

Colgan's vice president of administration stated that, as part of a pilot applicant's background check, the company checked the paperwork required by PRIA (see section 1.18.2.1) but that many of the pilots hired by the company did not have previous experience with other airlines, so the information required under PRIA would not be available for them. However, as noted previously, the captain had failed, on three separate occasions, to pass an FAA checkride on his initial attempt. On his application for employment with Colgan, the captain acknowledged only one of the failures. PRIA requirements and FAA guidance (AC 120-68C, "Pilot Records Improvement Act of 1996," dated January 28, 2004) in place at the time that the captain was hired did not require operators to obtain notices of disapproval for flight checks for certificates and ratings.

On January 27, 2005, the NTSB issued Safety Recommendation A-05-1 as a result of the accident involving Air Sunshine flight 527 in Treasure Cay, Great Abaco Island, Bahamas. Safety Recommendation A-05-1 asked the FAA to "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."

On September 9, 2005, the FAA stated that requiring all Part 121 and 135 air carriers to obtain these notices would necessitate FAA rulemaking or a change to the PRIA statute. Instead, the FAA stated it would amend AC 120-68C to indicate that a letter of consent signed by a pilot applicant could be used to authorize the FAA to release records of notices of disapproval for flight checks for certificates and ratings to an air carrier making such a request. On November 3, 2006, the NTSB stated that, because the AC information was not mandatory, the FAA needed to survey operators to determine how many were obtaining airman certification records for their pilot applicants from the FAA so that the effectiveness of the FAA's planned action could be assessed. The NTSB classified this recommendation "Open—Acceptable Alternate Response" pending results from the survey and the revision of AC 120-68C.

On November 7, 2007, the FAA issued AC 120-68D, which contained the following information in bold print:

> A request with a signed consent by the pilot/applicant may be used to authorize the FAA to release records of Notices of Disapproval for flight checks for certificates and ratings to an air carrier making such a request. Air carrier representatives involved in the pre-employment screening process may find this additional information helpful in evaluating the pilot/applicant. These requests, however, are not an integral part of the standard PRIA request process.

At the public hearing for this accident, the FAA's program manager for PRIA stated that air carriers have always had the ability to request records from the FAA beyond those required by PRIA as long as the carriers obtained a signed consent statement from the pilot applicant (as highlighted by the revised AC on PRIA). The program manager stated that he did not know how many air carriers had obtained additional FAA airman certification information for their pilot applicants, but he stated that only one or two air carriers had contacted him for such information. The FAA's manager for air carrier certification also stated that he did not know how many operators were obtaining these data because the survey that the NTSB requested in its November 2006 letter has not been conducted.

The NTSB continues to believe that airman certification information concerning previous notices of disapproval should be included in an air carrier's assessment of the suitability of a pilot applicant. The NTSB also considers notices of disapproval to be safety-related records that must be included in an air carrier's evaluation of a pilot's career progression, along with the detailed training records requested in Safety Recommendations A-10-17 through -20. The revision to AC 120-68 is an interim solution for this safety issue; however, a more permanent action through rulemaking would ensure that air carriers would be required to obtain and evaluate notices of disapprovals for pilot applicants. The NTSB concludes that notices of disapproval need to be considered along with other available information about pilot applicants so that air carriers can fully identify those pilots who have a history of unsatisfactory performance. Because of the FAA's failure to demonstrate voluntary compliance with the advisory information in AC 120-68D, the NTSB reiterates Safety Recommendation A-05-1 and reclassifies it "Open—Unacceptable Response."

In addition, although AC 120-68D had not been issued when the captain was a pilot applicant, Colgan could have still obtained a signed consent statement from him that would have allowed the company to obtain and review his three notices of disapproval. As previously stated, Colgan's vice president of administration indicated that, if the company had known about the captain's complete history of FAA checkride failures, then he would have been dismissed from the company. Also, Colgan did not obtain a signed consent statement from the first officer when she was a pilot applicant, even though she was hired after AC 120-68D had been issued. As a result, the NTSB concludes that Colgan Air did not use all available sources of information on the flight crew's qualifications and previous performance to determine the crew's suitability for work at the company.

2.8 Airspeed Selection Procedures

Bombardier specified procedures for the use of the ref speeds switch in the Q400 AFM, which is an FAA-required document. The AFM's procedures for use of the ref speeds switch were included in a section about ice protection features. As discussed in sections 1.17.2.2 and 2.2.2, the procedures indicated that the ref speeds switch was to be turned to the increase position before entering icing conditions or upon initial detection of icing and was to be turned to the off position when the airplane was aerodynamically clean (that is, all ice was removed from the visible leading edges of the wing and wing tips). For a flaps 15 landing with the ref speeds switch in the increase position, pilots needed to increase airspeeds by 20 knots.

Q400 operators were responsible for developing their own procedures for the use of the ref speeds switch that were consistent with the AFM and approved by the FAA. Colgan's procedures for the Q400 were summarized in its CFM, which provided the normal procedures and checklists for flight crews. However, the only direct or indirect references in the Q400 CFM regarding how and when to use the ref speeds switch were the following:

- In the expanded portion of the after start checklist, which is accomplished before takeoff, a caution note stated, "Ensure the REF SPEEDS switch is set to OFF. If REF SPEEDS switch is set to INCR, the stick shaker may activate on takeoff."
- An item on the expanded portion of the climb checklist was "ice protection – as req'd," with the remark, "make sure de-icing and anti-icing switches are set as required for the ambient conditions."
- An item on the cruise checklist was "24-hr ice protection test – as req'd." (As previously indicated, the ref speeds switch was one of the items to be checked.)

During postaccident interviews, Colgan pilots indicated that they were familiar with the function and operation of the ref speeds switch. However, some company pilots expected to be able to turn off the switch before the approach and landing flight phases, as the airplane descended out of icing conditions. For example, one pilot stated that he had turned the ref speeds switch to the off position after descending out of icing conditions but had planned to "mentally" add 20 knots to the airspeed if ice had resumed on final approach. The captain of the BTV stick shaker event stated that she had briefed the landing speeds based on the expectation that the ref speeds switch would be turned to the off position before the beginning of the approach, but she had forgotten to turn the switch to off, and the first officer had not noticed the position of the switch.

Even though the ref speeds switch is relatively uncommon among air carrier airplanes,[268] it is still important for the switch to be properly matched to the airspeed bugs on those airplanes with the switch installed. In the Q400, airspeed bugs are set by pilots using a rotary knob on their outboard forward panel. Two bugs are available for landing, but the AFM does not require their use or specify how they should be set.

The NTSB found that Q400 operators used different bug speeds for landing. One operator, which had operated the airplane for 10 years, instructed its pilots to set the two available bugs to V_{ref} and $V_{ref\ (ice)}$ for every approach to prevent confusion or the need to reset bugs during an approach if conditions were to change. Another operator, whose director of flight operations was previously a Q400 certification test pilot, had its pilots set the landing bugs to V_{ref} and V_{ga} partly because landings accomplished with the higher (icing) reference speed were rare. This operator found that, even when operating during wintertime in a northern climate, most conditions at 1,000 feet agl were such that the landing could be conducted at normal reference speeds.

Colgan chose to have its pilots set either V_{ref} or $V_{ref\ (ice)}$ and V_{ga} as the landing bugs. If V_{ref} had been set and icing conditions were encountered, or if $V_{ref\ (ice)}$ had been set and the airplane was no longer in icing conditions, each pilot was expected to manually reset the airspeeds.

Colgan's guidance on setting landing bugs was contained in the CFM expanded approach checklist. The guidance indicated that pilots were to determine the landing weight and airspeeds and then set the solid blue bug to V_{ref} or $V_{ref\ (ice)}$ and the open blue bug to V_{ga}. Both flight crewmembers were to verify this action by responding "set." This procedure did not mention cross-referencing the airspeed bug settings with the ref speeds switch position (which are independent of each other) and did not include information about the early stall warning that could result from setting normal V_{ref} speeds with the ref speeds switch in the increase position.

After the accident, Colgan issued two operations bulletins pertaining to the ref speeds switch and airspeed settings.[269] The first bulletin, 09-001, included two warnings and two cautions under the heading, "ref speeds switch." The warnings prohibited (1) moving the ref

[268] The NTSB is not aware of any air carrier airplanes that have a ref speeds switch besides the Q400, which is operated by two other U.S air carriers in addition to Colgan.

[269] The first bulletin was issued before the BTV event, and the second one was issued after the event.

speeds switch to the increase position below 1,000 feet agl during takeoff and (2) changing the position of the ref speeds switch below 1,000 feet agl during landing. The cautions indicated that (1) if airspeed is within 20 knots of the low-speed cue, then the airspeed must be increased before the ref speeds switch is selected to the increase position, or a stall warning might occur, and (2) if V_{ref} is used for landing, then the ref speeds switch must be selected to the off position, or a stall warning might occur at an airspeed higher than V_{ref}. The bulletin also added a specific response to any ice protection system checklist item and required both flight crewmembers to respond, and it reiterated the proper icing terminology to use with the ACARS system ("icing" or "eice")[270] to ensure that the proper ice speeds were received (from AeroData) for V_{ref} and V_{ga}.

The second bulletin, 09-003, added a specific line item to the approach checklist, "ref speeds switch – as req'd," with both crewmembers responding. It also provided guidance to flight crews, including a requirement to decide on the position of the switch before the initial approach phase, a prohibition against changing the switch position below 1,000 feet agl, a requirement to use only $V_{ref\ (ice)}$ and $V_{ga\ (ice)}$ with the ref speeds switch set to the increase position, and a statement that the speed bugs could be reset to V_{ref} and V_{ga} if the ref speeds switch was turned to the off position above 1,000 feet agl. A reference to the switch was added to the takeoff profile, and the approach profiles were changed to require a minimum airspeed of 180 knots before lowering the landing gear.

Colgan's flight crew training on the use of the ref speeds switch was incorporated into its ground school curriculum. An examination of the company's slides used during Q400 initial training showed that the function of the ref speeds switch was described in the module on the ice and rain protection system. However, the actual use of the ref speeds switch was not included in the modules on AeroData, ACARS, line-oriented flight training, situational awareness and safety, or winter operations.[271]

Colgan's training manual, which contained the syllabus for Q400 upgrade and transition training, did not specifically mention the ref speeds switch in ground school subject matter sections, including the one on ice and rain protection. Also, the simulator training modules described in the manual made no direct reference to the use of the ref speeds switch. Thus, it is unlikely that crews were appropriately trained on the use the ref speeds switch, especially during simulator training, when it is important for pilots to demonstrate an understanding of the need to match the approach speed bug settings to the position of the ref speed switch.

The NTSB acknowledges Colgan's efforts after the accident to educate its flight crews, through CFM operations bulletins, about the relationship between the ref speeds switch and airspeed bug settings. However, training in this area would further emphasize this relationship. The NTSB concludes that Colgan Air's procedures and training at the time of the accident did not specifically require flight crews to cross-check the approach speed bug settings in relation to

[270] Before the accident, the CFM showed these terms, which could be used in the optional remarks field of the landing condition screen, but the manual did not elaborate on the effect that the entries would have on the airspeed and landing distances received. Also, the CFM did not mention the need to cross-reference the position of the ref speeds switch when requesting landing performance data using either of the terms.

[271] Colgan's ground school training included slides on ACARS and winter operations. However, specific information about entering icing terminology into ACARS and the relationship of these entries to the stall warning and the ref speeds switch were not discussed.

the ref speeds switch position; such awareness is important because a mismatch between the bugs and the switch could lead to an early stall warning. Therefore, the NTSB recommends that the FAA direct Part 121, 135, and 91K operators of airplanes equipped with a ref speeds switch or similar device to (1) develop procedures to establish that, during approach and landing, airspeed reference bugs are always matched to the position of the switch and (2) implement specific training to ensure that pilots demonstrate proficiency in this area.

2.9 Stall Training

During training for private and commercial certificates, pilots perform recoveries from fully developed stalls. Even though these stall recoveries are typically accomplished in small trainer-type airplanes, the sensations and lessons from this training usually remain with a pilot. However, as pilots transition to larger, autopilot-equipped, transport-category airplanes, they rarely, if ever, receive reinforcement of how actual stalls feel and how they are to be handled because air carrier training does not require pilots to practice recoveries from fully developed stalls.

The airline transport pilot practical test standards provide explicit guidance regarding how airline pilots should enter, induce, and recover from an impending stall (known as an approach to stall) but not a full aerodynamic stall. The approach-to-stall maneuvers require strict adherence to precise airspeed, altitude, and heading control and continuous smooth positive control. Colgan's training manual referenced the practical test standards in its procedures for stall training, and training records indicated that the accident pilots had met these standards during their Q400 training.[272]

The practical test standards 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 an appropriate method for determining if a pilot can recognize and properly respond to a fully developed stall. Once a stall has occurred, an airplane cannot be recovered until the wing's AOA is reduced, which will necessitate a loss of altitude. At stall AOAs, drag is high, and the thrust available may not be sufficient to overcome the drag. The nose of the airplane must be pitched down using the elevators. The amount of altitude loss during the recovery depends on several variables, including how slow the airplane is flying and how quickly the airplane is pitched down. Section 2.6.3.1 of the *Airplane Upset Recovery Training Aid* states, "to recover from a stall, angle of attack must be reduced below the stalling angle—apply nose down pitch control and maintain it until stall recovery."

Current air carrier training emphasizes the need to maintain altitude through the use of power during a stall recovery, and most turbine-powered aircraft can be flown nearly to a stall and recovered primarily with the application of full power (and pitch control inputs as required

[272] The captain's stall training at GIA was consistent with the training that he received at Colgan. The BE-1900 AFM contained a warning to avoid the pitch excursions that can happen as power is increased during an approach-to-stall recovery. The stall profiles for the clean, takeoff, and landing configurations included the following comment: "With stall warning indication the aircraft will have approximately 10° nose up pitch. During recovery DO NOT lower or allow the nose to fall. Allow the aircraft to fly out of the stall."

to counter any power-induced pitch changes). Colgan Q400 pilots indicated that, with approach-to-stall recoveries, the application of full power would typically require some nose-down pressure on the control column but that little change in pitch was required. The pilots stated that they were trained to use a balance of forward and aft column pressure to obtain the desired pitch during a recovery (rather than use a pronounced push forward) so that the airplane could regain a flying AOA and airspeed.[273]

Even though air carrier pilots are trained to use power to maintain altitude during approach-to-stall recoveries, positive nose-down control force is the necessary first step that a pilot must take once an actual aerodynamic stall has occurred. Because the application of power by itself will not recover a stalled airplane, approach-to-stall training may negatively affect a pilot's actions if a full stall were to develop. Although the accident captain responded as trained when he applied power in an apparent attempt to maintain altitude, he did not apply full power (the engine power levers were advanced to about 70°, but the rating detent was 80°), and he responded inappropriately to the stall warning by applying back pressure on the control column.

The NTSB identified three possible reasons related to Colgan's Q400 approach-to-stall simulator training to explain why he was apparently startled and confused by the stall warning. First, Colgan's simulator training did not include the use of the ref speeds switch set to the increase position. Thus, the training had not prepared the flight crew to recognize the early activation of the stick shaker as a result of the ref speeds switch being set to the increase position. Second, the simulator training was performed as a preplanned proficiency maneuver (the approach-to-stall maneuvers to be performed are well known by pilots in advance of their training) rather than as a maneuver with an element of surprise. However, a fully developed stall is an unplanned, emergency situation in which the airplane's nose must be pushed down to reduce the AOA. Third, the simulator training was hand flown by pilots. During the accident flight, the autopilot had been engaged until the onset of the stick shaker, at which time the autopilot disconnected automatically. Although autopilot disconnect needs to occur for a stall recovery maneuver to be accomplished, the captain (and the first officer) had not been trained to experience the sudden transition from automated to manual flight with an active stall warning.

The NTSB has investigated other accidents in which pilots applied inappropriate nose-up pitch control inputs during an attempted stall recovery. For example, on October 14, 2004, Pinnacle Airlines flight 3701, a Bombardier CRJ-200, was on a repositioning flight when the airplane stalled at 41,000 feet. FDR data showed that the flight crew moved the control column aft after the first stick shaker activation and moved the column aft with increasing magnitude after three subsequent activations of the stick pusher.[274]

[273] During Q400 simulator observations, the NTSB found that initial nose-up pitch attitudes of 7° to 10° were needed to recover from approaches to stalls with a minimal altitude loss compared with the greater nose-down pitch attitudes that are typically needed for stall recoveries in small trainer-type aircraft with the minimal loss of altitude appropriate for the airplane.

[274] FDR data showed that the stick shaker activated five times and that the stick pusher activated four times.

Also, on December 22, 1996, an Airborne Express DC-8-63 was on a postmodification functional evaluation flight when it crashed in Narrows, Virginia.[275] The flight crew failed to apply positive nose-down control inputs in response to a stall at 14,000 feet. (The stall protection system was inoperative during the flight.) After the airplane stalled, the crew applied power to recover but did not establish nose-down control inputs.

Another such accident involved West Caribbean Airways flight 708, an MD-82, near Machiques, Venezuela, on August 16, 2005. FDR data showed that the horizontal stabilizer reached its full nose-up position as the airplane descended from 31,000 feet. The CVR recorded the aural warning "stall, stall" and the continuous sound of the stick shaker for 1 minute 46 seconds before impact.[276]

The NTSB has continued to advocate for flight crew training in the post-stall flight regime because of multiple accidents in which flight crews did not apply appropriate recovery procedures. For example, in a letter dated May 7, 2009, the NTSB commented on an NPRM titled, "Qualification, Service, and Use of Crewmembers and Aircraft Dispatchers," which proposed to amend the regulations for training programs for flight and cabin crewmembers and dispatchers. The NTSB indicated that stall recovery training should go beyond approaches to stall to include recoveries from a full stall condition and that available flight data from flight tests, accidents, and incidents should be used to model stall behavior to facilitate training beyond the initial stall warning.

If the approach-to-stall training that the flight crew received had been properly applied, then the crew should have recovered the airplane from the stall warning and the pitch excursion. However, the NTSB concludes that the current air carrier approach-to-stall training did not fully prepare the flight crew for an unexpected stall in the Q400 and did not address the actions that are needed to recover from a fully developed stall. Therefore, the NTSB recommends that the FAA require Part 121, 135, and 91K operators and Part 142 training centers 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.

2.9.1 Stick Pusher Training

The NTSB has investigated prior accidents in which pilots have responded incorrectly to the stick pusher. As previously indicated, the NTSB found that the flight crew of Pinnacle Airlines flight 3701 had responded to the stick pusher activations by pulling back on the control column, which caused the airplane to enter an aerodynamic stall. As a result, the NTSB issued Safety Recommendation A-07-4, which asked the FAA to do the following: [277]

[275] During the flight, a stall series was being performed to verify that the airspeeds at which the airplane experienced stick shaker activation and stall indication were in accordance with precalculated values for the airplane.

[276] The investigation of this accident is being conducted by the Comite de Investigación de Accidentes Aéreos of Venezuela.

[277] The NTSB notes that it issued a related safety recommendation, A-94-173, to the FAA after the United Express flight 6291 accident. This recommendation is discussed in section 1.18.1.6.

> Convene a multidisciplinary panel of operational, training, and human factors specialists to study and submit a report on methods to improve flight crew familiarity with and response to stick pusher systems, and, if warranted, establish training requirements for stick pusher-equipped airplanes based on the findings of this panel.

On April 13, 2007, the FAA stated that it planned to ask the working group that developed the *Airplane Upset Recovery Training Aid* to reconvene and develop materials for this issue. On January 22, 2008, the NTSB classified this recommendation "Open—Acceptable Response."

In November 2008, the revised *Airplane Upset Recovery Training Aid* was published. However, the revised guidance does not explicitly address the need for, or methods to accomplish, stick pusher familiarization training. The NTSB is 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. In addition, the FAA has not taken any other actions to meet the intent of Safety Recommendation A-07-4.

During the public hearing for this accident, a Bombardier test pilot stated that company pilots receive a stick pusher demonstration during training because pilots need to see and experience the tactile feel associated with the pusher's operation. Also, a NASA research scientist remarked that such training would help make the stick pusher's operation "somewhat less astonishing" if the pusher were to activate during flight, which could help in a situation similar to the one faced by the accident flight crew. The NTSB recognizes, however, that pusher familiarization training needs to be done correctly and provided in a context that does not lead to negative training.

When he flew the Saab 340, the captain received exposure to the stick pusher during ground checks before the first flight of the day,[278] and, as indicated in section 2.2.3, he might have received simulator training on the pusher. However, stick pusher training was not consistently provided to Colgan's Q400 pilots, and a check airman stated that about 75 percent of pilots who were shown the pusher in the simulator would try to recover by overriding the pusher. After the accident, the company implemented stick pusher familiarization training for its fleets.

The NTSB concludes that the circumstances of this and other accidents in which pilots have responded incorrectly to the stick pusher demonstrate the continuing need to train pilots on the actions of the stick pusher during flight and the airplane's initial response to the pusher. Therefore, the NTSB recommends that the FAA require all Part 121, 135, and 91K operators of stick pusher-equipped aircraft to provide their pilots with pusher familiarization simulator training. In addition, because the *Airplane Upset Recovery Training Aid* published in 2008 did not address the intent of Safety Recommendation A-07-4 and no other FAA action has met the

[278] First-flight-of-the-day checks are not substitutes for stick pusher familiarization training in a simulator. In addition, there may be negative transfer during these checks because of a tendency for pilots to hold some pressure against the pusher.

recommendation's intent, Safety Recommendation A-07-4 is reclassified "Closed—Unacceptable Action/Superseded."

2.9.2 Simulator Fidelity

Flight training simulators contain computer-coded aerodynamic, engine, flight control, and other models to calculate the forces and moments on the airplane, which are then used to simulate the airplane's motion. The FAA's acceptance of flight training simulator devices had been guided by AC 120-40B, "Airplane Simulator Qualification," until May 30, 2008, when 14 CFR Part 60 became effective. Part 60 governs the initial and continuing qualification and use of flight simulation training devices and outlines the maneuvers and the tolerances to be used when comparing simulators and flight test time history data. According to Part 60, approval of full flight simulators (levels A through D) depends on passing a series of objective tests that compare the response of the simulator with the response of an airplane during a flight test.

Part 60 applies more rigorous standards for all flight simulators than those described in AC 120-40B. For example, the regulation requires that full flight simulator stall characteristics be tested "for full stall and initiation of recovery." One of the simulator tests, "Stall Characteristics," states the following requirement, which must be met during the second segment climb, approach, or landing configuration:

> Time histories data must be recorded for full stall and initiation of recovery. The stall warning signal must occur in the proper relation to buffet/stall … FFSs [full flight simulators] of airplanes exhibiting a sudden pitch attitude change or 'g break' must demonstrate this characteristic.

The NTSB notes that the stall fidelity testing required under Part 60 is a significant improvement compared with the testing under AC 120-40B, which required only that the stall warning signal occur in the proper relation to stall. However, the NTSB also notes that Part 60 contains no bank tolerance requirement for speeds below stick shaker, no pitch tolerance requirement for any speed, and no requirements to address power-on or turning flight stalls.[279] In addition, because Part 60 applies only to simulators qualified after May 30, 2008, most training simulators currently in operation may not meet the regulation's requirements.

Flight crew training on full stalls and recoveries had 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, the NTSB believes that advances in technology can allow post-stall aircraft behavior to be modeled in simulators.

In the late 1990s, a government/industry commercial aviation safety team found that loss of control was among the top three causes of all worldwide fatal commercial aircraft accidents and was the second highest cause of passenger fatalities between 1988 and 1997. In its final

[279] The Part 60 requirements for stall characteristics are based on idle power, wings-level stalls at deceleration entry rates of 1 knot or less per second.

report, the team identified several intervention strategies to reduce loss-of-control accidents,[280] including the following:

> To mandate stall recognition and recovery training, regulators must modify the appropriate regulations.
>
> Airlines/operators should develop and implement a ground school and simulator training program to train pilots to handle post stall recovery as part of advanced maneuver training.
>
> Regulators should mandate the implementation of a ground school and simulator training program to train pilots to handle post stall recovery as part of advanced maneuver training.

The team's final report also noted, "several of the interventions address the need for upset recovery, stall and post-stall recovery training. To accomplish this training, improved aerodynamic modeling near the limits of the flight envelope (high angles of attack and/or sideslip)[281] is necessary for appropriate simulator fidelity."

In response to this work, NASA, along with Boeing, conducted a study beginning in the late 1990s to increase simulator model fidelity beyond the data envelope that existed at the time. This study used rotary balance and conventional wind tunnels to develop an aerodynamic model for the higher AOA and sideslip ranges that are required to simulate stall upsets in large transport-category airplanes. This enhanced upset recovery aerodynamic model was validated using certification flight test maneuver data, including stalls, and accident data. NASA and Boeing reported that simulations involving the enhanced upset recovery aerodynamic model were able to reasonably reproduce the results of stall flight tests, unlike the baseline simulation used in flight training at the time.

According to a 2005 paper that summarized findings from the NASA and Boeing study, this research demonstrated that simulation fidelity could be significantly improved and that the useful data envelope for upset training could be expanded. The paper concluded, "results from NASA/Boeing research conducted to date have led to a recommendation to re-examine the potential uses of simulators that are specifically designed for upset training. This research has demonstrated that simulation fidelity can be significantly improved such that the useful envelope for upset training may be expanded."[282]

Similarly, a 2009 paper on aerodynamic modeling for upset training concluded the following:

[280] Joint Safety Analysis Team, Loss of Control, Commercial Aviation Safety Team Approved Final Report, December 15, 2000.

[281] Sideslip is the lateral angle between the longitudinal axis of the airplane and the direction of motion (flightpath or relative wind). Sideslip is normally produced by rudder forces, yawing motion resulting from asymmetrical thrust, or lateral gusts.

[282] J.V. Foster, K. Cunningham, et al., "Dynamics Modeling and Simulation of Large Transport Airplanes in Upset Conditions," American Institute of Aeronautics and Astronautics, Report No. AIAA-2005-5933, 2005.

> Much work has been performed in the modeling and simulation of flight dynamics in 'extreme' conditions. Through this work, a process has been established that yields [a] model that [has] very good predictive capability and subsequent correlation with flight test data. Although most of the work in this area has focused on highly maneuverable military aircraft, the concepts for data collection and reduction are well suited for use in the civil arena, as was proven during two effort[s] sponsored by NASA in the past decade.[283]

In June 2009, the Royal Aeronautical Society[284] hosted a flight simulation conference, titled "Flight Simulation: Towards the Edge of the Envelope." Participants at the conference discussed the need for upset recovery training, training strategies, the role of motion cues in upset recovery training,[285] and aerodynamic modeling for upset recovery training. The aerodynamic modeling presentations indicated that extended envelope modeling (higher AOA and sideslip data ranges) was now possible for civil aircraft simulators and pointed out that military aircraft simulators already included such modeling.[286]

Also, a paper presented at the flight simulator conference indicated that Boeing was testing a higher-data-range simulator that incorporated lessons learned from the NASA and Boeing study.[287] According to the paper, several pilots who were tested in this higher-data-range simulator were typically able to complete upset training maneuvers without exceeding the simulator's validated flight envelope. Boeing's testing, however, did not evaluate pilot performance in upset recoveries with fully developed stall scenarios.

The NTSB notes that among the contributing causes to the Airborne Express/Narrows accident (previously discussed in section 2.9) was the company's DC-8 flight training simulator's inadequate fidelity in reproducing the airplane's stall characteristics. Specifically, the stalls practiced by the flight crew in the training simulator resulted in a high sink rate at a nose-high attitude without the large roll excursions and uncommanded pitch-down experienced by the accident airplane. As a result, on July 29, 1997, the NTSB issued Safety Recommendation A-97-47, which asked the FAA to do the following:

> Evaluate the data available in the stall characteristics of airplanes used in air carrier service and, if appropriate, require the manufacturers and operators of flight simulators used in air carrier pilot training to improve the fidelity of these

[283] D.R. Gingras and J.N. Ralston, "Aerodynamic Modeling for Training on the Edge," *Proceedings of the Spring 2009 Flight Simulation Conference*, Royal Aeronautical Society, 2009.

[284] According to its website, the Royal Aeronautical Society, headquartered in London, England, is a multidisciplinary professional institution dedicated to the global aerospace community.

[285] Higher-level flight simulators consist of a simulated cab on a motion platform to provide pilots with onset motion cues. Such cues provide a vestibular/kinetic sense of the aircraft's motion, which is coupled with the motion of the visual scene.

[286] As a result of the conference, the Royal Aeronautical Society chartered an international committee for aviation training in extended flight envelopes. The committee's goals are to define best practices for upset recovery, training scenarios for these best upset recovery practices, and methods to validate simulator responses in training these scenarios.

[287] David C. Carbaugh, Robert A. Curnutt, et al., "Simulator Upset Recovery Training," *Proceedings of the Spring 2009 Flight Simulation Conference*, Royal Aeronautical Society, 2009.

simulators in reproducing the stall characteristics of the airplanes they represent to the maximum extent that is practical; then add training in recovery from stalls with pitch attitudes at or below the horizon to the special events training programs of air carriers.

On June 9, 1999, the FAA stated that an aircraft in an aerodynamic stall might handle and perform differently than the programming in the simulator might indicate for an identical circumstance and that the acquisition of data in this flight condition would have questionable accuracy and would be costly and dangerous to acquire. On November 19, 1999, the NTSB stated that the ability of simulators to replicate an airplane's actions in some stall and stall recovery regimes could be improved and that the FAA's lack of action to improve simulator fidelity in reproducing stall characteristics was disappointing. As a result, Safety Recommendation A-97-47 was classified "Closed—Unacceptable Action."

As previously discussed, advances in post-stall modeling have occurred since the FAA's June 1999 response to Safety Recommendation A-97-47. However, during this and other accidents (including the Airborne Express/Narrows and the West Caribbean Airways flight 708 accidents), the pilots did not apply appropriate recovery controls after the airplane entered a sustained stall,[288] and the AOA might have exceeded the AOA validated for the full stall and initiation of recovery required by Part 60. In addition, statistics from the government/industry commercial aviation safety team for 1999 through 2008 showed that loss of control had become the leading cause of all worldwide fatal commercial aircraft accidents and the leading cause of passenger fatalities.

Operators should be aware of the possibility of negative effects when conducting stall training in flight regimes that exceed the validated flight envelope. If the full stall training requested in Safety Recommendation A-10-22 would be accomplished in a simulator, then it is essential that the simulator be approved for this training beyond the fully developed stall AOA. Simulator improvements to the high AOA flight characteristics will reduce the likelihood of negative training. The NTSB concludes that pilots could have a better understanding of an airplane's flight characteristics during the post-stall flight regime if realistic, fully developed stall models were incorporated into simulators that are approved for such training. Therefore, the NTSB recommends that the FAA define and codify minimum simulator model fidelity requirements to support an expanded set of stall recovery training requirements, including recovery from stalls that are fully developed. These simulator fidelity requirements should address areas such as required AOA and sideslip angle ranges, motion cueing, proof-of-match with post-stall flight test data, and warnings to indicate when the simulator flight envelope has been exceeded.

[288] During a sustained stall, the airplane can reach AOAs beyond those that occur when an appropriate and a timely stall recovery technique is used. The flight characteristics of such sustained stalls are different from those of an unstalled airplane. Timely recognition of sustained stall characteristics could represent the last chance for a pilot to lower the AOA and recover the airplane.

2.9.3 Tailplane Stall Training

The accident flight crew had seen a NASA-produced video, titled “Icing for Regional and Corporate Pilots,” during winter operations training in initial, transition, and recurrent ground school. The video was intended to enhance a pilot’s ability to assess hazardous icing conditions and understanding of icing effects on an airplane. The video also discussed tailplane stalls and wing stalls as a result of icing conditions. In addition, the video stated that pilots needed to properly diagnose icing problems (while maintaining airspeed awareness) because the differences between a wing and a tailplane stall were subtle but the recovery techniques were different.

As previously indicated in section 2.2.3.1, the video indicated that tailplane stalls were most likely to occur with ice accumulation on the horizontal stabilizer and that symptoms of tailplane stalls included lightening of the controls, pitch excursions, difficulty in pitch trim, buffeting of the controls, and sudden nose-down pitching. 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.

Postaccident interviews with Colgan pilots about tailplane stalls produced varying responses. One captain stated that the video about tailplane icing made a big impression on him, and another captain stated that the video got his attention. Some pilots indicated that they would apply the tailplane stall procedure if they had clearly identified the symptoms of a tailplane stall, whereas other pilots stated that it would be difficult to determine if the airplane was in a conventional wing stall or a tailplane stall. Some pilots thought that the Q400 might be susceptible to a tailplane stall, some pilots were not sure about the airplane’s susceptibility, and one pilot (a check airman) stated that the possibility of a tailplane stall in the Q400 had “never crossed [his] mind.”

Colgan’s manuals and training materials (except for the NASA icing video) made no reference to tailplane stalls or tailplane stall recovery techniques. Further, the company’s director of flight standards indicated that the company did not teach pilots tailplane stall recovery techniques, and no procedures for tailplane stalls were included in the company’s CFM or the Q400 AFM.

During the public hearing for this accident, officials from Bombardier testified that the Q400 was not susceptible to tailplane stalls. For example, the Bombardier principal engineering test pilot for the DHC-8 series stated that, during Q400 testing, the airplane showed no tailplane stall tendencies, and a Bombardier engineering manager stated that the company did not have a tailplane stall recovery procedure because the airplane was demonstrated to be free from tailplane stalls under all conditions. The engineering manager also stated that he was not aware of any formal document to Q400 operators indicating that the airplane was not susceptible to tailplane stalls.

Also during public hearing testimony, the FAA’s manager of air carrier training stated his belief that no airplanes currently being operated by Part 121 air carriers were susceptible to tailplane stalls. He recalled that the early versions of two airplanes, the Saab 340 and the Jetstream J31, had tailplane stall tendencies but stated that these tendencies were corrected by airworthiness directives and manufacturing changes. The FAA manager further indicated that training programs should not lead to negative training or possible miscues regarding how flight crews are to handle a full wing stall.

As stated in section 2.2.3.1, it is unlikely that the captain was deliberately attempting to perform a tailplane stall recovery in response to the stick shaker activation. Nevertheless, the NTSB concludes that the inclusion of the NASA icing video in Colgan Air's winter operations training may lead pilots to assume that a tailplane stall might be possible in the Q400, resulting in negative training. Therefore, the NTSB recommends that the FAA identify which airplanes operated under Part 121, 135, and 91K are susceptible to tailplane stalls and then (1) require operators of those airplanes to provide an appropriate airplane-specific tailplane stall recovery procedure in their training manuals and company procedures and (2) direct operators of those airplanes that are not susceptible to tailplane stalls to ensure that training and company guidance for the airplanes explicitly states this lack of susceptibility and contains no references to tailplane stall recovery procedures.

2.10 Federal Aviation Administration Oversight

Oversight of the Colgan certificate and the Q400 program were provided by a POI and a Q400 APM. The POI was based at the Washington FSDO, which was near the company's headquarters at the time of the accident, and the Q400 APM was based at the Teterboro FSDO, which was near the EWR base. The investigation of this accident found that FAA records of oversight activities at Colgan showed no deficiencies related directly to the circumstances of the accident.

The investigation also found that, between February 2007 and February 2008, Colgan underwent a period of substantial growth. During this time, the Q400 was introduced into the company's operations, a relatively large number of pilots ("a couple of hundred," according to the company's vice president of administration) was hired, and a new Q400 base of operations was established at EWR.[289] In addition, Colgan had to outsource Q400 flight crew training (with FlightSafety International in Toronto) until the company could become fully qualified to conduct its own Q400 flight crew training (which occurred in July 2008).

FAA Order 8900.1, "Flight Standards Information Management System," notes that POIs must determine when surveillance retargeting is required based on, among other things, significant changes in an air carrier's operating environment, including changes in the scope and scale of operations (that is, growth or downsizing).[290] The order indicated that such changes could affect a carrier's ability to balance its resources, size, and organizational structure with

[289] The 15 Q400 airplanes that Colgan purchased and the pilots hired to fly the airplanes represented about a 30-percent increase in the size of the company.

[290] FAA Order 8900.1 also states that surveillance retargeting is required for other triggering events, such as accidents or incidents.

operational requirements. The investigation of this accident did not find any evidence that surveillance retargeting had occurred. For example, no evidence showed that the size of the certificate management team changed despite the significant growth that Colgan was experiencing. The POI stated, during a postaccident interview, that the only other aviation safety inspector on his staff (besides the Q400 APM) was an APM for the Saab 340.

Also, neither the POI nor the previous Q400 APM (who was in the position from March 2007 to February 2008) was qualified on the Q400 at the time that it was initially incorporated into Colgan's fleet. The POI received his Q400 training in October and November 2007, which was the same time that Colgan line pilots were being initially trained on the airplane. Also, he and the previous APM were responsible for overseeing proving flights[291] for the Q400, even though they were not completely familiar with the airplane. The current Q400 APM was assigned to the certificate in March 2008, after Q400 revenue service had begun, and received his Q400 training in May 2008. Although both FAA aviation safety inspectors were experienced pilots,[292] they were responsible for overseeing the newly introduced service of an airplane for which they were not previously qualified and had not flown except during simulator training. As a result, the inspectors had to continue to become familiar with the airplane while they were conducting their day-to-day management of the certificate.

In December 2009, Colgan moved its headquarters from the Washington, D.C., area to Memphis, but the Colgan certificate remained with the Washington FSDO. Thus, the POI is providing oversight of operations at Colgan headquarters and the company's training center (also located in Memphis) from a remote location. However, during its investigation of the December 2007 Air Wisconsin Airlines flight 3758 accident in Providence, Rhode Island, the NTSB found that providing remote oversight was difficult for the company's POI, assistant POI, and APM, who were not located near the company's primary training center and crew bases.[293]

FAA Order 8900.1 also states that rapid expansion or growth of an air carrier could affect its training programs. In October 2007, during Colgan's rapid growth period, the captain was disapproved for a Saab 340 airline transport pilot certificate and type rating on his initial attempt to upgrade to captain. (He received the airline transport pilot certificate and type rating later that month on a subsequent attempt.) This disapproval was the captain's second failed checkride since beginning work for Colgan; he had also been previously graded "train to proficiency" during another checkride. Because of his continued weaknesses in basic aircraft control and attitude instrument flying, the captain was a candidate for remedial training. However, the POI did not recommend that the company provide remedial or another type of supplemental training to the captain or other pilots with persistent training deficiencies, even though SAFO 06015,

[291] Before revenue service can be operated, proving flights have to be conducted as part of compliance with a new aircraft process document, which directs the activities and provides guidance for aviation safety inspectors during the addition of a new aircraft make and model to an air carrier's operations.

[292] During postaccident interviews, the POI stated that he was type rated on the Bombardier CRJ-200, the Jetstream 31, and an early model DHC-8, and the APM stated that he was type rated on the DHC-8 and a variant of the Dassault Falcon. Both the POI and APM had accumulated more than 8,000 hours total flight time.

[293] The inspectors were located in Chicago, Illinois; the company's primary training center was located in Charlotte, North Carolina; and the crew bases were in Philadelphia, Pennsylvania, Washington, D.C., and Norfolk.) Additional information about this accident, NTSB case number DCA08FA018, is available on the NTSB's website.

issued in 2006, recommended the implementation of such training. (During the public hearing for this accident, the POI for Colgan stated that he was not aware of the SAFO.)

Even though Colgan's training and checking programs were approved by the FAA, the FAA aviation safety inspectors could only conduct a small number of the training and checking events at the airline because of their other responsibilities. As a result, the inspectors had to rely on company aircrew program designees (under the aircrew designated examiner program) for airline transport pilot certifications and type ratings and check airmen for proficiency and line checks. The POI was responsible for operations within the aircrew designated examiner program, and the Q400 APM supported the POI by providing surveillance of program activities associated with that specific airplane type. The APM was also responsible for recommending candidate aircrew program designees to the POI, who made the selections, and for qualifying each designee in the conduct of airman certification. In addition, the APM was responsible for overseeing check airmen and ensuring that they maintained high standards when conducting proficiency and line checks.

FAA Order 8900.1 further states, "air carrier expansion or growth can also raise potential safety and quality concerns, and influence the likelihood of noncompliance with existing processes and controls." Because of the 15 new Q400 airplanes in its inventory, Colgan needed to upgrade pilots to Q400 captains and train newly hired (and low-time) pilots as Q400 first officers. This situation warranted additional FAA oversight of Colgan's check airmen and aircrew program designees to ensure that training and checking standards were not affected by pressures to qualify these pilots. The NTSB notes that this focused oversight was also needed because of the lack of detail in Colgan's electronic pilot training records and the lack of previous Part 121 experience of some company Q400 check airmen and aircrew program designees.[294] Available Q400-qualified aviation safety inspectors from all FAA regions and from Part 142 training centers could have augmented the certificate's inspectors and provided quality assurance over Colgan's aircrew program designees.

In addition, the International Air Transport Association (IATA) and the Department of Defense (DOD) conducted independent audits of Colgan in 2007. Both of the audits contained findings that necessitated corrective actions by Colgan. The corrective actions taken by Colgan in response to the audit findings were accepted by IATA in September 2007 and DOD in April 2008. The Colgan POI stated that he was aware of these audits but did not get a copy of the reports, which prevented him from having a comprehensive understanding of the reports' findings. For example, the POI believed that IATA's findings were minor[295] and that a DOD issue was not within the scope of his responsibilities because it was not mandated by the FAA.

One finding from the audits involved Colgan's internal evaluation program (IEP),[296] which is not required by FAA regulations. As stated in section 2.7.2, the NTSB found significant

[294] After the accident, the NTSB interviewed five company Q400 check airmen and two company Q400 aircrew program designees. The NTSB learned that none of the check airmen or aircrew program designees had any previous Part 121 experience before their employment with Colgan.

[295] The NTSB has made no determination to characterize the audit findings.

[296] As stated in AC 120-59, "Air Carrier Internal Evaluation Programs." IEPs are voluntary self-monitoring and auditing programs adopted by most Part 121 air carriers.

problems with Colgan's pilot training records. These problems would likely have been prevented by a sound IEP, which did not exist at the time of the audits and during Colgan's period of rapid growth.[297] However, the issues with Colgan's IEP were subsequently corrected to the satisfaction of the auditing organizations. Although the NTSB recognizes that the POI needed to perform his duties in accordance with stated regulations and procedures, use of evaluation tools, such as these audits, might have alerted him to items that required close review.

On December 20, 1996, the NTSB issued Safety Recommendation A-96-163 as a result of its investigation of the December 1995 Tower Air flight 41 accident in Jamaica, New York. Safety Recommendation A-96-163 asked the FAA to do the following:

> Develop, by December 31, 1997, standards for enhanced surveillance of air carriers based on rapid growth, change, complexity, and accident/incident history; then revise national flight standards surveillance methods, work programs, staffing standards, and inspector staffing to accomplish the enhanced surveillance that is identified by the new standards.

On November 24, 2004, the NTSB stated that the FAA had briefed NTSB staff in March 2004 about programs related to oversight and surveillance of air carriers, including ATOS and the Surveillance and Evaluation Program.[298] The NTSB indicated that, during this briefing, the FAA had stated that the risk indicators used by the Surveillance and Evaluation Program for targeting surveillance resources included rapid growth or expansion, new or major program changes, complexity of aircraft or new aircraft types, and accident and incident history. Because the FAA had developed these surveillance standards, the NTSB classified Safety Recommendation A-96-163 "Closed—Acceptable Action."

Since that time, the NTSB has investigated several accidents in which inadequate FAA oversight was a factor and issued several recommendations to address these inadequacies. For example, Safety Recommendation A-05-8, issued as a result of the Air Sunshine flight 527 accident (see section 1.18.1.8), asked the FAA in part to review the procedures used during its oversight of the company, including those for the Surveillance and Evaluation Program, to determine why the inspections failed to ensure that the operational and maintenance issues that existed at the company were corrected.[299]

Colgan's substantial growth came at a time when the air carrier was transitioning from, according to the Q400 APM, a "mom and pop," or startup, airline. Also, the POI for Colgan stated that the safety culture at the company was "more reactive than I'd like … not quite as proactive." As a result, additional resources for enhanced FAA oversight of the certificate were needed but were not provided. This situation is problematic because, according to a Pinnacle Airlines third quarter 2009 financial report, 30 additional Q400s have been ordered for Colgan

[297] At that time, the program was in its early stages of development.

[298] According to the FAA, as part of the Surveillance and Evaluation Program, tools were developed for principal inspectors to assess the overall risk situation of a carrier, document and analyze their observations, and refocus the surveillance program toward those areas for which the highest risks were perceived.

[299] Safety Recommendation A-05-8 was classified "Closed—Acceptable Action" on August 27, 2009.

(15 of which will be delivered beginning in 2010), continuing the company's expansion and rapid growth.

A June 2005 report by the Department of Transportation's Office of Inspector General found that, at five Part 121 air carriers that were experiencing rapid growth, FAA inspectors were not able to effectively use oversight systems (ATOS and the Surveillance and Evaluation Program) to monitor the rapidly occurring changes.[300] The NTSB concludes that the current FAA surveillance standards for oversight at air carriers undergoing rapid growth and increased complexity of operations do not guarantee that any challenges encountered by the carriers as a result of these changes will be appropriately mitigated. Therefore, the NTSB recommends that the FAA develop more stringent standards for surveillance of Part 121, 135, and 91K operators that are experiencing rapid growth, increased complexity of operations, accidents and/or incidents, or other changes that warrant increased oversight, including the following: (1) verify that inspector staffing is adequate to accomplish the enhanced surveillance that is promulgated by the new standards, (2) increase staffing for those certificates with insufficient staffing levels, and (3) augment the inspector staff with available and airplane-type-qualified inspectors from all FAA regions and Part 142 training centers to provide quality assurance over the operators' aircrew program designee workforce.

2.11 Company Policies

2.11.1 Flight Operational Quality Assurance

FOQA is a voluntary safety program in which an air carrier collects, deidentifies, and analyzes actual in-flight data from a QAR or an FDR to identify potential operational risks and implement corrective actions. According to the FAA, as of October 30, 2009, 19 of the 82 Part 121 certificate holders had FAA-approved FOQA programs.[301]Although Colgan had received FAA approval for its FOQA implementation and operations plan in October 2008, the FOQA program was not fully implemented and was not providing useful information at the time of the accident. The FAA manager for voluntary safety programs reported that FOQA implementation could take about 1 year and that Colgan's implementation efforts were hindered by unanticipated issues affecting the installation of FOQA hardware. In October 2009, Colgan stated that QAR data analysis was projected to begin by the end of January 2010.

[300] Department of Transportation, *Safety Oversight of an Air Carrier Industry in Transition*, Report Number AV-2005-062 (Washington, DC: DOT/OIG, 2005).

[301] FOQA programs are not required to be approved by the FAA. However, an advantage of having an FAA-approved FOQA program is participation in the FAA's Aviation Safety Information Analysis and Sharing (ASIAS) system. According to the FAA's director of aviation safety analytical services, ASIAS is a government-industry partnership that brings together safety information in a protected forum, allowing queries and analysis of multiple databases. This director stated that, as of July 2009, 21 air carriers with FAA-approved FOQA programs were participating in ASIAS. Although ASIAS has been used to analyze events such as tail strikes and wrong runway departures, it has not yet been used to analyze stick shaker or stall warning events.

Colgan's voluntary reporting systems, including ASAP, did not include any reports of stall warnings. However, it is possible that a stall warning resulting from a mismatch between the ref speeds switch and the airspeed bugs may be a more common occurrence than currently realized, given the circumstances of the accident flight and the BTV event. The frequency and circumstances of stall warnings could be examined as part of a FOQA program because, in developing FOQA programs, operators select the recorded flight parameters to be analyzed and one available parameter is the in-flight activation of the stall warning system.[302] Any information learned from analysis of FOQA program data could result in revised company procedures, checklists, and training and could be shared with the FAA and others in the aviation industry.

Even though Colgan did not have a functioning FOQA program at the time of the accident, the company might have benefited from other air carriers' information about the Q400, including stall warnings. However, the two other U.S. operators of the Q400 are both regional airlines without FOQA programs.

Most of the operators with FOQA programs were established major airlines, which had a significant amount of data about the operation of the aircraft in their fleet. At the time of the accident, the FAA made no systematic attempt to determine whether newer or smaller airlines, including regional airlines, were participating in FOQA programs and whether newer aircraft, including the Q400, were included in FOQA data monitoring efforts.

Not all airplanes are capable of supporting a FOQA data recording. Those airplanes that are currently able to support these recordings are equipped with a data bus that allows information to be transmitted in digital format from multiple data sensors to QARs. The FAA has not done a survey of the Part 121 air carrier fleet to determine how many airplanes are QAR capable. However, operators of those airplanes that are capable of supporting a QAR recording might still need a supplemental type certificate for a QAR retrofit, which could be expensive and time-consuming. Some new aircraft have QAR capability already installed, so the process to implement a FOQA program could be greatly simplified for operators of these airplanes.

On January 23, 2007, the NTSB issued Safety Recommendation A-07-11, which asked the FAA to strongly encourage and provide assistance to all regional air carriers to implement an approved ASAP and a FOQA program. As indicated in section 1.18.1.9, on April 13, 2007, the FAA stated that it took several actions in response to this recommendation, including participation at Regional Airline Association conferences to increase awareness of ASAP and FOQA and the issuance of AC 120-92, which identified FOQA as an integral part of an SMS. As a result of these actions, Safety Recommendation A-07-11 was classified "Closed—Acceptable Action" on January 22, 2008.

Also in its response to Safety Recommendation A-07-11, the FAA recognized that there was significant participation in ASAP among regional operators but that only a few regional operators participated in FOQA. The recommendation asked the FAA to "strongly encourage"

[302] The accident airplane's FDR recorded stick shaker and stick pusher parameters once every 4 seconds. In contrast, a QAR might be designed to record hard-target FOQA parameters at higher sample rates to yield a high-confidence analysis of stall warning events in the Q400 fleet.

regional air carriers to voluntarily implement a FOQA program, yet only three regional airlines had FOQA programs either planned or underway as of July 2009.

As indicated in AC 120-82, FOQA programs provide objective safety information that would not otherwise be obtainable. Also, FOQA was established as a worldwide standard by ICAO in 2005, but U.S. air carriers are not required to conform with this standard because FOQA is currently a voluntary program. During his December 2009 testimony before the U.S. Senate, the FAA Administrator stated that he had asked operators without a FOQA program to implement this program and develop data analysis processes to ensure effective use of program information. The NTSB concludes that mandatory FOQA programs would enhance flight safety because all operators would have readily available data to identify operational risks and use in developing corrective actions. Therefore, the NTSB recommends that FAA require all Part 121, 135, and 91K operators to (1) develop and implement FOQA programs that collect objective flight data, (2) analyze these data and implement corrective actions to identified systems safety issues, and (3) share the deidentified aggregate data generated through these analyses with other interested parties in the aviation industry through appropriate means.

The NTSB recognizes that, as indicated in AC 120-82, FOQA is built upon the provisions of 49 *United States Code* 40123 and 14 CFR Part 193, which establish protection of voluntarily submitted information. The FAA states in AC 120-82 that maintaining confidentiality of FOQA information among operators is important for providing a cooperative environment. If FOQA data were required to be provided to the FAA, these data would no longer fall under the protections provided by 49 *United States Code* 40123 and 14 CFR Part 193. The NTSB concludes that the viability of FOQA programs depends on the confidentiality of the data, which would currently not be guaranteed if operators were required to implement these programs and were required to share the data with the FAA. Therefore, the NTSB recommends that the FAA seek specific statutory and/or regulatory authority to protect data that operators share with the FAA as part of any FOQA program.

In addition, Colgan had previously proposed including, as part of its FOQA program, a sample of CVR recordings from routine line operations. The company indicated that the sample CVR recordings could be used to determine, among other information, how well pilots adhered to sterile cockpit and standard operating procedures, which could help to prevent accidents. The company asserted that its use of the CVR for FOQA purposes would ensure pilots' confidentiality.

The NTSB has recognized the benefits of using flight recorder information for safety purposes. For example, on October 1, 2009, the NTSB issued Safety Recommendation A-09-99, which asked helicopter emergency medical services operators to "establish a structured flight data monitoring program that incorporates routine reviews of all available sources of information to identify deviations from established norms and procedures and other potential safety issues." Aircraft operators would benefit from similar reviews of available safety information sources that are downloaded as part of a company's FOQA program. The NTSB concludes that the systematic monitoring of all available safety data, as part of a flight operational quality assurance program, could provide operators with objective information regarding the manner in which flights are conducted and that a periodic review of this information would enhance flight safety by assisting operators in detecting and correcting deviations from standard operating procedures. Therefore, the NTSB recommends that the FAA require Part 121, 135, and 91K operators to (1) routinely download and analyze all available sources of safety information, as part of their FOQA program, to identify deviations from established norms and procedures; (2) provide appropriate protections to ensure the confidentiality of the deidentified aggregate data; and (3) ensure that this information is used for safety-related and not punitive purposes.

2.11.2 Use of Personal Portable Electronic Devices on the Flight Deck

The NTSB has identified hazards associated with the use of mobile phone technology (including texting) in rail and highway accidents and has issued recommendations to restrict the use of this technology by transport operators.[303] Also, in 2008, the NTSB added, to its Most Wanted List, the need to restrict cellular telephone use by commercial drivers of school buses and motorcoaches, except in emergencies.

During the taxi phase of the accident flight, the first officer sent a text message on her personal cell phone about 2113, which was about 5 minutes 30 seconds before ATC cleared the flight for takeoff. (Evidence indicated that the airplane was not moving at the time that she used her mobile phone.) However, AC 91.21-1B, "Use of Portable Electronic Devices Aboard Aircraft,"[304] which was issued on August 25, 2006, indicated that cell phones were not to be used while an aircraft was taxiing for departure after leaving the gate. The AC further stated that cell phones should be turned off and properly stored so that the aircraft could be prepared for takeoff. Although Colgan's policy on the use of mobile phones on the flight deck was consistent with the guidance contained in AC 91.21-1B, the company's pilot checklists did not address turning off cell phones in preparation for departure. Colgan also stated that it considered the use of cell phones by flight crewmembers to be covered as part of sterile cockpit procedures.

On February 4, 2009, the FAA published SAFO 09003, "Cellular Phone Usage on the Flight Deck." The purpose of this SAFO was to alert all Part 121 and 135 operators to the potential hazards associated with flight crewmembers leaving their cellular phones on during critical phases of flight. The SAFO was the result of an inspector's observation of a ring tone/warbling sound coming from a first officer's cellular phone during a takeoff roll just before reaching the airplane's takeoff decision speed. The SAFO stated that the ring tone was a

[303] For example, on November 30, 2006, the NTSB issued Safety Recommendation H-06-27, which asked the Federal Motor Carrier Safety Administration to "publish regulations prohibiting cellular telephone use by commercial driver's license holders with a passenger-carrying or school bus endorsement, while driving under the authority of that endorsement, except in emergencies." The recommendation is currently classified "Open—Acceptable Response." Also, on June 13, 2003, the NTSB issued Safety Recommendation R-03-1, which asked the Federal Railroad Administration to "promulgate new or amended regulations that will control the use of cellular telephones and similar wireless communication devices by railroad operating employees while on duty so that such use does not affect operational safety." The recommendation was classified "Closed—Acceptable Alternate Action" on September 17, 2009.

[304] According to the AC, portable electronic devices are personal devices that include, for example, mobile telephones; computers with wireless network capabilities; and other wireless-enabled devices, such as personal digital assistants. Such devices are not provided by an operator for use in supporting flight operations. Electronic flight bags or laptop computers used for landing performance calculations would thus not be considered personal portable electronic devices.

distraction to the flight crew and could have resulted in an unnecessary rejected takeoff. The FAA found that the company's guidance did not prohibit flight crewmembers from leaving phones on while on the flight deck and that the company's checklists did not address turning off cell phones in preparation for departure.

The SAFO recommended that directors of operations of all Part 121 and 135 certificate holders review guidance to determine if procedures are in place to remind flight crews to turn off phones while on the flight deck. The SAFO also recommended a review and evaluation of the operator's indoctrination and recurrent training curriculums concerning cell phone use and the sterile cockpit concept.

On October 21, 2009, Northwest Airlines flight 188, an Airbus A320, N374NW, became a "NORDO" (no radio communications) flight at 37,000 feet. The flight was operating under 14 CFR Part 121 from San Diego, California, to Minneapolis-St. Paul International/Wold-Chamberlain Airport (MSP) with 5 crewmembers and 144 passengers on board. The flight was NORDO for about 1 hour 17 minutes. During that time, the airplane flew past MSP and continued northeast for about 100 miles. When the flight crew and the MSP center controller reestablished communications, the first officer stated, "we got distracted and we've overflown MSP. We are overhead Eau Claire [Wisconsin] and would like to make a 180 [degree turn] and do an arrival from Eau Claire." About 5 minutes later, the controller asked the first officer to explain what had caused the situation, and he replied, "just cockpit distraction, that's all I can tell you."

During interviews with the Northwest flight crew, the NTSB learned that the distraction involved the use of personal laptop computers during the discussion of new flight crew scheduling software and procedures. However, Delta Air Lines policy (which governed Northwest operations as a result of a merger with the company),[305] prohibited the use of personal computers and other personal electronic devices on the flight deck.[306]

Although the Colgan first officer's use of her personal cell phone during the taxi phase of the accident flight was not directly associated with the accident, the event described in SAFO 09003 illustrates the potential for such devices to create a hazardous distraction during a critical phase of flight. In addition, the Northwest event showed that the use of a personal computer during cruise flight could severely affect flight crew situational awareness. The NTSB concludes that distractions caused by personal portable electronic devices affect flight safety because they can detract from a flight crew's ability to monitor and cross-check instruments, detect hazards, and avoid errors. Therefore, the NTSB recommends that the FAA require all Part 121, 135, and 91K operators to incorporate explicit guidance to pilots, including checklist reminders as appropriate, prohibiting the use of personal portable electronic devices on the flight deck.

[305] Delta's website indicated that the airline had acquired ownership of Northwest and was in the process of fully integrating Northwest into Delta's operations.

[306] For more information about this incident, see DCA10IA001 on the NTSB's website.

2.12 Safety Alerts for Operators

According to FAA Order 8000.87A, SAFOs "contain important safety information that is often critical." SAFOs are intended for FAA inspectors; air carrier directors of safety, operations, and maintenance; fractional ownership program managers; training center managers; repair station managers; and others as applicable. Although FAA inspectors are among the intended audience, the order states, "SAFOs do not burden FAA inspectors with additional responsibilities not included in their work programs and not processed in accordance with the agreement between the FAA and its inspectors' bargaining unit." At the public hearing for this accident, the FAA's manager of air carrier operations asserted that this language was included in the order because FAA inspectors are heavily tasked.

As previously noted, the FAA had issued SAFOs concerning issues identified in this investigation, including SAFO 06004, "Approach and Landing Accident Reduction: Sterile Cockpit, Fatigue," dated April 28, 2006, and SAFO 06015, "Remedial Training for Part 121 Pilots," dated October 27, 2006 (see sections 1.18.1.1 and 1.18.1.7, respectively). The recommended actions discussed in these SAFOs included increased emphasis on sterile cockpit discipline, fatigue countermeasures and operator fatigue management, and additional training and oversight for pilots who have experienced multiple training and checking failures. FAA Order 8000.87A stated that operators are responsible for implementing the actions recommended in a SAFO. However, no evidence showed that Colgan had initiated any of the recommended actions in these SAFOs.

The FAA does not routinely track whether the recommended actions included in SAFOs have been adopted,[307] citing inspector workload as a reason. The FAA order states that SAFOs are "especially valuable" to air carriers in meeting their statutory duty to operate with the highest degree of safety. The NTSB recognizes the importance of an air carrier's statutory responsibility to provide safe transportation. However, the FAA has a statutory responsibility to provide effective oversight of the aviation industry. Assessing an operator's need to implement action on "important safety information that is often critical" and measuring the resulting change is an inherent responsibility of FAA inspectors and must be considered part of their workload. Delegating the responsibility for these actions solely to an operator may not produce the desired outcome.

SAFOs may be an appropriate method for disseminating routine or initial information to operators in a timely manner. However, when safety-critical information, which often requires a change in industry practices or procedures, needs to be distributed, SAFOs are not the appropriate format because no requirement exists for the FAA to measure whether the SAFO achieved its intended result. The FAA uses an SMS approach to structure its oversight processes, but transmitting critical safety information to operators without measuring results is inconsistent with the basic principles of this system.

[307] The FAA has undertaken tracking efforts for some SAFOs to determine whether the desired safety benefit has been realized. For example, FAA Notice 8900.71 was issued on April 23, 2009, in response to the NTSB's March 2009 request for an assessment of industry actions taken in response to SAFOs 06015 and 06005 (the latter of which discussed bounced landing training).

The FAA's manager of air carrier operations testified at the public hearing that the agency was considering the establishment of a new transmittal method for safety-critical information, referred to as an operational directive, which would be similar to an airworthiness directive. Thus, operators would be responsible for complying with the operational directive, and FAA inspector surveillance would be required to determine whether the recommended actions had been accomplished. The NTSB is encouraged that the FAA is considering this new method for transmitting safety-critical information. The same safety benefit could be achieved if the FAA revised Order 8000.87A so that the SAFO process would incorporate FAA followup. The NTSB concludes that the current use of SAFOs to transmit safety-critical information is not effective because oversight and documentation of an operator's response are not required and critical safety issues may not be effectively addressed. Therefore, the NTSB recommends that the FAA implement a process to document that all Part 121, 135, and 91K operators have taken appropriate action in response to safety-critical information transmitted through the SAFO process or another method.

2.13 Preflight Weather Documents and Icing Terminology

As previously stated, no evidence showed that the icing conditions that existed before the accident were abnormal for wintertime operations in the BUF area. However, the NTSB's investigation of this accident identified two weather-related safety issues—preflight weather documents provided to Part 121 flight crews and icing terminology used in the *Aeronautical Information Manual* (AIM)—that warranted changes. These issues are discussed in sections 2.13.1 and 2.13.2, respectively.

2.13.1 Preflight Weather Documents

Chapter 26 of FAA Order 8900.1, Aviation Weather Information Systems for Air Carriers, section 3-2094, "Operational Requirements—Flightcrews," states the following regarding weather information provided to flight crews:

> Flightcrews need accurate weather information to determine the present and forecast weather conditions on any planned operation. For example, for adequate flight planning, flightcrews should know existing and expected weather conditions at the departure airport, along the planned route of flight, and at destination, alternate, and diversionary airports.

The section also provides a list of the numerous weather products that flight crews need to consider in operational preflight planning decisions.

Chapter 26 of the order, section 3-2096, "Adverse Weather Phenomena Reporting and Forecasting Requirements,"[308] states that any weather information system used in Part 121

[308] According to section 3-2096, adverse weather phenomena are meteorological conditions that could affect safety if encountered during flight or ground operations. Examples of such phenomena include surface winds

operations must include an FAA-approved adverse weather phenomena reporting and forecasting subsystem. Such subsystems allow operators to monitor weather reports from various sources to quickly and accurately identify adverse weather phenomena and predict their effects on flight and ground operation safety. The subsystems are required to include forecasting capabilities that are at least equal to those of government weather forecasting systems.[309] Even though the subsystems are automated, dispatch personnel are responsible for (1) programming the subsystems to ensure that they capture specific weather products during specific time periods for the arrival and alternate airports for each flight and (2) providing weather documents containing this information to flight crews. In this case, the Colgan director of dispatch was responsible for programming the company's FAA-approved private weather contractor subsystem to capture specific weather products for the route of flight between EWR and BUF (and from EWR to ROC, the alternate airport).

The weather document for the accident flight was issued about 1800. The NTSB's review of this document revealed that it was missing pertinent information. For example, the weather document did not contain relevant AIRMETs, even though they are among the in-flight weather advisories that flight crews need to determine present and forecast weather conditions for an operation. One of the missing AIRMETs relevant to the accident flight extended over the flight route and alerted pilots to expect moderate rime icing below 8,000 feet. Another missing and relevant AIRMET extended over a larger region in the northeast, including the accident site, and alerted pilots to expect occasional moderate icing below 18,000 feet. The icing conditions in both of these AIRMETs were expected to last from 2145 to 0400 the next day.[310] The NTSB's investigation of this accident verified the conditions detailed in the AIRMETs.

The only icing information included in the weather document for the accident flight was the reports and forecast of snow at BUF and two PIREPs indicating light-to-moderate rime icing in the BUF area between 3,000 and 14,000 feet. Even though the minimal aircraft performance degradation resulting from ice accumulation did not affect the flight crew's ability to fly and control the airplane, the NTSB is concerned that pertinent preflight information regarding icing along the flight route was not relayed to the crew. The AIRMETs relevant to the accident flight that were not included in the weather document would have provided the crew with additional information about icing and, accordingly, would have increased situational awareness. However, this increased situational awareness would not likely have affected the outcome of the flight for the reasons previously discussed in section 2.2.

On August 15, 1996, the NTSB issued Safety Recommendation A-96-48 as a result of its investigation of the American Eagle flight 4184 accident in Roselawn, Indiana (see section

exceeding 30 knots, active thunderstorms, moderate or severe in-flight icing, severe or extreme turbulence, and meteorological conditions causing runway surface contamination.

[309] According to 14 CFR 121.101, "each certificate holder conducting domestic or flag operations shall adopt and put into use an approved system for obtaining forecasts and reports of adverse weather phenomena, such as clear air turbulence, thunderstorms, and low altitude wind shear, that may affect safety of flight on each route to be flown and at each airport to be used."

[310] Other AIRMETs in effect at the time described IFR conditions and turbulence over the BUF area. These AIRMETs were also not included in the weather document.

1.18.1.13). Safety Recommendation A-96-48 recognized the importance of AIRMETs and Center Weather Advisories (CWAs)[311] in flight planning and asked the FAA to do the following:

> Direct principal operations inspectors (POIs) to ensure that all 14 *Code of Federal Regulations* (CFR) Part 121 air carriers require their dispatchers to provide all pertinent information, including airman's meteorological information (AIRMETs) and Center Weather Advisories (CWAs), to flightcrews for preflight and in-flight planning purposes.

On April 24, 1997, the FAA stated that it issued Flight Standards Information Bulletin for Air Transportation 97-03 on March 17, 1997, which directed POIs to ensure that air carriers require dispatchers to provide pertinent information, including AIRMETs and CWAs, when appropriate, for preflight and in-flight planning purposes. The FAA also stated that the information in the bulletin would be incorporated into FAA Order 8400.10, "Air Transportation Operations Inspector's Handbook."[312] On August 20, 1997, the NTSB stated that the flight standards information bulletin addressed the intent of Safety Recommendation A-96-48 and classified it "Closed—Acceptable Action." However, this accident demonstrates that, even though the FAA took actions to address this safety issue, weather documents are still missing pertinent information, including AIRMETs.

In addition, the NTSB's review of the weather document for the accident flight revealed that some of the information was outdated. For example, the weather document included three CWAs, but they were not valid at the time of the accident flight.[313] Also, the wind and temperature aloft forecast for BUF, which was issued about 1300 and was valid between 1200 and 1600, had expired before the accident flight. This outdated information should not have been part of the weather document but was included in it because of programming limitations of Colgan's weather contractor subsystem.

Problems with weather documents have also been found at other Part 121 air carriers. For example, on April 12, 2007, Pinnacle Airlines flight 4712, a Bombardier/Canadair Regional Jet CL600-2B19, N8905F, departed the end of the runway while landing at Cherry Capital Airport, Traverse City, Michigan (see section 1.18.1.5). None of the 3 crewmembers and 49 passengers was injured; the airplane was substantially damaged. The accident flight's weather document, which was prepared by the Pinnacle Airlines dispatcher, did not include any NWS in-flight weather advisories. However, NWS AIRMETs for icing, turbulence, and IFR conditions were valid for the area at the time of the accident.

Also, on December 25, 2007, Alaska Airlines flight 464, a McDonnell Douglas DC-9-83, N943AS, encountered severe turbulence during the descent for landing at Ontario International

[311] A CWA is an aviation warning for conditions that are meeting or approaching national in-flight advisory criteria (for example, AIRMETs, SIGMETs, or Convective SIGMETs) and are impacting the respective airspace. These short-term warnings are typically valid for 2 hours.

[312] FAA Order 8400.10 has been superseded by FAA Order 8900.1.

[313] Two CWAs for low-level windshear, issued by the New York Air Route Traffic Control Center, had expired at 1320. A CWA for scattered thunderstorms, issued by the Cleveland Center, expired about 1630.

Airport, Ontario, California.[314] Two flight attendants sustained serious injuries during the turbulence encounter, and the third flight attendant, the two flight crewmembers, and the 109 passengers were not injured. During its investigation of this accident, the NTSB determined that two NWS Significant Meteorological Information (SIGMET) advisories were not included in the weather document for the flight. The SIGMETs were issued before the flight's departure as a result of occasional severe turbulence for the Ontario area. The NTSB determined the probable cause of this accident was the lack of turbulence forecast information available to the flight crew, which resulted in the flight attendants not being seated when the flight encountered the severe turbulence. Contributing factors to the accident included the failure of the company that provided the flight's weather briefing information to forecast severe turbulence and the failure of the airline dispatcher to provide the SIGMETs to the flight crew.[315]

Flight crews need to be provided with an operationally useful weather document containing all relevant weather information, including AIRMETs and SIGMETs, for each flight so that they can make sound safety-of-flight decisions based on that information. Such documents must contain up-to-date information so that flight crews do not have to sort through outdated or unrelated information for their flight. The NTSB concludes that weather documents missing key weather products or containing products that are no longer valid prevent flight crewmembers from having relevant, readily available weather-related safety information for preflight and in-flight decision-making. Therefore, the NTSB recommends that the FAA require Part 121, 135, and 91K operators to revise the methodology for programming their adverse weather phenomena reporting and forecasting subsystems so that the subsystem-generated weather document for each flight contains all pertinent weather information, including AIRMET, SIGMET, and other NWS in-flight weather advisories, and omits weather information that is no longer valid. The NTSB further recommends that the FAA require POIs of Part 121, 135, and 91K operators to periodically review the weather documents generated for their carriers to verify that those documents are consistent with the information requested in Safety Recommendation A-10-32.

2.13.2 Icing Terminology

Chapter 7 of the AIM, Safety of Flight, section 7-1-21, describes the effects of ice on an aircraft and provides terminology for pilots to use when describing icing conditions to ATC. However, during its investigation of this accident, the NTSB found that the definitions for reportable icing intensities in the July 2008 version of the AIM had not been updated to reflect the definitions published in December 2007 in AC 91-74A, "Pilot Guide: Flight in Icing Conditions." Table 4 shows the differences in terminology between AIM section 7-1-21(b) and AC 91-74A.

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[314] Additional information about this accident, NTSB case number SEA08LA050, is available on the NTSB's website.

[315] The NTSB discussed these weather-related issues with Alaska Airlines, which added NWS products to the weather subsystem used to generate its weather documents.

Table 4. Icing Definitions

Icing intensity	*Aeronautical Information Manual* definition	Advisory Circular 91-74A definition
Trace	Ice becomes perceptible. Rate of accumulation is slightly greater than sublimation. Deicing/anti-icing equipment is not utilized unless encountered for an extended period of time (over 1 hour).	Ice becomes noticeable. The rate of accumulation is slightly greater than the rate of sublimation. A representative accretion rate for reference purposes is less than 1/4 inch (6 mm) per hour on the outer wing. The pilot should consider exiting the icing conditions before they become worse. Pilots should be aware that any ice, even in trace amounts, could be potentially hazardous.
Light	The rate of accumulation may create a problem if flight is prolonged in this environment (over 1 hour). Occasional use of deicing/anti-icing equipment removes/prevents accumulation. It does not present a problem if the deicing/anti-icing equipment is used.	The rate of ice accumulation requires occasional cycling of manual deicing systems to minimize ice accretions on the airframe. A representative accretion rate for reference purposes is 1/4 inch to 1 inch (0.6 to 2.5 cm) per hour on the outer wing. The pilot should consider exiting the condition.
Moderate	The rate of accumulation is such that even short encounters become potentially hazardous and use of deicing/anti-icing equipment or flight diversion is necessary.	The rate of ice accumulation requires frequent cycling of manual deicing systems to minimize ice accretions on the airframe. A representative accretion rate for reference purposes is 1 to 3 inches (2.5 to 7.5 cm) per hour on the outer wing. The pilot should consider exiting the condition as soon as possible.
Heavy	None.	The rate of ice accumulation requires maximum use of the ice protection systems to minimize ice accretions on the airframe. A representative accretion rate for reference purposes is more than 3 inches (7.5 cm) per hour on the outer wing. Consider immediate exit from the conditions.
Severe	The rate of accumulation is such that deicing/anti-icing equipment fails to reduce or control the hazard. Immediate flight diversion is necessary.	The rate of ice accumulation is such that ice protection systems fail to remove the accumulation of ice, and ice accumulates in locations not normally prone to icing, such as areas aft of protected surfaces and any other areas identified by the manufacturer. Immediate exit from the condition is necessary.

Note: AC 91-74A also states that deicing or anti-icing systems are expected to be activated and operated continuously in the automatic mode, if available, at the first sign of ice accumulation or as directed in the AFM and that occasional and frequent cycling refers to manually activated systems. The AC further states that accretion rates can be measured by an icing rate meter.

As shown in table 4, three main differences exist between the icing terminology in the AIM and AC 91-74A. First, the AC provides an accretion rate for each icing definition, which can help pilots evaluate and accurately describe the icing conditions. Second, the AC contains a fifth icing category—heavy—to explain the environment that occurs between moderate and severe icing, providing additional icing information for pilots to consider. Last, the AC includes more detailed guidance than the AIM for pilot actions in icing conditions, providing pilots with further information for addressing specific icing situations.

The light-to-moderate icing terminology used in the two PIREPs that were included in the weather document for the accident flight had likely portrayed accurate conditions at the time of the flight. Nevertheless, the NTSB is concerned that pilots transmitting airframe icing PIREPs may not be using the most updated definitions in determining and reporting the severity of icing. Although the AC is advisory only, it is important that the icing definitions and accretion rates in the AC be incorporated into the AIM because that publication is the FAA's official guide for basic flight information and ATC procedures. The NTSB concludes that detailed icing definitions that include accretion rates and recommended pilot actions would help pilots more accurately determine the icing conditions to report in airframe icing PIREPs and more effectively respond to those conditions. Therefore, the NTSB recommends that the FAA update the definitions for reportable icing intensities in the AIM so that the definitions are consistent with the more detailed intensities defined in AC 91-74A.

3. Conclusions

3.1 Findings

1. The flight crew was properly certificated and qualified in accordance with applicable Federal regulations.

2. The airplane was properly certified, equipped, and maintained in accordance with Federal regulations.

3. The recovered components showed no evidence of any preimpact structural, engine, or system failures, including no indications of any problems with the airplane's ice protection system.

4. The air traffic controllers who were responsible for the flight during its approach to Buffalo-Niagara International Airport performed their duties properly and responded immediately and appropriately to the loss of radio and radar contact with the flight.

5. This accident was not survivable.

6. The captain's inappropriate aft control column inputs in response to the stick shaker caused the airplane's wing to stall.

7. The minimal aircraft performance degradation resulting from ice accumulation did not affect the flight crew's ability to fly and control the airplane.

8. Explicit cues associated with the impending stick shaker onset, including the decreasing margin between indicated airspeed and the low-speed cue, the airspeed trend vector pointing downward into the low-speed cue, the changing color of the numbers on the airplane's indicated airspeed display, and the airplane's excessive nose-up pitch attitude, were presented on the flight instruments with adequate time for the pilots to initiate corrective action, but neither pilot responded to the presence of these cues.

9. The reason the captain did not recognize the impending onset of the stick shaker could not be determined from the available evidence, but the first officer's tasks at the time the low-speed cue was visible would have likely reduced opportunities for her timely recognition of the impending event; the failure of both pilots to detect this situation was the result of a significant breakdown in their monitoring responsibilities and workload management.

10. The flight crew did not consider the position of the reference speeds switch when the stick shaker activated.

11. The captain's response to stick shaker activation should have been automatic, but his improper flight control inputs were inconsistent with his training and were instead consistent with startle and confusion.

12. The captain did not recognize the stick pusher's action to decrease angle-of-attack as a proper step in a stall recovery, and his improper flight control inputs to override the stick pusher exacerbated the situation.

13. It is unlikely that the captain was deliberately attempting to perform a tailplane stall recovery.

14. No evidence indicated that the Q400 was susceptible to a tailplane stall.

15. Although the reasons the first officer retracted the flaps and suggested raising the gear could not be determined from the available information, these actions were inconsistent with company stall recovery procedures and training.

16. The Q400 airspeed indicator lacked low-speed awareness features, such as an amber band above the low-speed cue or airspeed indications that changed to amber as speed decrease toward the low-speed cue, which would have facilitated the flight crew's detection of the developing low-speed situation.

17. An aural warning in advance of the stick shaker would have provided a redundant cue of the visual indication of the rising low-speed cue and might have elicited a timely response from the pilots before the onset of the stick shaker.

18. The captain's failure to effectively manage the flight (1) enabled conversation that delayed checklist completion and conflicted with sterile cockpit procedures and (2) created an environment that impeded timely error detection.

19. The monitoring errors made by the accident flight crew demonstrate the continuing need for specific pilot training on active monitoring skills.

20. Colgan Air's standard operating procedures at the time of the accident did not promote effective monitoring behavior.

21. Specific leadership training for upgrading captains would help standardize and reinforce the critical command authority skills needed by a pilot-in-command during air carrier operations.

22. Because of the continuing number of accidents involving a breakdown of sterile cockpit discipline, collaborative action by the Federal Aviation Administration and the aviation industry to promptly address this issue is warranted.

23. The flight crewmembers' performance during the flight, including the captain's deviations from standard operating procedures and the first officer's failure to challenge these deviations, was not consistent with the crew resource management (CRM) training that they had received or the concepts in the Federal Aviation Administration's CRM guidance.

24. The pilots' performance was likely impaired because of fatigue, but the extent of their impairment and the degree to which it contributed to the performance deficiencies that occurred during the flight cannot be conclusively determined.

25. All pilots, including those who commute to their home base of operations, have a personal responsibility to wisely manage their off-duty time and effectively use available rest periods so that they can arrive for work fit for duty; the accident pilots did not do so by using an inappropriate facility during their last rest period before the accident flight.

26. Colgan Air did not proactively address the pilot fatigue hazards associated with operations at a predominantly commuter base.

27. Operators have a responsibility to identify risks associated with commuting, implement strategies to mitigate these risks, and ensure that their commuting pilots are fit for duty.

28. The first officer's illness symptoms did not likely affect her performance directly during the flight.

29. The captain had not established a good foundation of attitude instrument flying skills early in his career, and his continued weaknesses in basic aircraft control and instrument flying were not identified and adequately addressed.

30. 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.

31. Colgan Air's electronic pilot training records did not contain sufficient detail for the company or its principal operations inspector to properly analyze the captain's trend of unsatisfactory performance.

32. Notices of disapproval need to be considered along with other available information about pilot applicants so that air carriers can fully identify those pilots who have a history of unsatisfactory performance.

33. Colgan Air did not use all available sources of information on the flight crew's qualifications and previous performance to determine the crew's suitability for work at the company.

34. Colgan Air's procedures and training at the time of the accident did not specifically require flight crews to cross-check the approach speed bug settings in relation to the reference speeds switch position; such awareness is important because a mismatch between the bugs and the switch could lead to an early stall warning.

35. The current air carrier approach-to-stall training did not fully prepare the flight crew for an unexpected stall in the Q400 and did not address the actions that are needed to recover from a fully developed stall.

36. The circumstances of this and other accidents in which pilots have responded incorrectly to the stick pusher demonstrate the continuing need to train pilots on the actions of the stick pusher and the airplane's initial response to the pusher.

37. Pilots could have a better understanding of an airplane's flight characteristics during the post-stall flight regime if realistic, fully developed stall models were incorporated into simulators that are approved for such training.

38. The inclusion of the National Aeronautics and Space Administration icing video in Colgan Air's winter operations training may lead pilots to assume that a tailplane stall might be possible in the Q400, resulting in negative training.

39. The current Federal Aviation Administration surveillance standards for oversight at air carriers undergoing rapid growth and increased complexity of operations do not guarantee that any challenges encountered by the carriers as a result of these changes will be appropriately mitigated.

40. Mandatory flight operational quality assurance programs would enhance flight safety because all operators would have readily available data to identify operational risks and use in developing corrective actions.

41. The viability of flight operational quality assurance programs depends on the confidentiality of the data, which would currently not be guaranteed if operators were required to implement these programs and were required to share the data with the Federal Aviation Administration.

42. The systematic monitoring of all available safety data, as part of a flight operational quality assurance program, could provide operators with objective information regarding the manner in which flights are conducted, and a periodic review of this information would enhance flight safety by assisting operators in detecting and correcting deviations from standard operating procedures.

43. Distractions caused by personal portable electronic devices affect flight safety because they can detract from a flight crew's ability to monitor and cross-check instruments, detect hazards, and avoid errors.

44. The current use of safety alerts for operators to transmit safety-critical information is not effective because oversight and documentation of an operator's response are not required and critical safety issues may not be effectively addressed.

45. Weather documents missing key weather products or containing products that are no longer valid prevent flight crewmembers from having relevant, readily available weather-related safety information for preflight and in-flight decision-making.

46. Detailed icing definitions that include accretion rates and recommended pilot actions would help pilots more accurately determine the icing conditions to report in airframe icing pilot reports and more effectively respond to those conditions.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this 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 (1) the 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.

4. Recommendations

4.1 New Recommendations

As a result of the investigation of this accident, the National Transportation Safety Board makes the following recommendations to the Federal Aviation Administration:

> Require 14 *Code of Federal Regulations* 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 Advisory Circular (AC) 120-71A, "Standard Operating Procedures for Flight Deck Crewmembers"; if the procedures are found not to be consistent, revise the procedures according to the AC guidance to promote effective monitoring. (A-10-10)

> Require that airspeed indicator display systems on all aircraft certified under 14 *Code of Federal Regulations* Part 25 and equipped with electronic flight instrument systems depict a yellow/amber cautionary band above the low-speed cue or airspeed indicator digits that change from white to yellow/amber as the airspeed approaches the low-speed cue, consistent with Advisory Circular 25-11A, "Electronic Flight Displays." (A-10-11)

> For all airplanes engaged in commercial operations under 14 *Code of Federal Regulations Parts* 121, 135, and 91K, require the installation of low-airspeed alert systems that provide pilots with redundant aural and visual warnings of an impending hazardous low-speed condition. (A-10-12) (Supersedes Safety Recommendations A-03-53 and -54 and is classified "Open—Unacceptable Response")

> Issue an advisory circular with guidance on leadership training for upgrading captains at 14 *Code of Federal Regulations* Part 121, 135, and 91K operators, including methods and techniques for effective leadership; professional standards of conduct; strategies for briefing and debriefing; reinforcement and correction skills; and other knowledge, skills, and abilities that are critical for air carrier operations. (A-10-13)

> Require all 14 *Code of Federal Regulations* Part 121, 135, and 91K operators to provide a specific course on leadership training to their upgrading captains that is consistent with the advisory circular requested in Safety Recommendation A-10-13. (A-10-14)

> Develop, and distribute to all pilots, multimedia guidance materials on professionalism in aircraft operations that contain standards of performance for professionalism; best practices for sterile cockpit adherence; techniques for

assessing and correcting pilot deviations; examples and scenarios; and a detailed review of accidents involving breakdowns in sterile cockpit and other procedures, including this accident. Obtain the input of operators and air carrier and general aviation pilot groups in the development and distribution of these guidance materials. (A-10-15) (Supersedes Safety Recommendation A-07-8)

Require all 14 *Code of Federal Regulations* Part 121, 135, and 91K operators to address fatigue risks associated with commuting, including identifying 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)

Require 14 *Code of Federal Regulations* Part 121, 135, and 91K operators to document and retain electronic and/or paper records of pilot training and checking events in sufficient detail so that the carrier and its principal operations inspector can fully assess a pilot's entire training performance. (A-10-17)

Require 14 *Code of Federal Regulations* Part 121, 135, and 91K operators to include the training records requested in Safety Recommendation A-10-17 as part of the remedial training program requested in Safety Recommendation A-05-14. (A-10-18)

Require 14 *Code of Federal Regulations* Part 121, 135, and 91K operators to provide the training records requested in Safety Recommendation A-10-17 to hiring employers to fulfill their requirement under the Pilot Records Improvement Act. (A-10-19)

Develop a process for verifying, validating, auditing, and amending pilot training records at 14 *Code of Federal Regulations* Part 121, 135, and 91K operators to guarantee the accuracy and completeness of the records. (A-10-20)

Direct 14 *Code of Federal Regulations* Part 121, 135, and 91K operators of airplanes equipped with a reference speeds switch or similar device to (1) develop procedures to establish that, during approach and landing, airspeed reference bugs are always matched to the position of the switch and (2) implement specific training to ensure that pilots demonstrate proficiency in this area. (A-10-21)

Require 14 *Code of Federal Regulations* Part 121, 135, and 91K operators and 14 *Code of Federal Regulations* Part 142 training centers 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 reference speeds switch. (A-10-22)

Require all 14 *Code of Federal Regulations* Part 121, 135, and 91K operators of stick pusher-equipped aircraft to provide their pilots with pusher familiarization simulator training. (A-10-23) (Supersedes Safety Recommendation A-07-4)

Define and codify minimum simulator model fidelity requirements to support an expanded set of stall recovery training requirements, including recovery from stalls that are fully developed. These simulator fidelity requirements should address areas such as required angle-of-attack and sideslip angle ranges, motion cueing, proof-of-match with post-stall flight test data, and warnings to indicate when the simulator flight envelope has been exceeded. (A-10-24)

Identify which airplanes operated under 14 *Code of Federal Regulations* Part 121, 135, and 91K are susceptible to tailplane stalls and then (1) require operators of those airplanes to provide an appropriate airplane-specific tailplane stall recovery procedure in their training manuals and company procedures and (2) direct operators of those airplanes that are not susceptible to tailplane stalls to ensure that training and company guidance for the airplanes explicitly states this lack of susceptibility and contains no references to tailplane stall recovery procedures. (A-10-25)

Develop more stringent standards for surveillance of 14 *Code of Federal Regulations* (CFR) Part 121 135, and 91K operators that are experiencing rapid growth, increased complexity of operations, accidents and/or incidents, or other changes that warrant increased oversight, including the following: (1) verify that inspector staffing is adequate to accomplish the enhanced surveillance that is promulgated by the new standards, (2) increase staffing for those certificates with insufficient staffing levels, and (3) augment the inspector staff with available and airplane-type-qualified inspectors from all Federal Aviation Administration regions and 14 CFR Part 142 training centers to provide quality assurance over the operators' aircrew program designee workforce. (A-10-26)

Require all 14 *Code of Federal Regulations* Part 121, 135, and 91K operators to (1) develop and implement flight operational quality assurance programs that collect objective flight data, (2) analyze these data and implement corrective actions to identified systems safety issues, and (3) share the deidentified aggregate data generated through these analyses with other interested parties in the aviation industry through appropriate means. (A-10-27)

Seek specific statutory and/or regulatory authority to protect data that operators share with the Federal Aviation Administration as part of any flight operational quality assurance program. (A-10-28)

Require 14 *Code of Federal Regulations* Part 121, 135, and 91K operators to (1) routinely download and analyze all available sources of safety information, as part of their flight operational quality assurance program, to identify deviations from established norms and procedures; (2) provide appropriate protections to ensure the confidentiality of the deidentified aggregate data; and (3) ensure that this information is used for safety-related and not punitive purposes. (A-10-29)

Require 14 *Code of Federal Regulations* Part 121, 135, and 91K operators to incorporate explicit guidance to pilots, including checklist reminders as appropriate, prohibiting the use of personal portable electronic devices on the flight deck. (A-10-30)

Implement a process to document that all 14 *Code of Federal Regulations* Part 121, 135, and 91K operators have taken appropriate action in response to safety-critical information transmitted through the safety alert for operators process or another method. (A-10-31)

Require 14 *Code of Federal Regulations* Part 121, 135, and 91K operators to revise the methodology for programming their adverse weather phenomena reporting and forecasting subsystems so that the subsystem-generated weather document for each flight contains all pertinent weather information, including Airmen's Meteorological Information, Significant Meteorological Information, and other National Weather Service in-flight weather advisories, and omits weather information that is no longer valid. (A-10-32)

Require principal operations inspectors of 14 *Code of Federal Regulations* Part 121, 135, and 91K operators to periodically review the weather documents generated for their carriers to verify that those documents are consistent with the information requested in Safety Recommendation A-10-32. (A-10-33)

Update the definitions for reportable icing intensities in the *Aeronautical Information Manual* so that the definitions are consistent with the more detailed intensities defined in Advisory Circular 91-74A, "Pilot Guide: Flight in Icing Conditions." (A-10-34)

4.2 Previously Issued Recommendations Reiterated in This Report

The NTSB reiterates the following recommendations to the Federal Aviation Administration:

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-05-1)

Require all 14 *Code of Federal Regulations* Part 121 air carrier operators to establish training 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)

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)

4.3 Previously Issued Recommendations Reclassified in This Report

Safety Recommendation A-07-13 is reclassified "Open—Unacceptable Response" in section 2.3.1 of this report.

Safety Recommendations A-03-53 and -54 are reclassified "Closed—Unacceptable Action/Superseded" in section 2.3.3 of this report. The recommendation is superseded by Safety Recommendation A-10-12.

Safety Recommendation A-07-8 is reclassified "Closed—Unacceptable Action/Superseded" in section 2.4.2 of this report. The recommendation is superseded by Safety Recommendation A-10-15.

Safety Recommendation A-05-1 is reclassified "Open—Unacceptable Response" in section 2.7.3 of this report.

Safety Recommendation A-07-4 is reclassified "Closed—Unacceptable Action/Superseded" in section 2.9.1 of this report. The recommendation is superseded by Safety Recommendation A-10-23.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

DEBORAH A.P. HERSMAN
Chairman

ROBERT L. SUMWALT
Member

CHRISTOPHER A. HART
Vice Chairman

Adopted: February 2, 2010

Board Member Statements

Chairman Hersman, Vice Chairman Hart, and Member Sumwalt filed the following concurring statements.

Notation 8090A
Chairman Hersman, Concurring:

This accident refocuses much needed attention on many long-standing issues of concern to the Safety Board – issues such as flight crew monitoring, pilot performance and training, sterile cockpit rules, FAA oversight, and the use of personal electronic devices, among others. I commend our staff for holding a public hearing and completing a thorough investigation in advance of the one-year anniversary of the accident. Their accomplishment was significant and had a tremendous impact on identifying critical concerns in the aviation industry.

I voted in support of the findings, the probable cause and the recommendations and, along with my colleagues, supported the adoption of the final report. However, during the public Board meeting, I submitted a proposal to the Board to amend the probable cause by adding fatigue as a fifth contributing factor, specifically that the flight crew members' fatigue contributed to the accident because they did not obtain adequate rest before reporting to duty. After open discussion, the Board rejected the amendment 2 to 1. While I would have preferred for fatigue to be included in the probable cause, that in no way diminishes my support for the Board's final product which I believe advances aviation safety.

Let me explain why I think fatigue, an issue that has been on our Most Wanted List of Transportation Safety Improvements since its inception in 1990, was a factor in this accident. Numerous accident investigations, research data and safety studies show that operators, like the flight crew in this accident, 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, and generally results in performance deficiencies like those present during this accident flight. As we conclude in the accident report, the flight crews' errors, including the captain's inappropriate response to the activation of the stick shaker and the flight crews' failure to monitor air speed, adhere to sterile cockpit procedures and adequately monitor the flight, were the causal and contributing factors of this accident. But I also believe that these errors are consistent with fatigue.

According to the FAA, operator fatigue is one of the most persistent hazards in all travel modes, including commercial aviation.[1] The Safety Board has examined operator fatigue in its safety studies on flight crew errors,[2] commuter airlines,[3] and aviation safety in Alaska.[4] In the flight crew study, the Board found that crews, comprised of captains and first officers whose time since awakening was above the median for their crew position, made more errors overall. In the study on commuter airline safety, the Board found that self-reports from commuter airline pilots indicated that most pilots had flown while fatigued. In the study on aviation in Alaska, the Board concluded that the consecutive, long duty days, permitted by Title 14 *Code of Federal Regulations* (14 CFR) Part 135.261 for commuter airline and air taxi flight crews

[1] Federal Aviation Administration, SAFO 06004; Approach and Landing Accident Reduction: Sterile Cockpit, Fatigue. 04/28/06.
[2] 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.
[3] National Transportation Safety Board, 1994. *Commuter Airline Safety.* Safety Study NTSB/SS-94/02.
[4] National Transportation Safety Board, 1995. *Aviation Safety in Alaska.* Safety Study NTSB/SS-95/03.

in Alaska, can contribute to fatigue and are a detriment to safety.[5] A 1999 NASA study found that 80% of regional airline pilots said they had nodded off during a flight,[6] and fatigue continues to show up in reports in NASA's Aviation Safety Reporting System.[7]

The question is why, after more than 40 years of documentation and investigation of the hazards of fatigue, so little has changed in our identification of fatigue as a causal or contributing factor in accidents. I would like to contrast how we have addressed fatigue with two other human factors issues that have matured in the last four decades -- alcohol impairment and adherence to standard operating procedures (SOPs).

Today, the impairing effects of alcohol are well understood and accepted by NTSB investigators and society at-large. However, this has not always been the case. Early in the Safety Board's history, the prevailing view was that an individual could be under the influence with a blood alcohol content above today's legal limit, and still not be considered drunk. For example, we investigated the 1967 collision in Baker, California, between a car travelling the wrong way on the highway and a bus which resulted in 20 fatalities and 11 injuries.[8] The NTSB calculated that at the time of the collision, the driver of the car had a blood-alcohol level of between .15 and .19 (or higher). Nonetheless the accident report states that "there is a difference between being "under the influence" of alcohol and varying degrees of drunkenness. In the common acceptance of the term, "drunkenness" is taken to mean that a person is in a helpless state of immobility." The report goes on to determine that the driver was not "drunk" because prior to the accident he successfully traveled around town by car, talked with friends and "therefore, it is logical to believe that he was able to read, comprehend and respond to traffic control devices, although probably not as well or as quickly as if he were sober." In the report, alcohol was not cited as one of the probable cause factors; it was listed as a contributing factor. The Safety Board concluded that because the driver was not immobilized by the alcohol, alcohol was not a causal factor. The use of alcohol, to a certain extent, was tolerated in the transportation industry and by society in general if an impaired individual could still function at some level.

Fortunately, we have advanced beyond this limited viewpoint. Alcohol testing is now a routine component of our accident investigations, and society has placed stricter limits on alcohol use. Today, safety-sensitive transportation employees are subject to random and post-accident drug and alcohol testing, and every state now has impaired driving laws with an .08 or higher breath or blood concentration legal limit. Federal regulations establish an even lower .04 limit for transportation professionals.

Fatigue-impaired performance is not unlike alcohol-impaired performance. For example, a 2003 study demonstrated that sleep loss is at least as potent as ethanol in its performance-impairing effects and two hours of sleep loss equates to a breath ethanol concentration of approximately .05%.[9] Other studies establish that prolonged wakefulness significantly impairs speed and accuracy, hand–eye coordination,

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[5] Evaluation of U.S. Department of Transportation Efforts in the 1990s to Address Operator Fatigue, NTSB/SR-99/01, May 1999.
[6] Co, E.L, et al. Crew Factors in Flight Operations XI: A survey of fatigue factors in regional airline operations. NASA/TM report no.199-208799.
[7]Michael B. Mann, Deputy Associate Administrator, NASA, Hearing on Pilot Fatigue, Aviation Subcommittee of the Committee on Transportation and Infrastructure, United States House of Representatives, August 3, 1999.
[8] National Transportation Safety Board, Interstate Bus Automobile Collision on Interstate Route 15, Baker, California, March 7, 1968.
[9] Roehrs T; Burduvali E; Bonahoom A et al. Ethanol and sleep loss: a "dose" comparison of impairing effects. *Sleep* 2003; 26(8):981-5.

decision making, and memory,[10] and one study, in fact, correlates prolonged wakefulness with impairment, such that being awake for 16 hours is equivalent to a .05 BAC.[11]

We have successfully identified the problem of impairment due to alcohol and drugs in the workplace, and the regulators and industry have devised rules, testing and treatment countermeasures to address the problem. The challenge we face now is creating an environment in which to identify the impairing effects of fatigue. Whether it is using predictive scheduling tools, technology such as eye or voice assessment, administering self tests to quickly assess fatigue or even coming up with a blood test to identify the extent to which fatigue is affecting an individual's ability to be vigilant, react quickly and avoid both lapses of attention and response errors – we need to address this critical problem.[12]

Another example of the progress we have made during the Safety Board's four decades-long investigations of human factors is adherence to Standard Operating Procedures, such as the sterile cockpit rule (prohibiting extraneous conversation below 10,000 feet). We have made the connection between violating the sterile cockpit rule and creating a lax environment in the cockpit that results in crews not being attentive to the task at hand. Today, for sterile cockpit violations to be cited in the probable cause, crews do not have to be engaged in a conversation at the time the accident sequence commences; the conversation just has to be present at some point during the flight.

An example of how far this concept has advanced was brought to my attention a few years ago in a petition for reconsideration for a 1967 mid-air collision of Piedmont Airlines flight 22, a Boeing 727, with a twin engine Cessna 310. The 727 was departing Asheville Regional Airport in North Carolina and the Cessna was on approach to the same airport. All 82 people aboard both aircraft were killed. The petition for reconsideration raised three points, one of which was that the NTSB report made no mention of a fire in a cockpit ashtray that preoccupied the Piedmont crew in the final 35 seconds before the collision. The time that lapsed from take-off to collision was only about 2 minutes and 37 seconds, however, the final accident report's only reference to the crew's recorded cockpit conversation stated that it was "concerned primarily with the operation of the aircraft and nothing was found of a probative value to the investigation." As difficult as it is to believe, the crew's preoccupation with the fire was not mentioned in the final report.

We have certainly come a long way. Today, extraneous conversation in the cockpit while under 10,000 feet is an unacceptable safety hazard and has regularly been cited as a causal or contributing accident factor. Like with fatigue, we do not have a test to demonstrate the degree to which a sterile cockpit violation affects a crew's performance. We similarly do not require that any causal or contributing factor equate to a percentage or share of the cause of an accident. Nonetheless, the Safety Board recognizes that a sterile cockpit violation can be a contributing factor for an accident, as was the case in this accident. In this accident, the crew was not behind in their checklists and had not violated the sterile cockpit rule in the two minutes prior to the upset. However the Board did believe that the sterile cockpit violation earlier in the flight created an "environment" where errors were not detected or recognized. Consequently, the sterile cockpit violation was one of four contributing factors to the accident. The exact same logic should be applied to our determination of fatigue; we can demonstrate that the crew was fatigued at the time of the accident and consistent with research, data and science, fatigue results in performance deficiencies that were displayed by the crew. Thus, fatigue should be included as a contributing factor.

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[10] Babkoff et al., 1988; Florica et al., 1968; Gillberg et al., 1994; Linde and Bergstrom, 1992; Mullaney et al., 1983.
[11] Dawson D, Reid K: Fatigue, alcohol and performance impairment. *Nature* 1997; 388: 235.
[12] Fatigue Management in Transportation Operations. 2009 International Conference; http://depts.washington.edu/uwconf/fmto/FatigueManagementAbstracts.pdf.

Just as the aviation industry, including the NTSB, has addressed alcohol use and adherence to SOPs, it must also address the issue of fatigue. Unlike many of our complex, technical or cutting edge findings that require further explanation to the public to show why we made the finding, I believe this situation is one that requires an explanation of why we did not reach a conclusion – that is, why we did not identify fatigue in the probable cause determination. Anyone who has attempted to overnight in a crew lounge, an office or an airport waiting room, or has tried to get a night's sleep on a red-eye flight from Seattle to Newark will tell you, this type of sleep in not recuperative, and the data and science support this. Anyone who has a new baby at home or is caring for an ill relative can tell you that interrupted sleep is not restorative sleep, and studies support this. Any employee who is asked to remain awake throughout the day and be prepared for the most demanding portion of their workday at 10pm after they have been awake for at least 15 consecutive hours would likely acknowledge that they are not at peak performance, and research supports this. Safety Board studies indicate that the duration of the most recent sleep period, the amount of sleep during the previous 24 hours, and split or fragmented sleep patterns are among the most critical factors leading to fatigue-related accidents.[13]

The failure of the Safety Board to include fatigue as one of the contributing factors in this accident is symptomatic of the Board's inconsistent approach to addressing fatigue in transportation accidents. We have developed a methodology to be used by our investigators in our on-going efforts to address fatigue in accident investigations through a fatigue checklist.[14] It is not necessary for fatigue to be the sole cause of an accident, but it should be included as a factor when it is present and performance deficiencies consistent with fatigue are identified. In 1999 the NTSB recognized that, "[a]lthough generally accepted as a factor in transportation accidents, the exact number of accidents due to fatigue is difficult to determine and likely to be underestimated. The difficulty in determining the incidence of fatigue-related accidents is due, at least in part, to the difficulty in identifying fatigue as a causal or contributing factor in accidents. There is no comparable chemical test for identifying the presence of fatigue as there is for identifying the presence of drugs or alcohol; hence, it is often difficult to conclude unequivocally that fatigue was a causal or contributing factor in an accident. In most instances, one or more indirect or circumstantial pieces of evidence are used to make the case that fatigue was a factor in the accidents."[15]

There is consensus at the Safety Board that the flight crew in this accident was likely fatigued, and our accident report makes this conclusion. The factual information in the docket establishes the presence of fatigue for both of these crew members.[16] The captain spent the night before the accident sleeping in the company crew room, where he obtained, at best, 8 hours of interrupted sleep as evidenced by multiple log-ins to the CrewTrac system at 2151, then 0310 and again at 0726. At worst, it was poor-quality, interrupted sleep of a shorter duration. NASA and other studies show that even in an onboard rest facility with beds available for long haul flight crews, pilots might get three hours of sleep and the quality does not approach 'home' sleep.[17] So, conservatively, the captain in this accident obtained 2 fewer hours sleep than his usual sleep and perhaps, significantly less based on the quality of sleep. In addition to this acute

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[13] National Transportation Safety Board, *Factors That Affect Fatigue in Heavy Truck Accidents*, Highway Safety Study NTSB/SS-95/01 (Washington, D.C.: NTSB, 1995).

[14] http://www.ntsb.gov/info/fatigue_checklist_V%202_0.pdf.

[15] SR99-01 - Evaluation of U.S. Department of Transportation Efforts in the 1990s to Address Operator Fatigue

[16] National Transportation Safety Board, Aircraft Accident Report: Crash on Approach to Airport Colgan Air, Inc. Operating as Continental Connection Flight 3407 Bombardier DHC-8-400, N200WQ Clarence Center, New York, Feb. 12, 2009, Human Performance Group Chairman Factual Report, Docket No. SA-531, and Addendum 1 DCA09MA027.

[17] Rosekind, M.R., Gregory, K.B., Miller, D.L., Co, E.L. (2000). Crew factors in flight operations XII: A survey of sleep quantity and quality in on-board crew rest facilities. (Technical Memorandum 2000-20961). Moffett Field, CA: NASA and Rosekind, M. R., Gregory, K. B., Miller, D. L., Oyung, R. L., Neri, D. F., & Dinges, D. F. Sleep quantity and quality of augmented long-haul flight crews in on-board crew rest facilities. *Sleep Research*, 1997, 26:41.

sleep loss, he had a cumulative sleep debt of between 6 and 12 hours, which reflected the 2 to 4 hours of sleep debt he accumulated over the course of each of the preceding three nights, two of which were spent in the crew lounge. At the time of the accident, he had been awake at least 15 hours – 3 hours more than the level at which the 1994 NTSB study identified performance degradation in accident flight crews. Finally, the accident occurred at the time of day when the captain would normally go to sleep.

The first officer was similarly not properly rested. 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. While she may not have experienced cumulative sleep debt, she likely had some acute sleep loss and, in the preceding 34 hours, had only gotten a maximum of 8.5 total hours of sleep – 3.5 hours of which were while traveling overnight cross-country (1 ½ hours from Seattle and 2 hours from Memphis to Newark), and the remaining 5 while resting in the company crew room. However, based on information contained in the docket including an interview of a flight attendant who had a conversation with the first officer during the 1100 hour, the 5 hours of rest in the crew lounge between 0800 and 1300 are questionable. Again, it is not likely that she obtained recuperative sleep in a busy, well-lit crew room.

Reflective of these facts, the Safety Board accident report concludes that "[t]he pilots' performance was likely impaired because of fatigue…" However, the report diminishes the significance of this finding when it states that "[sic] the extent of their impairment and the degree to which [fatigue] contributed to the performance deficiencies that occurred during the flight cannot be conclusively determined." More simply, the report concludes that while fatigue likely impaired the pilots' performance, because we could not assign fatigue a percent or number, we discount it as a contributing factor of the accident.

This approach is not consistent with our determinations in other accident investigations. For example in the collision between a truck and an Amtrak train in Bourbonnais,[18] the Safety Board stated that "despite the fact that the truck driver was suffering from fatigue at the time of the accident, investigators could not determine the extent to which fatigue accounted for his performance" (analysis page 55). However, that did not prevent the Board from citing in the probable cause for the accident the truck driver's "inappropriate response to the grade crossing warning devices and his judgment, likely impaired by fatigue." Similarly, in a collision between two trains in Macdona, Texas,[19] the Safety Board concluded that "neither the engineer nor the conductor of the Union Pacific Railroad train made effective use of the time that was available to them to obtain rest." In that accident, the Safety Board identified fatigue as the cause of the crew's inappropriate response to wayside signals governing the movement of their train. Contributing to the crewmembers' fatigue was their failure to obtain sufficient restorative rest prior to reporting for duty because of their ineffective use of off-duty time and the company scheduling practices which inverted their sleep cycles. In the 1989 grounding of the U.S. tank ship *Exxon Valdez*, many recall the intoxication of the ship's Captain, but this was also a significant fatigue accident. Fatigue was identified as a major contributor that, subsequently, was given serious national and international attention when the Board stated that "there were no rested deck officers on the *Exxon Valdez* available to stand the navigation watch when the vessel departed from the Alyeska Terminal."[20] Fatigue was cited in the probable cause of the accident.

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[18] National Transportation Safety Board, Collision of National Railroad Passenger Corporation (Amtrak) train 59 with a loaded truck-semitrailer combination at a highway/rail grade crossing in Bourbonnais, Illinois, March 15, 1999.

[19] National Transportation Safety Board, Collision of Union Pacific Railroad Train MHOTU-23 With BNSF Railway Company Train MEAP-TUL-126-D With Subsequent Derailment and Hazardous Materials Release; Macdona, Texas; June 28, 2004; RAR0603.

[20] National Transportation Safety Board, Grounding of U.S. Tank ship Exxon Valdez on Bligh Reef, Prince William Sound Near Valdez, Alaska, March 04 1989. NTSB/ MAR-90/04, Washington D.C.: NTSB.

In other more recent Safety Board aviation accident investigations, the Board concluded that fatigue – even if unquantifiable – caused or contributed to the accident. For example, in the Shuttle America accident in Cleveland in 2007[21], the Board determined that fatigue was one of four contributing factors, such that the captain's fatigue affected his ability to effectively plan for and monitor the approach and landing. Also in 2007, in our investigation of the Pinnacle, Traverse City accident,[22] the Board found that poor decision making by the pilots likely reflected the effects of fatigue produced by a long, demanding duty day. In another case, the 2004 Kirksville, Missouri accident,[23] the Board found that the pilots' fatigue likely contributed to their degraded performance. It is important to note that similar to this accident, in the CVR transcripts for both the Shuttle America and Kirksville accidents, the crewmembers are engaged in conversation throughout the flight, chatting about various topics, and in the Kirksville accident their sterile cockpit violation is also cited in the probable cause. In each of these investigations, the Safety Board determined that fatigue caused or contributed to the accident. We should be making a similar determination here.

Presently, we do not have the tools to conclusively determine the degree to which a person is fatigued. We cannot pinpoint whether fatigue results in 20% memory reduction, 50% degraded decision-making ability, 25% slower reaction time, or some other value for each individual. This difficulty, however, does not mean we cannot – or should not – find that fatigue contributed to the accident. Making a determination that fatigue is a contributing factor does not detract from this accident report's other determinations, nor is it an all-or-nothing proposition. A captain can be a poor performer and also be fatigued. The crew may violate the sterile cockpit rules and be fatigued. A first officer may not adhere to standard operating procedures and also be fatigued.

The issue of fatigue challenges us to periodically adjust our lens and take a fresh look to ensure that the aviation industry and the crews who fly our skies report to work rested and fit for duty. Fatigue is complex and multifaceted. During my time at the Board, we have issued recommendations about sleep disorders, flight and duty time revisions, fatigue management systems, education and training. I suggest that our failure to identify fatigue as a factor in this accident is not just a missed opportunity, but also turns a blind eye to a situation that even the average person can recognize. We are never going to change the debate on fatigue unless we face it head on. That means dealing with all aspects of fatigue – from revising the hours of service to sleep disorders to personal responsibility to commuting.

Flight crew commuting is particularly challenging. A regional flight crew's home base changes often, and to offset the disruption of frequent relocations, pilots may commute from a home location. The Colgan Air pilots were commuting pilots. Both pilots were based in ERW but the captain lived in Florida and the first officer in Seattle. During the previous 14 months, the first officer lived in Phoenix (when hired by the company), then expected to be based in Houston before being sent to Norfolk, Virginia and then at the time of the accident, was based in Newark, New Jersey but lived in Seattle, Washington. Flight crew salaries are also problematic. It is financially challenging for pilots, whether earning $60,000 or $16,000, to regularly relocate their families or hold down multiple residences. When the FAA convened the fatigue

[21] National Transportation Safety Board, Aircraft Accident Report: Runway Overrun During Landing Shuttle America, Inc. Doing Business as Delta Connection Flight 6448 Embraer ERJ-170, N862RW Cleveland, Ohio February 18, 2007. AAR-08-01

[22] National Transportation Safety Board, Aircraft Accident Report: Runway Overrun During Landing Pinnacle Airlines Flight 4712 Bombardier/Canadair Regional Jet CL600-2B19, N8905F Traverse City, Michigan April 12, 2007, AAR-08-02.

[23] National Transportation Safety Board, Aircraft Accident Report: Collision with Trees and Crash Short of Runway, Corporate Airlines Flight 5966, British Aerospace BAE-J3201, N875JX, Kirksville, Missouri, October 19, 2004. AAR-06-01.

ARC in the summer of 2009, they took commuting off the table, and neither Colgan, nor ALPA addressed the issue of commuting in their accident submission documents, even though 70% of the pilots based in Newark commute and 20% commute from over 1000 miles away. I recognize that an objective analysis of commuting will be a difficult, and perhaps, uncomfortable discussion. But we should not be afraid to confront this issue in the context of understanding fatigue and its effect on pilot performance.

The one constant throughout this discussion is that the causes of fatigue among pilots are fairly well-defined and that the results of fatigue, namely accidents of varying degrees, are well-known. Unfortunately, in the aviation industry, fatigue-related decisions – 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.

The tragedy in this accident report is that what we uncovered in the investigation, we already knew. The FAA talks about safety being their highest priority. Colgan Air's slogan was never to compromise safety. The pilots want a safe profession. Yet, if we are serious about safety, we must establish an aviation system that minimizes pilot fatigue and ensures that flight crews report to work rested and fit for duty. Flying tired is flying dangerously, and it is a practice that needs to end.

Notation 8090C

Concurring Statement by Vice-Chairman Christopher A. Hart

In concurring with the report and decision regarding this tragic accident, I commend the staff for such a thorough and detailed investigation and report, and I commend the Board for bringing the benefit of various viewpoints and perspectives to help address some very complex and difficult issues, including several issues on which reasonable people can differ. I also commend the staff for recommending that two issues of industry-wide significance be treated in an industry-wide manner, rather than solely in relation to this accident – (a) pilot professionalism, and (b) the impact upon safety of code-sharing arrangements between major and regional carriers. In this concurring statement, I would like briefly to address the first of those two issues as well as FOQA.

Pilot Professionalism

In the sunshine meeting I stated my concern that our commercial aviation system is experiencing a declining percentage of airline pilots who have the benefit of military pilot training, and our system is not adequately responding to the challenges that are being created by that decline. Not only is military training world-class, but the military has a long history of effectively weeding out those who simply lack "the right stuff."

This is not to say that pilots cannot get world-class training in our civilian system; but that system needs, among other things, a more effective weeding process. Currently the pilot licensing process is based upon passing various written and flight tests – but there is no distinction between those who pass the *first* time, versus those who don't pass until the *third* time, versus those who don't pass until the *ninth* time. Most of what most attorneys do is not potentially life-threatening for their clients, yet some states limit the number of times that lawyers-to-be can fail the bar exam. In addition, I am aware of at least one mode of transportation in which failure to pass a critical written test the *second* time results in dismissal from the program, and passing the test requires a score of 100.

Similarly, there is no distinction in our civilian system between those who pass flight tests the first time versus those, such as the captain in this accident, who failed the first attempt in several different flight tests.

Moreover, written tests largely measure knowledge, and flight tests largely measure "stick and rudder" skills." Other crucial attributes are not generally measured by either of these tests, such as discipline and judgment – two attributes for which the effectiveness of military training is also well known, but that have also been shown lacking in this and other recent commercial aviation accidents and incidents.

Our civilian system needs to address the challenge of systematically continuing to provide the world-class pilot training that the military has provided for so many years, and the system particularly needs a better way to keep out those who should not begin or continue flying passengers for hire.

Flight Operational Quality Assurance (FOQA)

Before coming to the NTSB I was involved in developing and facilitating various proactive information programs at the FAA, and in doing so, I have frequently stated my opposition to mandating FOQA programs. Voluntary FOQA programs in the US provided much of the crucial information that the industry safety processes used to decrease the US fatal accident rate by 65% from 1997 to 2007 – amazing enough in and of itself, but even more so given that the industry was already generally considered to be very safe in 1997. Mandating FOQA in the wake of that success story could be viewed as “punishing” those who did the right thing, and runs the risk of making the perfect, i.e., 100% implementation of FOQA, the enemy of the good.

In a world in which FOQA programs are not as widely implemented as they are in the US, I certainly understand why ICAO wants them mandated; but in the US, where voluntary implementation is so widespread – the vast majority of passengers in the US are carried on airlines with FOQA programs – the need for a mandate is not so apparent.

One of my major concerns about mandating FOQA is that a mandate could result in a loss of the protection that FOQA information currently has when it is shared with the FAA. When the proposal was offered not to require sharing of the information with the FAA unless and until legislation is obtained that protects information that is shared with the FAA, I felt that it would be better for the safety of the system to concur with a mandate recommendation, as so modified, rather than having the mandate recommendation be adopted by majority vote, over my dissent, as it was originally proposed.

Notation 8090A
Member Sumwalt, Concurring

I fully support this aircraft accident report and applaud the work of staff to bring this report to the Board in a timely fashion. I file this concurring statement to amplify a few of the important decisions that were reached in the Board Meeting.

The Board approved a recommendation to "[r]equire all 14 *Code of Federal Regulations* Part 121, 135, and 91K operators to (1) routinely download and analyze all available sources of safety information, as part of their flight operational quality assurance (FOQA) program, to identify deviations from established norms and procedures; and (2) provide appropriate protections to ensure the confidentiality of the deidentified aggregate data; and (3) ensure that this information is used for safety-related and not punitive purposes."

I have long supported FOQA programs. I worked as a union-representative, reading and analyzing FOQA data, while employed as a pilot for a Part 121 airline. I realize that significant and sizable safety benefits can emerge from such programs. Because of these safety benefits, I have deep concerns about the safety commitment of those air carriers that do not have FOQA programs.

Presently less than a small handful of regional airlines have FOQA programs; a few major carriers do not, either. Remarkably, this is three years after the Board issued a recommendation to the FAA to strongly encourage regional airlines to incorporate FOQA. Despite the attention that has been drawn to the lack of FOQA within the regional airlines, few have implemented it. Quite simply, voluntary compliance isn't working in all cases.

I question how we can have one level of safety for the American traveling public if some airlines have FOQA while others do not. To bridge that gap, I voted for this recommendation to require all operators to implement FOQA programs.

I realize that our recommendation that air carriers should routinely download and analyze *all* available sources of safety information may also include the download and analysis of cockpit voice recorders (CVRs). The notion of using CVRs in a proactive manner (in a FOQA program) is a radical departure from my previous belief that CVRs should be used solely for accident investigation. But I, like the majority of today's safety professionals, have moved from the notion of waiting for an accident to occur to determine what failed, to a forward-thinking, proactive belief that it is better to use information to prevent the accident in the first place. And that was the very genesis of FOQA – utilizing data recorders that typically were not used until after an accident to now using them to discover trends and information that could be useful in the prevention of accidents.

An unfortunate reality in the wake of the Colgan Air accident and an October 2009 event that involved an airliner overflying its destination -- presumably due to the pilots being distracted with laptop computers -- is the tremendous public, media, and congressional attention upon the need to monitor pilots more closely for compliance with procedures. Some have suggested downloading and monitoring CVRs for use in a punitive environment. In that plan airlines would routinely review CVRs and discipline pilots for noncompliance.

Those of us with a safety focus, however, realize that a punitive culture cannot co-exist within an effective safety culture.

When FOQA programs were first established there was a great deal of skepticism and trepidation concerning potential abuse. But over the years, pilots have accepted – even supported - these programs, and the safety benefits have been enormous. I believe this proactive stance is one major reason for the significant decrease in commercial airline accidents in the past decade.

Can we achieve additional safety benefits by including CVRs in FOQA programs? Without question, we can. And considering that some are calling for using CVRs in a punitive fashion, I would prefer to see them instead used in a safety context. The language was clear in the recommendation approved by the Board: "ensure that this information is used for *safety-related* and not *punitive* purposes."

I believe that by keeping this information in a safety context rather than a punitive one, and by *requiring* FOQA instead of merely advocating it as a voluntarily program, we will raise the safety bar and move closer to one level of safety for the traveling public. And that is precisely our goal here at the Safety Board.

Next, I would like to discuss my position on the issue of fatigue. During the Board Meeting we had an insightful discussion regarding the role of fatigue and whether or not it should be included in the probable cause. In the end, the majority decided that it should not.

To be clear, I have no doubt that the crew was fatigued. The issue at hand, however, is the degree to which fatigue affected their performance.

There is essentially a two-pronged test that must be met before a reasonable determination can be made regarding fatigue and its role in an accident. First, we must show the crew was fatigued; second, we must show that fatigue adversely affected the crew's performance.

Regarding the first prong, I believe there is clear and convincing evidence that the crew was fatigued. As stated in the Board Meeting, the crew abdicated their professional responsibility to report to work rested and ready for work. The captain spent the night before the accident in the crew room -- a facility that is suitable for napping, but one that is unsuitable for obtaining overnight rest before acting as an airline crewmember. The first officer, likewise, commuted cross-country on overnight flights, arriving at her crew base the morning of the accident.

Additionally, as pointed out in the Board Meeting, the captain had likely been awake for at least 15 hours at the time of the accident and was likely running a sleep debt of six to twelve hours over the three days prior to the accident. From this, I conclude that the captain and the first officer were fatigued.

The second prong, however, is not as easy to prove. As noted in the report, throughout the flight the pilots were engaged in conversation. Neither acted withdrawn, lethargic or made any statements about being tired or receiving inadequate sleep. And, staff stated in the Board Meeting and in the report that the errors of the crew cannot be solely attributed to fatigue because of other explanations for their performance. For example, the fundamental error of failure to monitor to airspeed is an error that the Board has found in many other accidents – ones where the crews were not necessarily fatigued. The report also notes that the captain's poor performance on the night of the accident could be "consistent with his pattern of performance failures during testing, which he had experienced throughout his flying career."

In short, because the first prong of the fatigue test was met but not the second, the Board unanimously adopted the following finding of the investigation: "The pilots' performance was likely impaired because of fatigue, but the extent of their impairment and the degree to which it contributed to the performance deficiencies that occurred during the flight cannot be conclusively determined."

As to the question of whether or not to include fatigue as part of the probable cause statement, the majority felt that this would not be a reasonable conclusion. An NTSB investigation is a methodological, organized, and deliberate process. A flow of logic is an underpinning of a good investigation. This is assured by ensuring that the facts of the investigation support the analysis, the analysis supports the findings, and the findings support the probable cause and recommendations.

To state that fatigue was a contributing factor, and thus part of the probable cause, would be inconsistent with the above finding and would, therefore, disrupt this flow of logic.

I did not feel, therefore -- nor did the Board's majority -- that we had sufficient information or evidence to conclude that fatigue should be part of the probable cause of this accident.

Robert L. Sumwalt III   2-4-10

Robert L. Sumwalt, III

5. Appendixes

Appendix A

Investigation and Hearing

Investigation

The National Transportation Safety Board was notified of this accident about 2230 on February 12, 2009. A go-team launched early the next morning. Accompanying the team to Buffalo was former Board Member Steven Chealander.

The following investigative teams were formed: Operations, Human Performance, Structures, Systems, Powerplants, Air Traffic Control, Meteorology, Aircraft Performance, Maintenance Records, and Pipeline. Also, specialists were assigned to conduct the readout of the flight data recorder and transcribe the cockpit voice recorder at the NTSB's laboratory in Washington, D.C.

Parties to the investigation were the Federal Aviation Administration (FAA), Colgan Air, Air Line Pilots Association (ALPA), National Air Traffic Controllers Association, and United Steelworkers Union (Flight Attendants). In accordance with the provisions of Annex 13 to the Convention on International Civil Aviation, the Transportation Safety Board of Canada (TSB) participated in the investigation as the representative of the State of Design and Manufacture (Airframe and Engines), and the Air Accidents Investigation Branch of the United Kingdom (AAIB) participated in the investigation as the representative of the State of Design and Manufacture (Propellers). Transport Canada, Bombardier, and Pratt & Whitney Canada participated in the investigation as technical advisors to the TSB, and Dowty Propellers participated in the investigation as a technical advisor to the AAIB, as provided in Annex 13.

Public Hearing

A public hearing was held from May 12 to 14, 2009, in Washington, D.C. Former Acting Chairman Mark Rosenker presided over the hearing; Board Member and current Chairman Deborah Hersman, former Board Member Kathryn Higgins, and Board Member Robert Sumwalt also participated in the hearing. The issues presented at 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.

The technical panel comprised investigators from the NTSB and the TSB. Parties to the public hearing were the FAA, Colgan Air, ALPA, and Bombardier.

Appendix B

Cockpit Voice Recorder

The following is a transcript of the Honeywell model 6022 SSCVR 120 cockpit voice recorder, serial number 97896, installed on a Bombardier DHC-8-400, N200WQ, operated by Colgan Air, Inc., as Continental Connection flight 3407, which crashed into a residence in Clarence Center, New York, while on an instrument approach to Buffalo-Niagara International Airport, Buffalo, New York, on February 12, 2009:

LEGEND

CAM	Cockpit area microphone voice or sound source
HOT	Flight crew audio panel voice or sound source
INT	Interphone voice or sound source
PA	Public address sound source
RDO	Radio transmissions from N200WQ
RAMP	Radio transmission from Newark Ramp controller
GND	Radio transmission from Newark Ground controller
TWR	Radio transmission from the Newark Tower controller
DEP	Radio transmission from New York Departure controller
ZNY	Radio transmission from the New York Center controller
ZOB	Radio transmission from the Cleveland Center controller
APP	Radio transmission from the Buffalo Approach controller
OPS	Radio transmission from the Colgan Buffalo Operations ground controller
-A	First controller at identified ATC facility
-B	Second controller at identified ATC facility
-C	Third controller at identified ATC facility
-1	Voice identified as the captain
-2	Voice identified as the first officer
-3	Voice identified as the flight attendant
-?	Voice unidentified
*****	Unintelligible word
#	Expletive
@	Non-pertinent word
( )	Questionable insertion
[ ]	Editorial insertion

Note 1: Times are expressed in Eastern Standard Time.

Note 2: Generally, only radio transmissions to and from the accident aircraft were transcribed.

Note 3: Words shown with excess vowels, letters, or drawn out syllables are a phonetic representation of the words as spoken.

Note 4: A non-pertinent word, where noted, refers to a word not directly related to the operation, control or condition of the aircraft.

INTRA-AIRCRAFT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
20:15:48 **START OF RECORDING** **START OF TRANSCRIPT**			
20:16:03.4 **HOT-1**	heard somebody on the— on the phone earlier today before I saw you for the first time this morning. I believe it was— yeah yeah it was before that. that uh was talking about you know possibly getting Qs later this year.		
20:16:11.0 **HOT-2**	uh-huh… oh yeah?		
20:16:23.3 **HOT-1**	so there's been some scuttlebutt...uh...		
		20:17:30.3 **RAMP**	Colgan thirty four oh seven monitor ground on point eight. he'll be with you in about uh five minutes.
		20:17:35.7 **RDO-2**	over to ground Colgan thirty four zero seven.
20:17:43.2 **HOT-2**	yeah I've heard so many things and people say this and people say that.		
20:17:47.3 **HOT-1**	yeah.		
20:17:47.6 **HOT-2**	I'm just— I'm surprised at how calmly— I usually don't do very well with not knowing what's happening. I like to know exactly what it's going to be you know in my future for the next day the next week the next month. and I'm just— now that I'm commuting from Seattle I'm thinking you know it really doesn't matter where you know I would— if it went anywhere else I'd put in a bid to go anywhere but Newark. I can't get farther away from Seattle really...well so much I like Florida but I just have never heard any of those rumors.		
20:18:20.8 **HOT-1**	no I haven't either.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:18:22.1 **HOT-2**	or Atlanta.		
20:18:22.8 **HOT-1**	actually the the the Saab would do pretty well as long as they weren't on uh they would never go on derivative power. [sound of throat clearing] they have a derivative uh— oh man DC ten. or an MD eleven. one of the two.		
20:18:36.2 **HOT-2**	**.		
20:18:41.3 **HOT-1**	FedEx. oh you know those guys. that was like a carrier landing to them.		
20:18:45.2 **HOT-2**	yeah.		
20:18:49.1 **HOT-1**	um anyway uhhh— what was I gonna say...oh the Saab.		
20:18:57.1 **HOT-2**	yeah.		
20:18:57.3 **HOT-1**	they have a derivative engine program that uhh you know when the engine starts producing less then then rated power you know they— then we go into a derivative situation. the only time it hurts which would really hurt in Florida obviously is when it's hot and heavy.		
20:19:05.7 **HOT-2**	uh-huh...yeah.		
20:19:16.8 **HOT-1**	you know it doesn't climb for beans. but but as far as— I flew the nineteen hundred in in Florida and to go down there in the summertime in the afternoon when the thunderstorms are all developing and everything that nineteen hundred gets tossed around pretty good.		
20:19:35.5 **HOT-2**	yeah.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:19:36.1 **HOT-1**	but the uh the three forty is pretty solid. it it uh it bounces around but it it's so much heavier than the nineteen hundred it doesn't— it doesn't do too bad.		
20:19:47.3 **HOT-2**	yeah I was flying in Flagstaff and the density in Arizona— the density altitude of I think it's like eleven thousand five hundred.		
20:19:56.8 **HOT-1**	uh-huh.		
20:19:58.5 **HOT-2**	and that I was just in like an Arrow— a Piper Arrow. but the runway slopes a little bit and you can't climb faster than the runway slopes like you'll take off and then the runway slopes up a little bit— Sedona does the same thing and I was there around the same week when it was just horrible density altitude. and you'd take off and my students would try to pull the nose up and I'd push it right back down and you know you'd hit the runway again before you can get enough speed to actually get up and off the ground. it's really not a very comfortable feeling.		
20:20:24.5 **HOT-1**	wow.		
20:20:27.5 **HOT-2**	but when it's a hundred and twenty down in Phoenix and you get a little bit higher in the mountains and you know it's still it's cooled down to a hundred and five but you're at you know seven thousand feet altitude.		
20:21:22.9 **HOT-2**	I was in one of those this morning.		
20:21:25.4 **HOT-1**	yeah.		
20:21:26.1 **HOT-2**	I was in one of those this time last night.		
20:21:41.2 **HOT-1**	ohhh heavens.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:22:23.7 **HOT-1**	you know the bad thing is is uh because they you know cancelled the Rochester round trip— or wherever we were going— was it Rochester? yeah I think it was.		
20:22:33.7 **HOT-2**	yeah. now this doesn't mean anything.		
20:22:35.7 **HOT-1**	this doesn't mean anything. you know you can't uh make a dime off of this.		
20:22:41.0 **HOT-2**	yeah although I'm still excited about flight time so. [sound of laughter] I'm glad you know the more flight time I get the better.		
20:23:14.1 **HOT-?**	[sound of sniffle]		
20:23:14.5 **HOT-2**	no and they— I told you that they dropped a four day trip from my PC check.		
20:23:18.8 **HOT-1**	yeah yeah yeah.		
20:23:19.4 **HOT-2**	yeah so I think I'm at like sixty five hours or so anyways. it it would take a lot of over to get me up there.		
20:23:33.1 **HOT-2**	did you see the lines for next month?		
20:23:35.3 **HOT-1**	shew. yeah I saw them. not good for me. [sound of throat clearing]		
20:23:39.4 **HOT-2**	ohhh. I printed them out I didn't look at them.		
20:23:43.2 **HOT-1**	I'll be in the back. just a sec.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:23:44.7 **HOT-2**	I got one.		
20:23:46.7 **PA-1**	folks from the flight deck just to keep you updated. uh we're we're gonna be sitting here just for a few more minutes uh... we did have some taxi delays out there obviously because of the uh the weather. uh planes are moving right now we're about number twenty uh for takeoff so it'll be uh it'll probably be another forty minutes. forty to forty five minutes before we're airborne. I appreciate your patience.		
20:24:15.2 **HOT-1**	[sound of throat clearing]		
20:24:30.3 **HOT**	[sound of double chime]		
20:24:34.9 **INT-1**	what's up?		
20:24:35.3 **INT-2**	hi. passengers would like to know if they can use cell phones. they all need to do some calls.		
20:24:39.5 **INT-1**	oh I I figured as much. I thought about that right whenever uh I got done.		
20:24:46.1 **INT-3**	that be okay?		
20:24:46.7 **INT-1**	and I was just waiting for the call. I knew you were gonna call. I was just you know I was surprised you didn't call fifteen seconds earlier.		
20:24:49.1 **INT-3**	[sound of laughter]		
20:24:55.2 **INT-3**	and were gonna go ahead and give ‘em some water. is that okay?		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:24:58.2 **INT-1**	uh yeah but be careful because I may be moving up here just you know in just a little while just to a different place.		
20:25:03.8 **INT-3**	okay. okay that's fine.		
20:25:05.3 **INT-1**	and if you guys want to be up and uh do some water or something that'll be good.		
20:25:07.2 **INT-3**	yeah yeah just in case we can't do any service in the air. ‘cause I have to tell you a lot of them are not very happy so we'll try to get them happy. [sound of laughter]		
20:25:15.7 **INT-1**	okay that sounds wonderful. okay thanks.		
20:25:16.8 **INT-3**	thanks. alright.		
20:25:30.0 **PA-3**	ladies and gentlemen if you need to use your cellphones I have asked the captain and he said that it would be okay. thank you.		
20:25:39.5 **HOT-?**	[sound of sniffle]		
20:25:49.1 **HOT-1**	ohh heavens...I am glad I came over to the uh Q. my— my whole deal with uh you know comin' over even though I'm kind of getting screwed on the on the schedules.		
20:26:05.6 **HOT-2**	yeah.		
20:26:06.0 **HOT-1**	and I'll you how uh what it will do is if these things go to Houston in six months or nine months or whatever I'm already in the Q.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:26:16.5 **HOT-2**	yeah.		
20:26:19.3 **HOT-1**	uh there are a lot of guys in Houston right now that have more seniority than I do uh um that refuse to go to the Q until it gets to Houston.		
20:26:31.3 **HOT-2**	yeah.		
20:26:32.1 **HOT-1**	so I figured well you know I'll go ahead and jump in the Q.		
20:26:36.5 **HOT-2**	yeah.		
20:26:37.0 **HOT-1**	uh maybe I'll be able to uh take another day off.		
20:26:39.7 **HOT**	[sound of double chime]		
20:26:41.2 **HOT-1**	I'll get it.		
20:26:43.1 **INT-1**	yes?		
20:26:43.5 **INT-3**	what about using the lav? we've got a couple of people that are a little annoyed because we're telling them they can't use the lav.		
20:26:51.3 **INT-1**	uh well you know as long as I'm sittin' here uh let me know whenever they're seated because I I don't know when they're gonna— when they're gonna release us to uh to move. uh but go ahead and just keep us updated for each and every person that gets up to go to the lav I need to know when they're seated. when they're seated.		
20:27:09.1 **INT-3**	oh okay.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:27:09.7 **HOT-1**	okay?		
20:27:10.4 **INT-3**	alright.		
20:27:11.1 **INT-1**	alright.		
20:27:11.5 **INT-3**	alright.		
20:27:11.8 **INT-1**	tell them to piss off early.		
20:27:14.9 **HOT-2**	[sound of laughter]		
20:27:17.7 **HOT-2**	[sound of throat clearing]		
20:27:30.8 **HOT-1**	anyway. um you know I jumped on this thing. I figured you know I was busting my butt on the on the Saab.		
20:27:39.2 **HOT-2**	yeah.		
20:27:39.8 **HOT-1**	um my philosophy is it's all about the pay credit.		
20:27:44.3 **HOT-2**	uh-huh.		
20:27:44.6 **HOT-1**	'kay that's what I live and breath by but uh I mean I had one month last summer uh July or August. had a hundred forty seven hours of pay credit.		
20:27:59.0 **HOT-2**	yeah...that's nice.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:27:59.4 **HOT-1**	that was sweet. and and I you know I never did but I thought man if I— if I was on the Q—.		
20:28:05.5 **HOT**	[sound of double chime]		
20:28:07.3 **HOT-2**	that'd be so much more.		
20:28:08.3 **HOT-1**	yeah oh gosh yeah.		
20:28:09.2 **INT-2**	howdy.		
20:28:10.3 **INT-3**	I have someone in the lav right now and then there'll be another person going in and I'll let you know when they're out and seated. okay?		
20:28:17.1 **INT-1**	alright.		
20:28:17.5 **INT-3**	alright thanks.		
20:28:19.9 **HOT-1**	um but you know once I get down there it's gonna take a month month and a half for everybody to go through you know how ever many they take at a time.		
20:28:27.9 **HOT-2**	yeah.		
20:28:30.4 **HOT-1**	once it gets down there. plus there's also a bunch of other guys that are here that uh—.		
20:28:36.6 **HOT-2**	[sound of sneeze]		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:28:37.4 **HOT-1**	bless you. that want to uh go back to Houston.		
20:28:41.9 **HOT-2**	yeah.		
20:28:42.9 **HOT-1**	a bunch.		
20:28:45.4 **HOT-2**	there's a ton of em.		
20:28:48.8 **HOT-1**	there's uh there's even a few that uh have never been to Houston [sound of laughter] that want to get the heck out of Newark.		
20:28:54.5 **HOT-2**	that's that's me.		
20:28:55.8 **HOT-1**	so—.		
20:28:56.8 **HOT-2**	I'll go. I'll put in a bid for wherever this thing goes. I figured they— if it went to Houston there might be some more FOs that would want to transition over but they'd let me go down before they transition other guys over wouldn't they? yeah.		
20:29:08.1 **HOT-1**	oh sure oh sure. because they would let you go as the openings are available and your seniority dictates.		
20:29:14.4 **HOT-2**	yeah yeah.		
20:29:16.3 **HOT-1**	uh once you get down there and and this would be very similar to me.		
20:29:20.8 **HOT-2**	yeah.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:29:21.1 **HOT-1**	uh—.		
20:29:22.7 **HOT-2**	they can't kick me out once they allowed me down there though can they?		
20:29:25.1 **HOT-1**	oh no no.		
20:29:25.9 **HOT-2**	yeah.		
20:29:26.6 **HOT-1**	but it but it would happen the exact same thing with me as it would with you.		
20:29:31.8 **HOT-2**	yeah.		
20:29:32.4 **HOT-1**	we get down there shew we get this schedule this schedule this schedule and as they kept as they keep transitioning people over our schedules get worse and worse and worse.		
20:29:36.3 **HOT-2**	yeah yeah worse and worse and worse.		
20:29:43.8 **HOT-1**	but uh you know that's that's in the future we'll see what happens.		
20:29:44.5 **HOT-2**	[sound of sniffle]		
20:29:49.0 **HOT-2**	yeah.		
20:29:50.0 **HOT-1**	but even on the Saab uh I was able to make about uh gross about sixty thousand last year so—.		

INTRA-AIRCRAFT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
20:30:02.4 **HOT-2**	I made gross fifteen thousand eight hundred. I got here in January. aww.		
20:30:03.0 **HOT-1**	but I— yeah no I know no I know. I I understand. I was on the on the uh FO uh welfare—.		
20:30:12.9 **HOT-2**	you were there when it was nineteen an hour weren't you?		
20:30:15.4 **HOT-1**	no I never was on nineteen. no.		
20:30:16.3 **HOT-2**	[sound of sniffle] oh. that's good.		
20:30:20.1 **HOT-2**	I'm just lucky 'cause I have a husband that's working.		
		20:30:22.2 **GND**	Colgan thirty four zero seven you're at romeo mike correct?
		20:30:25.4 **RDO-2**	uh romeo hotel Colgan thirty four zero seven.
		20:30:27.6 **GND**	okay Colgan thirty four zero seven out of romeo hotel roger. you're gonna give way to Delta from the left and then taxi via bravo and hold short of kilo.
		20:30:37.8 **RDO-2**	give way to Delta then bravo short of kilo for Colgan thirty four zero seven.
20:30:41.8 **HOT-2**	[sound of sniffles]		
20:30:42.8 **HOT-1**	alright give way to Delta then I'm sorry.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:30:44.5 **HOT-2**	bravo short of kilo.		
20:30:45.6 **HOT-1**	bravo short of kilo.		
20:30:46.8 **HOT-2**	I don't see a Delta.		
20:30:48.0 **HOT-1**	right here. this uh plane here.		
20:30:50.0 **HOT-2**	oh gotcha.		
20:30:51.9 **HOT**	[sound of double chime]		
20:30:55.6 **HOT-1**	[sound of throat clearing]		
20:30:56.8 **INT-3**	hello?		
20:30:57.9 **INT-1**	hey are they are they back?		
20:30:58.6 **INT-3**	I still have another one in the bathroom and another one waiting. do you need—.		
20:31:02.6 **INT-1**	no I uh I uh we need to go.		
20:31:04.9 **INT-3**	okay uh.		
20:31:05.1 **INT-1**	so the one waiting has to wait and I I'm gonna have to coordinate to uh.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:31:05.8 **INT-3**	okay okay. one in there right now as soon as she comes out I'll—.		
20:31:14.7 **INT-1**	alright well this is— I was afraid of this. alright thanks.		
20:31:16.3 **INT-3**	okay okay alright.		
20:31:25.5 **HOT-2**	she might get out in time.		
20:31:30.0 **HOT-1**	God.		
20:31:34.4 **CAM**	[sound similar to door closing]		
20:31:35.4 **HOT-2**	there you can hear her getting out now.		
20:31:36.8 **HOT-1**	yeah.		
20:31:42.4 **HOT-2**	totally lose our spot you can hear him.		
20:31:49.3 **HOT-2**	here I go.		
20:31:49.7 **HOT**	[sound of double chime]		
20:31:50.4 **INT-2**	that it?		
20:31:51.3 **INT-3**	okay we're good.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:31:55.6 **HOT-?**	[sound of sniffle]		
20:32:15.2 **HOT-1**	I hate to make people wait. I understand needs and all that kind of stuff but uh.		
20:32:17.4 **HOT-2**	oh I know but if it means us taking off and us three people later in line.		
20:32:48.3 **HOT-1**	alright bravo short of kilo.		
20:33:05.6 **HOT-1**	yeah we're on ground now right?		
20:33:08.8 **HOT-2**	yeah.		
20:33:10.0 **HOT-?**	[sound of sniffle]		
20:34:02.1 **HOT-?**	[sound of sniffle]		
		20:34:06.5 **GND**	Colgan thirty four zero seven Newark Ground two two right at whiskey continue juliet at romeo follow JetBlue.
		20:34:14.4 **RDO-2**	juliet at romeo follow JetBlue Colgan thirty four zero seven.
20:34:18.5 **HOT-1**	yeah JetBlue's right behind uh the bent wing pencil jet.		
20:34:25.7 **HOT-2**	[sound of laughter]		
20:34:27.0 **HOT-1**	looked like a bent wing maybe it's not.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:34:31.2 **HOT-2**	what's that mean?		
20:34:31.8 **HOT-1**	it's just a lawn dart.		
20:34:33.0 **HOT-2**	oh I've never heard the term bent wing.		
20:34:37.3 **HOT-1**	bent wing is winglet.		
20:34:39.1 **HOT-2**	oh oh gotcha.		
20:35:16.7 **HOT-2**	come on JetBlue. I didn't realize JetBlue came in to here. I wonder where they go from.		
20:35:22.7 **HOT-1**	they have uh one flight to Tampa they have uh couple flights to Fort Lauderdale and uh three or four flights to Orlando.		
20:35:30.7 **HOT-2**	out of Newark?		
20:35:31.9 **HOT-1**	out of Newark.		
20:35:33.6 **HOT-2**	oh okay well that doesn't help me at all. 'cause JetBlue does a ton— there's like four flights from Seattle to JFK a day and I decided I figured it out that'd be you know if I'm only doing it a couple times a week or a couple times a month or like once a month. that's only— I think there's a twenty five dollar shuttle.		
20:35:51.1 **HOT-1**	yeah.		
20:35:52.1 **HOT-2**	that's not so bad.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:35:53.9 **HOT-1**	they have free TV. live TV.		
20:35:55.7 **HOT-2**	on the shuttle?		
20:35:57.1 **HOT-1**	on uh JetBlue.		
20:35:57.7 **HOT-2**	oh on JetBlue.		
20:35:58.8 **HOT-1**	you got to pay for your for your movies though. if you ever— if you fly Continental if they fly seven fives or the uh seven three nine hundreds the ones that are equipped you got free movies.		
20:36:13.2 **HOT-2**	that's cool.		
		20:36:13.4 **GND**	Lufthansa four one three heavy at juliet follow the Continental Express Embraer— make that the Continental uh Dash eight Q four hundred series.
20:36:19.6 **HOT-2**	Q four hundred.		
		20:36:33.0 **GND**	Colgan thirty four zero seven you follow JetBlue that's your sequence about number sixteen. monitor the tower.
		20:36:39.8 **RDO-2**	follow JetBlue and monitor tower Colgan thirty four zero seven.
20:36:48.2 **HOT-?**	[sound of sniffles]		
20:37:11.4 **PA-3**	ladies and gentlemen at this time once again if you'd be so kind and turn off your cell phones. thank you.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:37:17.8 **HOT-2**	you think they'd just be launching us off two two since all these planes have circle to land two nine...you'd think they'd be using the right and the left. [sound of sniffle] well I guess never mind because then you've got spacing going to the—.		
20:37:35.5 **HOT-1**	yeah the spacing off the arrivals still because uh until they break.		
20:37:37.4 **HOT-2**	yeah. that's right I forget about all that.		
20:37:59.9 **HOT**	[sound of master caution chime]		
20:38:00.7 **HOT-?**	[sound of sniffle]		
20:38:03.4 **HOT**	[sound of double chime]		
20:38:05.4 **INT-3**	hello?		
20:38:06.1 **INT-1**	hey if that one would like to go to the restroom now go ahead.		
20:38:09.1 **INT-3**	oh okay thank you.		
20:38:10.6 **INT-1**	and let me know if anybody else is in need uh after that one.		
20:38:14.1 **INT-3**	okay thank you. buh-bye.		
20:38:14.7 **INT-1**	okay thanks.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:38:19.3 **HOT-1**	oh let's see. what was I gonna tell— I was gonna tell you something. I didn't want to really say it off of uh in front of the ramp guys.		
20:38:28.1 **HOT-2**	oh you didn't have your FOPP. [Flight Operations Policies and Procedures Manual]		
20:38:29.6 **HOT-1**	oh yeah yeah yeah yeah yeah yeah uh you know @ right?		
20:38:34.3 **HOT-2**	yeah.		
20:38:34.9 **HOT-1**	um he was doing his PC check today.		
20:38:37.4 **HOT-2**	uh-huh.		
20:38:38.0 **HOT-1**	he came up last night and he's you know he's always been real good you know as far as just uh seems like a top notch guy.		
20:38:45.9 **HOT-2**	yeah.		
20:38:46.3 **HOT-1**	and he came in and he just— uh it just looked like his face was drained you know all the blood out of it and everything. he just came in told me he was headed to his PC check today. and he said he got on the plane he went to pull it out to uh to study.		
20:39:05.5 **HOT-2**	he was using it to study yeah.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:39:07.6 **HOT-1**	and he said it was not in his bag. says that was the first time he uh uh he figured out that he didn't have it. he left it at home. he says I've been with the company I forget what he said five or six years this is— this is the first time he's ever done that. I said dude it happens to the best of us. I said let's see if we can help you out so I gave him mine I said yeah I just got to make sure my FO has it you know tomorrow. we ha— we have to have one in the—.		
20:39:36.8 **HOT-2**	yeah I've got mine.		
20:39:37.9 **HOT-1**	and so that's all we have to have. but uh made sure it was up to date um which it was and uh he took it down there.		
20:39:51.1 **HOT-2**	that was nice of you.		
20:39:52.9 **HOT-1**	and he was he was coming in from Saint Lou— uh coming in from Saint Louis. he was gonna try to and make the one thirty flight today to get in at five oh clock.		
20:40:03.0 **HOT-2**	to Saint Louis?		
20:40:04.3 **HOT-1**	in. one thirty out of Saint Louis in here at five oh clock.		
20:40:07.8 **HOT-2**	oh yeah?		
20:40:08.3 **HOT-1**	and that flight was delayed until five thirty so he wasn't going to be in until uh about— what time is it now? eight oh clock it's eight forty yeah it's uh it's due in about any time.		
20:40:20.0 **HOT-2**	yeah...yeah.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:41:31.1 **HOT-?**	[sound of sniffle]		
20:41:34.5 **HOT-2**	oh I'm ready to be in the hotel room.		
20:41:38.2 **HOT-1**	I feel feel feel bad for you as far as feeling **.		
20:41:44.2 **HOT-2**	well this is one of those times that if I felt like this when I was at home there's no way I would have come all the way out here. but now that I'm out here.		
20:41:51.7 **HOT-1**	you might as well.		
20:41:52.7 **HOT-2**	I mean if I call in sick now I've got to put myself in a hotel until I feel better. you know we'll see how how it feels flying. if the pressure's just too much I you know I could always call in tomorrow at least I'm in a hotel on the company's buck but we'll see. I'm pretty tough.		
20:42:09.3 **HOT-?**	[sound of sniffle]		
20:42:15.3 **HOT-1**	oh that Airborne may help out a little bit.		
20:42:18.4 **HOT-2**	yeah.		
20:42:19.1 **HOT-1**	you could kill it with uh you know a bunch of OJ or a bunch of vitamin C.		
20:42:24.1 **HOT-2**	yeah I've got um got ‘em to give me a a carton of orange juice to take home with me.		
20:42:51.6 **HOT-1**	is that a triple seven? for TAP? oh nope it's an Airbus three thirty.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:42:55.7 **HOT-2**	no it's an Airbus.		
20:43:00.8 **HOT-?**	[sound of sniffle]		
20:43:10.2 **HOT-2**	so what did you do before you started flying for Colgan?		
20:43:13.6 **HOT-1**	oh I I'd been in the airline industry for a while. I worked for uh the original Piedmont Airlines merged with US Airways. watched two companies— two profitable companies with two completely different cultures uh merge together and turn to a pile of crap.		
20:43:33.5 **HOT-2**	oh that's too bad.		
20:43:34.8 **HOT-1**	and I lost my job in the— in the merger.		
20:43:39.0 **HOT-2**	how'd you lose your job?		
20:43:40.5 **HOT-1**	uh they took the position that I was doing— um do you have any napkins over there by chance?		
20:43:45.6 **HOT-2**	oh yeah I've got a whole load of them in my thing.		
20:43:48.6 **HOT-1**	[sound of coughing]		
20:43:50.2 **HOT-1**	thanks. uh they made my— well I I I guess I could— don't mean to say I lost my job but uh they gave me a a very poor choice to make.		
20:44:03.3 **HOT-2**	yeah.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:44:03.8 **HOT-1**	or a very poor alternative.		
20:44:06.6 **HOT-2**	what was that?		
20:44:07.1 **HOT-1**	uh I was in a management position— well I was temporarily in a management position. and because I was temporarily in that management position for longer than thirty days they considered me part of that department although I was not being paid the full management salary I was just getting a little uh...		
20:44:10.2 **HOT-2**	[sound of sniffle] uh-huh...yeah.		
20:44:33.1 **HOT-1**	...whatever you want to call it. uh a little add on. and anyway so uh they turned that position into a clerical position.		
20:44:37.1 **HOT-2**	[sound of sniffle]		
20:44:49.7 **HOT**	[sound of double chime]		
20:44:54.4 **INT-3**	yes sir.		
20:44:54.9 **INT-1**	hey is everyone down?		
20:44:56.4 **INT-3**	yeah.		
20:44:57.3 **INT-1**	okay thanks.		
20:44:57.9 **INT-3**	okay.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:44:59.7 **HOT-1**	um so they gave us uh an alternative uh an option to stay with the job it was going to a clerical position. we would lose approximately sixty five percent of our salary.		
20:45:14.6 **HOT-2**	whoa.		
20:45:15.8 **HOT-1**	um or you know sayonara so I went sayonara.		
20:45:23.9 **HOT-2**	yeah I would too.		
20:45:26.6 **HOT-1**	and then I worked for American Express for a while as a contract— a contract employee with RJ Reynolds tobacco company.		
20:45:36.0 **HOT-2**	oh yeah.		
20:45:36.6 **HOT-1**	and uh did a lot of travel packages hospitality events driver appearances		
20:45:42.6 **HOT-2**	oh that's cool.		
20:45:43.5 **HOT-1**	uh for uh for NASCAR uh NHRA track racing AMA superbikes unlimited hydroplane. that was— that was probably the best job I've ever had. probably the best one ever. just the most fun. it was challenging at times yet it was very rewarding you get to go to to the events and all that kind of stuff.		
20:46:04.0 **HOT-2**	oh I bet. why'd you leave there?		
20:46:07.8 **HOT-1**	uh the uh political uh arena with uh the tobacco companies and smoking in in general and that stuff.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:46:14.8 **HOT-2**	oh.		
20:46:18.4 **HOT-1**	uh the biggest thing that I ever learned in a business law class is uh US domestic laws are dictated by social acceptance. had a textbook about this thick.		
20:46:28.7 **HOT-2**	yeah.		
20:46:29.4 **HOT-1**	that was one sentence out of the— one of the chapters.		
20:46:33.3 **HOT-2**	uh-huh.		
20:46:33.6 **HOT-1**	that has stuck with me ever ever since I took that business law class.		
20:46:37.7 **HOT-2**	oh that's funny.		
20:46:38.4 **HOT-1**	and it is so true.		
20:46:39.7 **HOT-2**	yeah.		
20:46:40.3 **HOT-1**	uh I mean there's just so many examples that you could use. and and and look back and say that's true as true could be. but uh so they were cut back— oh and I did the sweepstakes stuff too. uh that was a whole messload of fun.		
20:46:58.8 **HOT-2**	oh yeah?		
20:46:59.0 **HOT-1**	they'd have different sweepstakes for their different uh cigarette brands.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:47:01.8 **HOT-2**	uh-huh.		
20:47:02.0 **HOT-1**	and like they'd have the uh uh Salem cigarettes their menthol brand. uh Salem's fortieth anniversary when the did uh they did forty winners for a three night cruise in the Bahamas.		
20:47:20.0 **HOT-2**	oh that's cool.		
20:47:21.0 **HOT-1**	so uh they gave me— basically they— uh I develop a package uh wrote all the little fine print went through legal with that made sure I was okay and uh then I just waited. waited until they had the drawing and they gave me a list of forty names. it wasn't just myself uh I was— I was the main contact point but uh I had two other people that uh helped me out with that and we had a whole a blast of fun. I mean we'd contact the winners and say you know this is so and so from American Express Travel on behalf of RJ Reynolds Tobacco Company and uh we have your name and we'll do your travel. uh and this is what's planned. this is you know all kinds of things to do. so anyway I did that as well.		
20:47:26.9 **HOT-2**	yeah...yeah.		
20:48:12.7 **HOT-1**	but uh just with all the political mumbo jumbo they uh they were cutting back on their brand promotions and sweepstakes and everything.		
20:48:20.5 **HOT-2**	yeah.		
20:48:20.8 **HOT-1**	so uh uh I transferred with American Express and went down— back down to Tampa er back down to Florida. I was in Orlando to get my **. but uh after that I worked for Verizon for a little while.		
20:48:28.4 **HOT-2**	yeah....Horizon?		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:48:39.5 **HOT-1**	Verizon.		
20:48:41.1 **HOT-2**	oh Verizon. oh okay.		
20:48:41.2 **HOT-1**	Veri— yeah. uh worked in the uh high speed internet uh division.		
20:48:45.6 **HOT-2**	okay.		
20:48:46.3 **HOT-1**	uh sold DSL and all the peripherals that go along with it. DSL and dial up and helped uh I was on the beta team for uh uh their FTTP is what we call just the FTTP FTTP program which is fiber tooth the premise is now called Verizon FIOS.		
20:49:06.6 **HOT-2**	yeah okay.		
20:49:10.0 **HOT-1**	and FIOS is out in uh would be out in the Seattle areas— some of the Seattle areas uh—.		
20:49:17.1 **HOT-2**	they just did that in the apartments that I was at in the Chesapeake I think.		
20:49:20.7 **HOT-1**	yeah yeah they go in and do uh you know like uh like an exclusive arrangement with a— with a community whether it's a you know a housing community a development or something like that or a condo community or you know apartments or whatever. they'll go in and do like an exclusive arrangement for x number of years and then go in and sell it to everybody give them a good price. but uh we developed all the the policies and procedures the setup. all that kind of stuff.		
20:49:21.8 **HOT-2**	yeah.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:49:26.7 **HOT**	[sound of master caution chime consistent with parking brake application]		
20:49:56.3 **HOT-2**	oh that's neat.		
20:50:01.1 **HOT-1**	so that was neat. they— they gave they gave a big package to management employees. it was geared toward the old uh technology people in management positions. uh but they extended it— extended it to everybody except wireless. and I wasn't in you know I wasn't part of wireless so I I took the package and left and went flying.		
20:50:32.7 **HOT-2**	okay.		
20:50:32.9 **HOT-1**	I went through Gulfstream's program 'cause uh you know it was just the best program for for my needs and and what I needed you know the timeframe that I had. you know how fast I wanted to get into the one twenty one environment and all that. so it really uh really worked out well for me.		
20:50:56.9 **HOT-2**	that's good.		
20:50:58.3 **HOT-1**	got hired with Colgan right after that.		
20:51:01.5 **HOT-2**	you've been here you said four years?		
20:51:03.4 **HOT-1**	what's that?		
20:51:04.7 **HOT-2**	you said you've been here four years?		
20:51:06.1 **HOT-1**	uh almost four years. about eh three and a half years.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:51:17.9 **HOT-1**	silly old Gulfstream they uh— I even had an interview with Pinnacle to go fly uh the RJs because they had a preferential program with uh Gulfstream preferential— preferential interview process.		
20:51:29.3 **HOT-2**	oh yeah?		
20:51:32.1 **HOT-1**	and uh I turned down the job because at that time they weren't they weren't paying anything for training.		
20:51:40.6 **HOT-2**	oh yeah?		
20:51:46.6 **HOT-1**	they just at that at that point in time I just like well if the company can't even invest in their employees as they go through training you know some sort of uh stipend or or something like that. fifty dollar a day per diem or—.		
20:52:02.6 **HOT-2**	yeah. oh they weren't giving anything?		
20:52:05.6 **HOT-1**	no.		
20:52:05.9 **HOT-2**	oh.		
20:52:07.4 **HOT-1**	nope they weren't giving anything.		
20:52:09.0 **HOT-2**	jeez.		
20:52:10.5 **HOT-1**	I mean I had a place to stay but you know I'dve still been out of out of uh income for about ten weeks is what they were calling for.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:52:18.5 **HOT-2**	yeah that's— that's really tough.		
20:52:34.2 **HOT-?**	[sound of sniffles]		
20:52:39.7 **PA-1**	folks from the flight deck just to uh give you another update. we're getting a little bit closer. we're still about number ten for departure. and we'll be airborne just uh shortly and just to kind of uh pass on a little bit more information from uh other pilots who have taken off earlier uh the turbulence has uh decreased uh quite a bit but uh there's still gonna be some bumps on the climbout so make sure those seatbelts are fastened tightly. thanks.		
20:53:16.7 **HOT-2**	they're calling winds three hundred at fifteen.		
20:53:19.6 **HOT-1**	three hundred at fifteen.		
20:53:43.7 **HOT-1**	interviewed with Colgan and and uh they gave me the choice of either going on the nineteen hundred or the Saab. I told them I've flown the nineteen hundred and it would be a pretty easy transition just learning the the particular you know profiles and callouts for Colgan as opposed to Gulfstream. I said but I'd rather have the the Saab so I could learn you know a little bit more CRM because they have a flight attendant and also uh I liked the bases better that the Saab had to offer.		
20:54:12.1 **HOT-2**	yeah...yeah.		
20:54:23.1 **HOT-1**	and uh I I was interviewing— have you ever flown with @?		
20:54:28.0 **HOT-2**	nope.		
20:54:28.4 **HOT-1**	do you know who he is?		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:54:29.3 **HOT-2**	I know who he is.		
20:54:31.1 **HOT-1**	he uh he was interviewing me along with uh @.		
20:54:32.1 **HOT-2**	**.		
20:54:37.0 **HOT-2**	oh okay.		
20:54:37.8 **HOT-1**	and uh I asked him after the interview. I said you know that's I mean that was an honest answer but I'd be more challenged in the in the Saab. he said no man that was a perfect answer. so.		
20:54:49.7 **HOT-2**	oh that's good. well they asked me what I wanted. I said I wanted the Q. I didn't know much buh difference between the Saab and the Q but um and they said well tough you can't have it. [sound of laughter] so I was like why did you ask me if you told me I can't have it? so then they put me in the Saab I got everything ready we were all set cause we wanted— me and my husband I mean we lived in Phoenix for a few years we don't have kids we don't have any commitments. we just you know we wanted to experience living in different places before we settled back down in Seattle so we were geared up ready to move to Houston.		
20:55:08.7 **HOT-1**	yeah...yeah go ahead.		
		20:55:14.9 **TWR**	attention all aircraft. current altimeter two niner six one.

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:55:20.7 **HOT-2**	uh six one's the altimeter. uh geared up ready to move to Houston. and then the day before I was supposed to go to training @ called and basically begged me to switch to the Q and that pushed me back a week in training and I waited a week and I asked my husband I said look when I upgrade like thirteen dollars an hour more. it's a bigger plane. I'd rather fly this plane than the Saab. he says hey we haven't signed anything we haven't— so we just like switched our whole gears up to Virginia.		
20:55:46.6 **HOT-1**	wow.		
20:55:48.9 **HOT-2**	if they'd told us that all those outstations were gonna close and we'd come to Newark but but we're ready to be back in Seattle anyway.		
20:55:56.1 **HOT-1**	are you from that area originally?		
20:55:58.5 **HOT-2**	yeah all my family's there. all my husband's family is there. we both grew up in Seattle. so we want to settle— we want to buy a house with the market the way it is and I mean it's hard to pass up buying a house right now.		
20:56:06.2 **HOT-1**	yeah.		
20:56:15.0 **HOT-2**	we * get you know my sister bought a house last year. she thought she was buying in the bottom of the market and her house has already decreased thirty thousand dollars in value.		
20:56:19.7 **HOT-1**	uh-huh...dohhh wow.		
20:56:24.8 **HOT-2**	yeah. and we know that that might happen to us too but we're not gonna— we're not looking to sell in a year or two. we're looking to buy settle down and live there for you know five to ten years.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:56:30.0 **HOT-1**	yeah...it's it's gonna take about that before it uh comes back up. yeah.		
20:56:36.8 **HOT-2**	picks back up.		
20:56:40.7 **HOT-1**	but it's it's got to be close to the bottom if not at the bottom at this point in time.		
20:56:45.8 **HOT-2**	yeah.		
20:56:51.3 **HOT-1**	yeah I I think— I don't know if it were me if I were buying at this point in time I think I would start looking about halfway through the year.		
20:56:59.7 **HOT-2**	yeah.		
20:57:00.6 **HOT-1**	halfway or you know into August September time frame.		
20:57:04.0 **HOT-2**	yeah well we're helping my grandpa right now is—. he is a hundred and he's losing— he doesn't— he's losing his memory. he he can't function. somebody has to be with him twenty four hours a day. he's not so bad— I mean if he if he could just— if he couldn't remember who people were all the time we'd put him in a home.		
20:57:23.1 **HOT-1**	right.		
20:57:23.9 **HOT-2**	but in the morning he's really sharp and then in the afternoon he's got what's called Sundowner's it's like part time Alzheimer's.		
20:57:29.2 **HOT-1**	okay.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:57:29.3 **HOT-2**	like in the afternoon he starts to go a little- he can't remember. and so my parents have been going insane. they live next door. they've been having to be there all the time and my aunts are having to be there. it's so hard so— while my husband finds a job we've been kind of staying between my parents house and his house helping out to give them a break. and then that gives us a break. we're not stuck in a lease for when we find a house.		
20:57:50.7 **HOT-1**	uh-huh...right.		
20:57:54.4 **HOT-2**	and it— you know it's really nice because everything we're saving goes straight to a down payment so.		
20:58:00.4 **HOT-?**	[sound of sniffle]		
20:58:04.3 **HOT-1**	yeah I've got a cousin that flies for UPS. he uh flies uh seven fives seven sixes right seat.		
20:58:11.6 **HOT-2**	yeah.		
20:58:11.8 **HOT-1**	he's in his tenth— or well past his tenth year so he's now in his eleventh year.		
20:58:15.6 **HOT-2**	yeah.		
20:58:18.4 **HOT-1**	and uh they just sold their house bout uh bout a year ago and they just bought another house uh and moved into it just at the end of this past year.		
20:58:32.4 **HOT-2**	yeah.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:58:33.1 **HOT-1**	so he he was kind of— he— they sold kind of as the market was going down.		
20:58:38.7 **HOT-2**	that's good though.		
20:58:38.8 **HOT-1**	they got— they got you know uh something decent out of it. he said he didn't get quite as much as he could have it he would have sold it you know six or eight months before.		
20:58:49.7 **HOT-2**	yeah.		
20:58:50.1 **HOT-1**	but um they they didn't lose any money by any means.		
20:58:54.8 **HOT-2**	oh that's good.		
20:58:55.7 **HOT-1**	and uh he got uh it was a house that he said he he had uh put an offer on and somebody else had already put an offer on which was a lot more money. and he he said well he could you know it just wasn't worth it to him.		
20:59:14.0 **HOT-2**	no point in getting into a bidding war in today's market.		
20:59:17.8 **HOT-1**	yeah exactly. and uh the guy's financing did not go through.		
20:59:24.1 **HOT-2**	oh that's nice.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
20:59:25.4 **HOT-1**	and uh you know it's still for sale still for sale still for sale and my cousin said he called and asked if it you know if it was still for sale or was it still pending. he said no the financing had had fallen through. so he offered— uh offered him forty or fifty thousand dollars lower than what they had offered him at first.		
20:59:49.4 **HOT-2**	yeah.		
20:59:49.8 **HOT-1**	and theirs was already the low offer.		
20:59:51.6 **HOT-2**	yeah.		
20:59:51.6 **HOT-1**	and they got— and they took it.		
20:59:53.5 **HOT-2**	that sucks. oh I mean it's great for your cousin but.		
20:59:56.4 **HOT**	[sound of master caution chime consistent with parking brake application]		
20:59:56.5 **HOT-1**	yeah yeah yeah I mean it sucks for them exactly.		
20:59:57.7 **HOT-2**	yeah.		
20:59:59.1 **HOT-1**	because they were trying— they were trying to get out it. and they were obviously trying to get the best they could.		
21:00:03.0 **HOT-2**	no of course.		
21:00:04.0 **HOT-1**	just like everybody else does.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:00:05.4 **HOT-2**	yeah.		
21:00:09.6 **HOT-1**	ohh wow that guy is— oh we'll see how close this is.		
21:00:13.2 **HOT-2**	ooo...that's not gonna happen.		
21:00:23.0 **HOT-1**	that's a seven two seven just landed. oh that's not too bad. okay.		
21:00:28.0 **HOT-2**	oh yeah 'cause now he just got a thirty knot headwind.		
21:00:28.9 **HOT-1**	*.		
21:00:38.2 **HOT-2**	that wasn't very * it looked a lot closer.		
21:00:40.4 **HOT-1**	yeah it did. it really did.		
21:01:11.2 **HOT-2**	everybody's five.		
21:01:29.1 **HOT-2**	Cargojet?		
21:01:31.1 **HOT-1**	yeah that was that seven two that just—.		
21:01:32.3 **HOT-2**	yeah.		
21:01:34.1 **HOT-1**	Cargojet whoever that is.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:01:35.4 **HOT-2**	yeah.		
21:02:46.2 **HOT-1**	Continental fifty. going to Frankfurt.		
21:02:59.1 **HOT-1**	have you guys done very much travelling?		
21:03:01.1 **HOT-2**	um-hmm.		
21:03:01.7 **HOT-1**	oh good.		
21:03:02.9 **HOT-2**	yeah we— my husband goes to— he was going to Phoenix almost every month. when he drilled there. he drilled once a month there.		
21:03:10.2 **HOT-1**	uh-huh.		
21:03:10.9 **HOT-2**	and uh he just got based back in Seattle which is nice because he make more in one weekend of drill than I make in an entire pay cycle here.		
21:03:19.6 **HOT-1**	that sucks. what branch is he with?		
21:03:20.3 **HOT-2**	well he's army.		
21:03:23.1 **HOT-1**	army.		
21:03:23.1 **HOT-2**	uh that'll hopefully change now I— the next paycheck that comes should have my five dollar raise on it.		
21:03:30.3 **HOT-1**	good.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:03:30.8 **HOT-2**	I thought the last one should because I got hired January sixteenth. but apparently the sixteenth through the thirtieth they said that you don't get your raise until the pay period after.		
21:03:39.3 **HOT-1**	it would be the twentieth.		
21:03:40.7 **HOT-2**	yeah that made me— but but no— but my but my pay from the sixteenth to the thirtieth didn't have the raise in it.		
21:03:46.1 **HOT-1**	uh-huh.		
21:03:47.6 **HOT-2**	and I got hired on the sixteenth.		
21:03:48.8 **HOT-1**	that's okay. it'll it'll be retroed back.		
21:03:50.8 **HOT-2**	no no she said it wouldn't. I called and asked.		
21:03:53.1 **HOT-1**	why wouldn't it be retroed back?		
21:03:54.1 **HOT-2**	because she says that your raise doesn't take effect until the first pay period— the first full pay period after you got hired. so I got hired on the sixteenth and the pay period started on the sixteenth. so from the sixteenth to the thirtieth that my raise wasn't in effect until after that. I'm thinking that's like two hundred buck— two hundred bucks to an FO is a lot of money.		
21:04:12.6 **HOT-1**	ohhh I think I'd question that.		
21:04:15.0 **HOT-2**	I did. and she— and I called payroll and they said that that's just how policy is.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:04:23.7 **HOT-2**	so I talked to two different people. I talked to payroll and they gave me someone from HR and that's what it— both of them said that and I thought that was a load of crap.		
21:04:30.0 **HOT-1**	okay oh that's not the way they used to do it. that may be how Pinnacle does it.		
21:04:35.1 **HOT-2**	yeah but.		
21:04:36.7 **HOT-1**	that's not how Colgan used to do it.		
21:04:39.1 **HOT-2**	no but I'll be getting an extra two hundred dollars each paycheck. now I'll be making more than he does in a weekend but.		
21:04:45.1 **HOT-1**	[sound of laughter]		
21:04:45.5 **HOT-2**	[sound of laughter] that's good.		
21:04:50.6 **HOT-2**	oh.		
21:04:54.1 **HOT-1**	what was it?		
21:04:55.2 **HOT-2**	is it a Bell?		
21:04:56.3 **HOT-1**	I don't know. kind of looked like it didn't it.		
21:04:58.5 **HOT**	[sound of master caution chime consistent with parking brake application]		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:04:59.4 **HOT-2**	yeah.		
21:05:01.0 **HOT-1**	well this isn't an elephant so I'm not scared of it.		
21:05:03.9 **HOT-2**	yeah that's for sure. no but we uh we travelled to Phoenix a lot and 'cause we used to live there and he went down to— we went to Disneyworld and now that we're back in Seattle— we've got two dogs. so now that we're back in Seattle with all of our family it's a lot easier to just take off and you know my sister can wake up in the morning and find two extra dogs in her backyard. [sound of laughter]		
21:05:24.7 **HOT-1**	right.		
21:05:36.0 **HOT-?**	[sound of sniffle]		
21:05:37.2 **HOT-1**	that's what uh my wife and I did before we— you know settled down and had you know bought a house and had you know started a family and all that kind of stuff. we uh wanted to get to know each other more and more and you know just enjoy the time between the two of us. because you know obviously when you start a family and everything and it's just not the same. it's just you're closing one chapter or one book and opening another.		
21:05:53.8 **HOT-2**	yeah...exactly.		
21:05:58.7 **HOT**	[sound of master caution chime]		
21:06:05.1 **HOT-1**	uh but we I mean we always fit our children into our schedule and uh you know and also you know focused on their schedules too to make a compromise. it wasn't all one sided. it wasn't all for the kids it wasn't all for us but uh we didn't let their lives run ours.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:06:19.3 **HOT-2**	yeah...that's good.		
21:06:31.9 **HOT-1**	and you know that's that's the big thing that I'd I'd recommend to any young couple that's that's out there just unsolicited advice you know just you know don't get in a big hurry.		
21:06:43.5 **HOT-2**	yeah. no we're not. we want to give it— we want to do a lot more travelling. although gosh I'm so freaking mad. I feel like Colgan walks all over me. this company treats me like crap so much. I've been assigned my vacation in March. and I have been— I have sent four emails and I've made a dozen calls saying I do not want vacation in march I never requested that. that was assigned to me. here are ten different other weeks that I'd like vacation that are open on the vacation slot and she won't give it to me. she won't give it to me. I've called @. she's the one dealing with it. I've left her voicemails she won't call me back. I've sent her emails she won't call me back. she won't change my vacation. it still even has me in Norfolk she won't change it. and I think I've got like two more days before I'm within the forty five days and they can't change it. and I know she's going to screw me over and I'm going to be so freaking mad if they make me take my vacation in march cause I can't— I don't want to take vacation when my husband can't take vacation because we want to go somewhere.		
21:07:17.2 **HOT-1**	sh— um...right right.		
21:07:39.4 **HOT-1**	um now that she she looks at it on the tenth of every month and then posts it right after that so take a look.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:07:46.1 **HOT-2**	but I— I did I did she just emailed me she said you can't have Christmas off. and I said but what about the other ten weeks I asked for off you know and she did— she wouldn't email me back and it's just like— I if I only get to bid one week every month the entire year's gonna go by without me being able to get a bid in. because if somebody else higher than me wants that week off and she she and she won't respond back the fact that I'm in Newark now and I had to wait until I was in Newark to make my bid that's what I waited 'til uh two months ago is when I started you know getting to do it. she won't do anything to help me and it's like I don't know what to do and I'm just gonna get screwed into having— I mean I literally have sent like several emails made several phone calls—.		
21:07:58.1 **HOT-1**	ah.		
21:08:27.1 **HOT-1**	go to @. that's what he's there for.		
21:08:29.7 **HOT-2**	is it?		
21:08:30.1 **HOT-1**	yeah oh hell yeah. oh yeah.		
21:08:32.1 **HOT-2**	because I just— you know I can't get walked on anymore.		
21:08:35.6 **HOT-1**	oh no. go to @ and just say look you know.		
21:08:38.6 **HOT-2**	I don't want— yeah.		
21:08:40.1 **HOT-1**	you know you don't want to piss anybody off. you don't want to make— you don't—.		
21:08:42.1 **HOT-2**	no and I have been very polite about it. I haven't— I haven't gotten angry. I haven't you know—.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:08:47.9 **HOT-1**	just just like you just told me. you feel like you're getting walked all over.		
21:08:51.5 **HOT-2**	oh yeah.		
21:08:52.1 **HOT-1**	and there's no reason for it. and you looked on the on the spreadsheet and there's weeks available and everything?		
21:08:56.3 **HOT-2**	and I sent her— and there's weeks available. and I sent her like— I sent I want you know I said if I can't have Christmas what about— I said I want Christmas I know that ones probably full. I'd like then the week after and then if that one's full the week before Christmas. if that one's full then Thanksgiving and then I went through I said if I can't have any of that I would like any week available after may. and she wouldn't give me any— there's got to be a week available after May.		
21:09:19.3 **HOT-1**	well you can check and see if there's weeks available.		
21:09:21.5 **HOT-2**	I did and all those weeks that I said— the only week that was filled was Christmas week. the week after was open. the week before was open and she wouldn't give me any of those. she only— she only responded saying that Christmas week was full. she didn't respond to any of the other— I can't get her to respond to me. she wouldn't tell me that any of the other weeks were full. she wouldn't sign me up for any of the other weeks and I'm still scheduled for vacation in March.		
21:09:41.9 **HOT-1**	okay uhh.		
21:09:44.9 **HOT-2**	but I'll give her a call again tomorrow and I haven't checked any of my emails.		
21:09:47.6 **HOT-1**	but she's— yeah she's not gonna look at uh vacation again basically until the tenth of next month.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:09:53.5 **HOT-2**	so that that means I'm screwed and I just have to have it in march 'cause the tenth of March.		
21:09:57.4 **HOT-1**	no no go to @.		
21:09:59.1 **HOT-2**	yeah I mean that's the thing I told her you know like if she waits 'til the tenth of march that's gonna be after you know after March bids are already— they'll have you know they'll have already given me vacation for March.		
21:10:14.8 **HOT-1**	oh yeah yeah I see what you're saying.		
21:10:17.0 **HOT-2**	so I can't you know I can't wait 'til—.		
21:10:19.8 **HOT-1**	okay yeah go to @.		
21:10:21.3 **HOT-2**	yeah.		
21:10:23.5 **HOT-1**	it it's been— what I would do before you go to @ is look up your FO vacation spreadsheet. print it.		
21:10:31.7 **HOT-2**	um-hum...yeah yeah.		
21:10:33.3 **HOT-1**	and say okay well you know this is— and and if you still have a copy of your email. print it. this is what I've done so far and highlight the the spaces that are still available and and it doesn't matter whether you're based in Newark or Norfolk or or Albany.		
21:10:35.3 **HOT-2**	yeah...um-hum...yeah...well sh— well if I was based—.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:10:50.9 **HOT-1**	cause every— everything on the Q is on the Q. everything on the Saab is on the Saab.		
21:10:57.1 **HOT-2**	um-hum.		
21:10:58.2 **HOT-1**	they don't do it by base anymore.		
21:11:00.3 **HOT-2**	oh I thought— that what she emailed me back. she said only two FOs per base can have each week off. but then there are some weeks—.		
21:11:07.6 **HOT-1**	well that's funny 'cause there's five captains that uh that are you know that out of five captains four of them are from Newark one's from Norfolk *.		
21:11:19.8 **HOT-2**	exactly.		
21:11:21.2 **HOT-1**	you know it's like *.		
21:11:23.4 **HOT-2**	and then if they do it that way then who doesn't get vacation? because there's more than fifty two FOs.		
21:11:28.9 **HOT-1**	because— and here's another thought. or here's another 'nother deal with that—.		
21:11:32.7 **HOT-2**	or a hundred four FOs.		
21:11:34.2 **HOT-1**	um then then you should have been given the vacation of your choice if you're based in Norfolk if they're if they're separating it.		
21:11:43.6 **HOT-2**	yeah.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:11:43.7 **HOT-1**	and the only people that you'd be competing with would be Norfolk based FOs.		
21:11:47.6 **HOT-2**	yeah but now I'm—.		
21:11:48.6 **HOT-1**	likewise Albany and stuff like that.		
21:11:51.5 **HOT-2**	yeah.		
21:11:53.6 **HOT-1**	but uh yeah I would just uh I would go to @ at this point.		
21:11:59.0 **HOT-2**	yeah cause I can't wait— I mean I tried— I sent her very polite very nice emails. I haven't been like this upset at her. I just— you know I've sent her nice polite emails. I cannot wait. I do not want to have vacation in march. I've been telling you this for two months. I don't want my vacation in march. I do not want to get stuck with having it— having to take it. 'cause it's not within forty five days.		
21:12:20.8 **HOT-1**	right.		
21:12:21.7 **HOT-2**	I mean I've never had a company be like this before with vacations.		
21:12:38.7 **HOT-2**	why can't we take off two two right?		
21:13:47.1 **HOT-?**	[sound of sniffle]		
21:13:48.1 **HOT-2**	my husband look at my email. I haven't looked for two days. I emailed her and then I— and then it was two days before—.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:14:27.0 **HOT-1**	not much on the departure roll.		
21:14:29.6 **HOT-2**	what?		
21:14:30.3 **HOT-1**	said not much on the departure roll. he ain't rollin' too fast.		
21:14:33.5 **HOT-2**	uh-uh.		
21:14:37.3 **HOT-1**	**.		
21:15:00.5 **HOT-1**	wow.		
21:15:50.8 **HOT-1**	let's do a taxi checklist.		
21:15:52.3 **HOT-2**	alrighty. taxi checklist. takeoff data briefing set complete.		
21:15:55.4 **HOT-1**	set complete.		
21:15:56.1 **HOT-2**	condition levers max?		
21:15:57.3 **HOT-1**	max.		
21:15:57.8 **HOT-2**	trims three set.		
21:15:58.9 **HOT-1**	three set.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:15:59.4 **HOT-2**	and takeoff warning?		
21:16:00.4 **HOT-1**	test.		
21:16:00.8 **HOT-2**	taxi check complete.		
21:16:06.5 **HOT-2**	and we're following JetBlue.		
21:16:09.4 **HOT-1**	well for the time being anyway.		
21:16:11.0 **HOT-2**	yeah *.		
21:16:12.1 **HOT-1**	unless they cut us off...which is entirely possible.		
21:16:23.4 **HOT-1**	slide right. leave a little room.		
21:16:25.3 **HOT-2**	what?		
21:16:25.9 **HOT-1**	** give these guys a little room here.		
21:16:28.6 **HOT-2**	yeah.		
21:16:29.3 **HOT-1**	JIC. just in case.		
21:16:31.7 **HOT**	[sound of master caution chime]		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:16:50.6 **HOT-1**	well.		
21:16:58.2 **HOT-1**	I'll take it.		
21:17:00.3 **HOT-2**	yeah me too.		
21:17:05.9 **PA-2**	folks it looks like we're number two for departure. should be pretty quick here. like to have the flight attendants please take their seats. thank you.		
		21:17:22.6 **TWR**	Colgan thirty four oh seven on uh departure you're gonna turn— fly heading two seven zero maintain two thousand now.
		21:17:30.1 **RDO-1**	two seven zero maintain two thousand Colgan thirty four oh seven.
21:17:30.7 **HOT-2**	oh.		
21:17:38.3 **HOT-1**	alright heading two seven zero.		
21:17:41.8 **HOT-2**	and it's still five thousand?		
21:17:42.9 **HOT-1**	and two thousand.		
		21:17:44.0 **TWR**	Colgan thirty four oh seven runway two two right at whiskey. position and hold.
		21:17:47.2 **RDO-2**	position and hold Colgan thirty four oh seven.
21:17:49.9 **HOT-1**	alright pos and hold. before takeoff checklist.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:17:55.7 **HOT-2**	uh before takeoff checklist. watch your legs. FA notification received transponder TCAS on ALT flight control checked free radar terrain off. flight taxi flight. cabin PA complete. external lights on. before takeoff checklist complete.		
21:18:18.9 **HOT-2**	okay.		
		21:18:22.8 **TWR**	and Colgan thirty four oh seven runway two two right at whiskey winds three zero zero at one niner cleared for takeoff.
		21:18:27.7 **RDO-2**	cleared for takeoff Colgan thirty four zero seven.
21:18:30.3 **HOT-1**	alright cleared for takeoff it's mine up to two thousand heading two seven zero after departure. here we go.		
21:18:35.4 **CAM**	[sound of increasing engine rpm]		
21:18:42.3 **HOT-1**	check power.		
21:18:44.6 **HOT-2**	and power checked.		
21:18:48.8 **HOT-2**	eighty knots.		
21:18:50.1 **HOT-1**	eighty.		
21:18:55.0 **HOT-2**	V one.		
21:18:56.2 **HOT-2**	rotate.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:19:01.6 **HOT-2**	positive rate.		
21:19:02.3 **HOT-1**	gear up.		
21:19:03.0 **CAM**	[sound similar to landing gear handle movement]		
21:19:07.5 **CAM**	[sound similar nose gear uplock and door closing]		
		21:19:10.4 **TWR**	Colgan thirty four oh seven turn right heading two seven zero maintain two thousand contact New York Departure.
		21:19:15.0 **RDO-2**	right two seventy two thousand and over to departure Colgan thirty four zero seven.
		21:19:20.7 **RDO-2**	Departure Colgan thirty four oh seven is seven hundred for two thousand heading two seventy.
		21:19:26.5 **DEP-A**	Colgan uh thirty four oh seven New York radar contact. climb maintain one zero ten thousand.
21:19:31.6 **HOT**	[sound similar to altitude alert]		
		21:19:32.5 **RDO-2**	up to ten thousand Colgan thirty four zero seven.
21:19:35.5 **HOT-2**	ten thousand.		
21:19:36.4 **HOT-1**	ten thousand alt sel flaps zero. set indicated airspeed two ten. climb checklist.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:19:44.3 **HOT-2**	alrighty.		
21:19:45.4 **CAM**	[sound similar to decreasing propeller rpm]		
		21:20:08.9 **DEP-A**	Colgan thirty four oh seven proceed direct COATE.
		21:20:11.5 **RDO-2**	direct COATE Colgan thirty four zero seven.
21:20:13.9 **HOT-2**	direct COATE.		
21:20:14.2 **HOT-1**	direct COATE.		
21:20:19.5 **HOT-1**	and NAV for me.		
21:20:20.2 **HOT-2**	NAV selected.		
21:20:39.9 **HOT-1**	wee this is fun.		
21:20:41.7 **HOT-2**	yeah.		
21:20:43.0 **HOT-1**	okay almost.		
		21:20:46.6 **DEP-A**	Colgan thirty four oh seven contact departure one one eight one seven. eighteen seventeen.
		21:20:50.9 **RDO-2**	eighteen seventeen Colgan thirty two— thirty four zero seven.

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
		21:21:00.9 **RDO-2**	[sound of mic click]
		21:21:10.0 **RDO-2**	departure Colgan thirty four zero seven five point seven for ten thousand.
		21:21:14.2 **DEP-B**	Colgan thirty four zero seven New York Departure roger.
21:22:27.0 **HOT-2**	and climb checklist complete. I don't know if I said it or not.		
21:22:31.0 **PA-3**	ladies and gentlemen for your continued safety we do ask that you keep your seatbelts securely fastened even if the captain turns off the fasten seatbelt sign. we would like to add a special welcome to our One Pass members. you'll be earning valuable miles for your trip today. if you are not already a member of the One Pass program you can enroll online at Continental dot com...Continental Connection is pleased to provide you with a complimentary copy of Sky Mall catalogue and Continental Magazine both located in your seat pocket.		
21:22:31.6 **HOT-1**	autopilot's engaged.		
21:22:33.5 **HOT-2**	alright.		
21:22:39.2 **HOT-1**	it's probably a good thing.		
21:22:43.7 **HOT**	[sound similar to altitude alert]		
21:22:44.9 **HOT-1**	nine ten alt sel.		
21:22:45.7 **HOT-2**	ten alt sel.		

INTRA-AIRCRAFT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
21:23:08.7 **HOT**	[sound of double chime]		
21:23:14.1 **PA-2**	we're through ten thousand feet.		
21:23:24.3 **PA-3**	ladies and gentlemen the use of approved portable electronic devices is now permitted.		
		21:23:56.6 **DEP-B**	Colgan thirty four zero seven climb maintain one two twelve thousand. proceed direct COATE.
		21:24:01.4 **RDO-2**	twelve thousand direct COATE Colgan thirty four zero seven.
21:24:04.6 **HOT-1**	twelve alt sel.		
21:24:05.4 **HOT-2**	twelve alt sel.		
21:24:18.4 **HOT-?**	[sound of sniffle]		
21:24:47.2 **HOT-1**	eleven twelve alt sel.		
21:24:47.3 **HOT**	[sound similar to altitude alert]		
21:24:48.6 **HOT-2**	eleven twelve alt sel.		
21:25:14.2 **HOT-1**	have you ever looked at the logbook very much as far as uh like putting your times and stuff in?		
21:25:19.8 **HOT-2**	um-hum.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:25:20.7 **HOT-1**	* okay. I kinda * you just haven't done like writeups?		
21:25:25.2 **HOT-2**	yeah I just haven't written anything in it but I've looked at it and looked up crew writeups.		
21:26:18.0 **HOT-1**	well I didn't write any numbers down so.		
21:26:21.8 **HOT**	[sound of double chime]		
21:26:23.6 **HOT-1**	uh.		
21:26:24.8 **INT-2**	hello.		
21:26:25.6 **INT-3**	hi what do you think about doing service?		
21:26:29.0 **INT-1**	actually I think if you could uh do something fairly quick I think we might be okay. I don't have a whole lotta cloud cover up here.		
21:26:36.4 **INT-3**	okay.		
21:26:37.1 **INT-1**	uh just be careful.		
21:26:38.8 **INT-3**	okay.		
21:26:39.1 **INT-1**	if we hear of anything—.		
21:26:40.7 **INT-3**	give us a buzz.		

INTRA-AIRCRAFT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
21:26:41.2 **INT-1**	we will.		
21:26:41.9 **INT-3**	alright thanks.		
		21:27:08.1 **DEP-B**	Colgan thirty four zero seven contact New York Center one tree two point six good day.
		21:27:12.6 **RDO-2**	one three two point six Colgan thirty four zero seven.
		21:27:22.4 **RDO-2**	departure Colgan thirty four zero seven twelve thousand direct COATE.
21:27:29.3 **HOT-1**	geez.		
21:27:30.7 **HOT-1**	this I **.		
		21:27:31.5 **ZNY-A**	Colgan thirty four zero seven New York Center you should be with the New York Center on one three two point six.
		21:27:40.8 **RDO-2**	alrighty we'll try them thirty four zero seven thanks.
		21:28:12.9 **RDO-2**	Center Colgan thirty four zero seven twelve thousand direct COATE.
		21:28:16.8 **ZNY-B**	Colgan thirty four zero seven New York Center roger. Wilkes-Barre altimeter two nine six seven.
		21:28:22.3 **RDO-2**	six seven thanks.

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:28:25.1 **HOT-2**	six seven.		
21:28:25.6 **HOT-1**	sixty seven set crosscheck.		
21:28:27.4 **HOT-2**	set crosschecked.		
21:28:30.1 **HOT-1**	alright.		
21:28:42.0 **HOT-1**	today's the twelfth right?		
21:28:43.5 **HOT-2**	yup.		
21:28:47.0 **HOT-2**	at least that's what you told me earlier.		
21:28:50.2 **HOT-1**	well that's my story and I'm sticking to it.		
21:28:52.2 **HOT-2**	alright.		
21:28:58.5 **HOT-1**	well that's good.		
21:29:19.7 **HOT-1**	so where's this page here? I don't see any writing on it.		
21:29:32.6 **HOT-1**	interesting.		
21:29:46.0 **HOT-?**	[sound of throat clearing]		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:29:50.1 **HOT-1**	alright I'll give that to you.		
21:29:52.8 **HOT-2**	alright.		
21:29:53.7 **HOT-1**	fill out what you can...I'll sign it **.		
21:30:31.1 **HOT-2**	it's Zulu time is the in and out right?		
21:30:34.3 **HOT-1**	uh that's in Zulu time but we want it local time.		
21:30:36.3 **HOT-2**	yeah local okay.		
21:30:38.5 **HOT-1**	on here. so just minus five. sooooo let's see.		
21:30:45.4 **HOT-2**	so nineteen forty five.		
21:30:47.5 **HOT-1**	seven forty five yeah nineteen forty five...wow an hour and a half taxi.		
21:30:53.7 **HOT-2**	yeah. **.		
21:30:57.8 **HOT-1**	oh that just— that just stinks...we can't reap the benefit.		
21:31:04.3 **HOT-2**	I know.		
		21:31:18.1 **RDO-1**	blocked.

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
		21:31:44.6 **ZNY-B**	Colgan thirty four zero seven climb to flight level— correction climb to one six thousand.
		21:31:50.0 **RDO-2**	one six thousand Colgan thirty four zero seven.
21:31:53.0 **HOT-2**	sixteen.		
21:31:53.5 **HOT-1**	sixteen alt sel.		
21:31:54.9 **HOT-2**	alt sel.		
21:32:08.4 **HOT-1**	oops. you didn't feel that.		
21:32:11.0 **HOT-2**	no I didn't feel that.		
21:32:13.0 **HOT-2**	they didn't do a twenty four hour ice protection test.		
21:32:15.4 **HOT-1**	yeah I just did.		
21:32:16.5 **HOT-2**	you did?		
21:32:17.2 **HOT-1**	yup.		
21:32:20.5 **HOT-1**	that's why I was looking back on all those pages.		
21:32:22.8 **HOT-2**	yeah.		

INTRA-AIRCRAFT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
21:32:23.2 **HOT-1**	it said it was miss— er uh you know.		
21:32:27.3 **HOT-2**	yeah.		
21:32:28.0 **HOT-1**	there uh there was one page there wasn't anything on it. so it's like they they tore it out in error.		
21:32:34.1 **HOT-2**	oh yeah.		
21:32:35.4 **HOT-1**	so.		
21:32:58.1 **HOT-2**	just twenty four ice test complete? or write—.		
21:33:02.0 **HOT-1**	yeah I'd— I'd put twenty four hour uh check's complete.		
21:33:19.1 **HOT-2**	alrighty.		
		21:33:20.9 **ZNY-B**	Colgan thirty four zero seven contact New York Center one tree tree point tree five.
		21:33:25.8 **RDO-2**	one three three point three five Colgan thirty four zero seven.
21:33:31.8 **HOT-1**	there we go.		
		21:33:32.9 **RDO-2**	thirty four zero seven fourteen point one for sixteen thousand.
		21:33:37.3 **ZNY-C**	Colgan thirty four zero seven New York Center roger. Wilkes-Barre altimeter two niner six seven.

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
		21:33:42.4 **RDO-2**	six seven thank you thirty four oh seven.
21:33:48.0 **HOT-2**	I'm assuming we're only gonna land once.		
21:33:51.6 **HOT-1**	yeah.		
21:33:56.8 **HOT-1**	the only thing that um I would not do— well the type of flight— I don't know if you can see it here. I'll show you.		
21:34:03.8 **HOT-2**	I see. oh yeah I didn't know what to—.		
21:34:05.9 **HOT-1**	if if you don't know the type of flight it is it's— it's down here on the bottom.		
21:34:08.1 **HOT-2**	uh-huh. oh oh okay.		
21:34:10.2 **HOT-1**	just a regular revenue flight—.		
21:34:11.4 **HOT**	[sound similar to altitude alert]		
21:34:12.3 **HOT-1**	fifteen sixteen alt sel. regular revenue flight is type one.		
21:34:15.2 **HOT-2**	okay.		
21:34:17.3 **HOT-1**	unless it's a reposition or special ferry or whatever it's something else.		
21:34:21.0 **HOT-2**	[sound of sneeze]		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:34:21.6 **HOT-1**	bless you.		
21:34:22.2 **HOT-2**	excuse me. okay.		
21:34:24.0 **HOT-1**	um a— and this is just my little deal and it is what I was taught and everything. and and it makes sense to me.		
21:34:31.9 **HOT-2**	sure.		
21:34:32.7 **HOT-1**	um on your two.		
21:34:35.6 **HOT-2**	uh-huh.		
21:34:36.3 **HOT-1**	what happens if we have to divert to an alternate?		
21:34:39.0 **HOT-2**	oh yeah that's true.		
21:34:40.0 **HOT-1**	um I was told it was their little uh uh like superstition.		
21:34:46.3 **HOT-2**	oh.		
21:34:46.6 **HOT-1**	you don't put— you don't put it until you land there.		
21:34:49.3 **HOT-2**	right right. no that makes sense.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:34:49.7 **HOT-1**	uh but well okay. well you can take it that far. I don't care. but it makes sense that if you have to divert someplace at least you're not scratching through and doing all that kind of stuff. uh but I still do the one landing and however many starts we have and fill the rest of it out.		
21:34:59.3 **HOT-2**	yeah.		
21:35:06.5 **HOT-2**	yeah.		
21:35:07.9 **HOT-1**	but uh other than that that's all there is to it. on your writeups—.		
21:35:15.0 **HOT-2**	I've written— I mean I've written other planes up before. just not from— with Colgan.		
21:35:18.1 **HOT-1**	okay alright so you know like the one P or the two P as you write 'em up like that?		
21:35:20.6 **HOT-2**	uh-huh. yeah.		
21:35:23.7 **HOT-1**	write it up. uh and if you're doing one twenty one ops you obviously know as short sweet to the point as you possibly can um.		
21:35:36.0 **HOT-2**	give em all the details that you need to give.		
21:35:38.2 **HOT-1**	yeah but but also don't get too wordy with it.		
21:35:42.4 **HOT-2**	right.		
21:35:44.0 **HOT-1**	um and what I try to do is— is I'd look up in the MEL book.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:35:54.7 **HOT-2**	uh-huh.		
21:35:55.3 **HOT-1**	to begin with before I write things up.		
21:35:58.0 **HOT-2**	so you know yeah.		
21:35:59.0 **HOT-1**	that way if I screw up and write it up one way and it grounds the airplane but it's not— it's not exactly or I could write it up slightly different to get an MEL to get it back to where you can do maintenance type of deal.		
21:36:15.1 **HOT-2**	yeah.		
21:36:16.3 **HOT-1**	it's it's a judgment call by all means.		
21:36:19.7 **HOT-2**	yeah.		
21:36:21.2 **HOT-1**	you you definitely want to write the proper thing up. um you know I try to uh uh get em to fix— I uh on the Saab we don't have glass we uh we had EFIS screens.		
21:36:37.7 **HOT-2**	right.		
21:36:40.1 **HOT-1**	but uh you had a EHSI and uh a EADI.		
21:36:45.5 **HOT-2**	uh-huh.		
21:36:46.2 **HOT-1**	I wrote up the course selector. course one selector.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:36:49.0 **HOT-2**	uh-huh.		
21:36:50.7 **HOT-1**	uh because it wouldn't move. it was stuck on one particular course setting.		
21:36:55.9 **HOT-2**	uh-huh.		
21:36:56.7 **HOT-1**	and uh wrote it up totally explained exactly what it was and they uh at the time there were four planes down. two getting line checks and then my airplane and another one uh that had something wrong with it. they only had four mechanics on duty at the time. so they were all trying to do something. er I'm sorry they had four down I was the fifth one.		
21:37:20.1 **HOT-2**	oh okay.		
21:37:21.1 **HOT-1**	so they tried to MEL the uh the uh the autopilot system uh because of the heading selector.		
21:37:32.0 **HOT-2**	yeah.		
21:37:32.6 **HOT-1**	I you know I wouldn't be able to turn. and it's like wait a minute. it doesn't even apply.		
21:37:36.4 **HOT-2**	yeah.		
21:37:37.4 **HOT-1**	so uh you got to be careful about that.		
21:37:40.5 **HOT-2**	yeah.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:37:41.2 **HOT-1**	just don't— you know understand the MELs that they uh they try to put on it make sure it applies to what you're doing.		
21:37:48.3 **HOT-2**	yeah.		
21:37:48.7 **HOT-1**	and the problem you're having. and I I called ‘em back and told ‘em uh that it doesn't have anything to do with the autopilot. well I mean doesn't it do this this this? no it's— this is what's wrong or this is what I told them before. ohhhhhh.		
21:38:03.6 **HOT-2**	yeah.		
21:38:04.6 **HOT-1**	ehh well can we just go ahead with that MELed we'll uh get it—. well I'll tell you we could go with that MEL but I can't sign the release. I guess we'll have to get somebody to fix it then won't we. well I guess we will.		
21:38:18.9 **HOT-2**	[sound of laughter]		
21:38:19.5 **HOT-1**	took em twenty minutes to fix it. they just had to pop out a panel uh little component put in another component.		
21:38:25.2 **HOT-2**	yeah.		
21:38:26.1 **HOT-1**	and it took em all of twenty minutes. it's just the fact that they were shorthanded.		
21:38:29.2 **HOT-2**	oh yeah.		
21:38:29.7 **HOT-1**	they were trying to uh uh—.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:38:31.9 **HOT-2**	save a minute here.		
21:38:32.7 **HOT-1**	yeah save a minute here. get us out back and then they would have time to do it.		
21:38:36.8 **HOT-2**	yeah.		
21:38:41.1 **HOT-1**	but of course that turned into a fiasco. we were going to Alexandria Louisiana that night.		
21:38:46.3 **HOT-2**	oh yeah.		
21:38:46.7 **HOT-1**	and uh let's do a cruise checklist.		
21:38:49.8 **HOT-2**	oh cruise checklist.		
21:38:51.2 **HOT-1**	yeah.		
21:38:52.4 **HOT-2**	altimeters two niner six seven set crosscheck.		
21:38:54.9 **HOT-1**	two niner six seven set crosscheck.		
21:38:57.5 **HOT-2**	power set seatbelt sign on lights set cabin pressure check. and well cabin pressure. what's Buffalo at?		
21:39:07.0 **HOT-1**	uh not too much. uh seven twenty eight.		
21:39:08.7 **HOT-2**	seven hundred.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:39:12.7 **HOT-2**	cabin pressure check and twenty four hour ice protection test complete. cruise checklist complete. um-huh.		
21:39:17.2 **HOT-1**	thanks. yeah we uh after they fixed it so— we were already delayed. they fixed it we were delayed a little bit more. no big deal.		
21:39:24.0 **HOT-2**	yeah.		
21:39:24.2 **HOT-1**	get in uh start up number two and we're doing the paperwork and all of a sudden we get bing. look— it looked— it was engine lookup light. I went oh crap that's not good. I looked up it was chip detect. right chip detect.		
21:39:43.3 **HOT-2**	what's that?		
21:39:43.7 **HOT-1**	what— what that— what that's doing is detecting chips of metal in the engine.		
21:39:48.4 **HOT-2**	oh.		
21:39:50.2 **HOT-1**	and uh we were thinking aww crap. so I said grab the checklist real quick and let's just go through it. well in the chip detect abnormal checklist there's nothing pertaining to on the ground. it's all pertaining to in the air so I said okay shut it down. called maintenance they came over they cleaned out a little filter screen. they said it was probably carbon built up blah blah blah.		
		21:40:05.3 **ZNY-C**	two eight charlie golf climb and maintain flight level two two zero.
		21:40:09.8 **N28CG**	two zero zero for two two zero two eight charlie golf.

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
		21:40:12.1 **ZNY-C**	and how would you describe the icing?
21:40:16.8 **HOT-2**	yeah.		
21:40:17.4 **HOT-1**	they fel— uh cleaned out this little carbon screen. did uh a runup check observation. I kept everybody on the plane. told em what was going on. man their eyes were you know they're all over here watching what they were doing. but it was either that or they'd have to get bussed around get out and bout the time that they'd get out they would bus em back around.		
		21:40:18.3 **N28CG**	yeah we'll call it about light to moderate rime.
21:40:36.7 **HOT-2**	yeah.		
21:40:37.2 **HOT-1**	anyway we started up ops check good. so filling out filling out the paperwork. got the door closed and everything. it's got a little whiskey hatch over here.		
21:40:45.4 **HOT-2**	uh-huh.		
21:40:46.0 **HOT-1**	I'm handing the paperwork out. ding. #. right chip detect— chip detect again.		
21:40:51.8 **HOT-2**	ohh.		
21:40:52.8 **HOT-1**	so I shut it down told everybody yeah we're gonna have to get another airplane. they had another airplane it was on a Saturday so they had extra— they had spares because of the schedule and everything.		
21:41:01.9 **HOT-2**	yeah.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:41:04.4 **HOT-1**	um so uh twenty minutes later we launch and get about halfway up there uh over this one VOR and uh all of a sudden oh and uh uh I'll back up a half a step. I was telling the—telling the FO this was like— I don't know a month after I upgraded to captain.		
21:41:29.7 **HOT-2**	oh geez.		
21:41:30.6 **HOT-1**	I said you know uh uh all this stuff is just happening to me. and it's— you know hell the only thing I haven't had is is an air return.		
21:41:39.8 **HOT-2**	oh God.		
21:41:40.8 **HOT-1**	so we get over this VOR headed to Alexandria. ding ding ding. that's not a caution light that's a master warning.		
21:41:48.5 **HOT-2**	yeah.		
21:41:50.5 **HOT-1**	and uh looked up avionics smoke detector.		
21:41:56.2 **HOT-2**	ohh.		
21:41:58.2 **HOT-1**	I'm going @ my FO cool as #. man should I get my uh smoke goggles on and everything. said yeah gimme— gimme the memory items. I'm— I'm over here. I don't smell anything. the avionics bay is right behind the captain's seat.		
21:42:15.9 **HOT-2**	yeah.		
21:42:17.1 **HOT-1**	there's a little uh fire bottle. little uh rubber kind of cover thing that you can stick the fire bottle into and blow it if you need to if you're actually on fire.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:42:21.1 **HOT-2**	uh-huh...uh-huh.		
21:42:28.2 **HOT-1**	I reach back in here and find it and uh I open it up because it's— it's kind of like a drainer in a sink.		
21:42:35.5 **HOT-2**	yeah.		
21:42:35.9 **HOT-1**	like over a garbage disposal. it's just kinda like this. and it's rubber and you can push.		
21:42:40.2 **HOT-2**	uh-huh.		
21:42:40.5 **HOT-1**	so I pushed it. man man I don't smell anything. called the flight attendant. @ hey do you smell any smoke back there? no. why? should I?		
21:42:53.3 **HOT-2**	[sound of laughter]		
21:42:55.5 **HOT-1**	well no you shouldn't. I'm glad you don't. thanks for playing the game. and— and I just cut her off. good *. [sound of laughter]		
21:43:04.3 **HOT-2**	nice.		
21:43:05.9 **HOT-1**	she calls back well uh what— what do you want me to do? I said naw man uh I said I think it's just a false alarm. but uh I was just checking. we just— we've got a light up here that went off. I said I don't think there's anything to it. so anyway she— she was good with that. and uh we didn't have ACARS— we don't have ACARS in the Saabs. so I called uh Manassas on ARINC. I said uh so uh what do you want me to do? go back to Houston? continue on or what? call us when you get on the ground in Alexandria. hey no problem. so they're gonna do a road trip and change the smoke detector out.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:43:23.7 **HOT-2**	yeah...yeah.		
21:43:48.5 **HOT-1**	and uh sure enough by the next morning— we were taking it out the next morning they had— they had come— they did a road trip from Houston. changed the deal out. away we went. of course after that day uh we all went to the uh steakhouse. we ate a steak baked potato and drank a messload of beer.		
21:44:09.4 **HOT-2**	yeah.		
21:44:10.2 **HOT-1**	it was just one of those— one of those days. yeah.		
21:44:12.1 **HOT-2**	one of those days where you have to have a few beers at the end.		
21:44:16.4 **HOT-1**	that was that was a good time. I like flying the Saab. if— if you upgrade to the Saab— I mean if you have the opportunity to upgrade to Saab versus the Q and you want to get your PIC time.		
21:44:29.2 **HOT-2**	um-huh.		
21:44:29.5 **HOT-1**	and uh you know and if that's uh you know a goal for you I guess go ahead and do it.		
21:44:34.0 **HOT-2**	yeah. um-huh.		
21:44:35.8 **HOT-1**	that a neat airplane to fly. it's not like this.		
21:44:38.2 **HOT-2**	yeah right.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:44:40.1 **HOT-1**	I mean it's taking five steps backwards but you're in the left seat.		
21:44:46.2 **HOT-2**	yeah.		
21:44:46.5 **HOT-1**	it's— it's like moms SUV or minivan. you know the soccer van uh you don't have to fly with your hands and your feet. you just fly with your hands.		
21:44:59.2 **HOT-2**	yeah.		
21:44:59.5 **HOT-1**	once you— once you flip the auto— uh the yaw damp on and autopilot on it's solid as a rock.		
21:45:05.2 **HOT-2**	works the rudders for you.		
21:45:07.1 **HOT-1**	yeah it works rudders for you. it's all coordinated.		
21:45:09.9 **HOT-2**	I think it's fun flying with— with captains. not so much any— lately but right at first that came from the Saab and they'd see— they'd see the rudder and they'd— aww # and kick it really hard and fling the plane back and forth.		
21:45:23.8 **HOT-1**	kind of like I did a little while ago.		
21:45:25.4 **HOT-2**	yeah kind of but uh at first I flew— I flew with some captains that were doing it really bad.		
21:45:30.5 **HOT-1**	really.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:45:30.9 **HOT-2**	like knock the flight attendants down in the back.		
21:45:32.7 **HOT-1**	[sound of laughter]		
21:45:34.5 **HOT-2**	like I'd see the flight attendants afterwards and they're like um who was flying.		
21:45:39.8 **HOT-1**	that would be that bonehead captain.		
21:45:42.8 **HOT-2**	[sound of laughter]		
21:45:44.0 **HOT-1**	you know what? yeah I tell you I'm getting a lot more used to it. uh I'm not saying I like it any better but I am getting used to it.		
21:45:51.0 **HOT-2**	yeah.		
21:45:55.6 **HOT-2**	yeah I don't know what I want to do with the upgrade. I'm not entirely in like a big rush to upgrade. um it would depend on where I'm based. just because having to commute to be the bottom of the list is gonna suck. and—.		
21:46:07.0 **HOT-1**	true and— and you know like you were talking about as far as uh right now your wanting to buy a house and wanting to have—.		
21:46:13.6 **HOT-2**	exactly if I hold off— you know if it's a matter of holding on a few months well then I'll be making a substantial amount more money in the— in the Q than I would in the Saab.		
21:46:22.0 **HOT-1**	right.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:46:22.9 **HOT-2**	depending you know how— how long would it be to make that worth my while. would it— would I make more money upgrading into the Saab right away or would I make more money if I waited for the Q for a little while.		
21:46:32.6 **HOT-1**	well think of it this way uh if you— if you stayed on the on the Q obviously you're gonna— you're not making the captain rate.		
21:46:42.0 **HOT-2**	right.		
21:46:42.5 **HOT-1**	but you may have a better quality of life to begin with uhh with regards to buying a house and having a schedule to where you you know you could work around and you could be—.		
21:46:55.3 **HOT-2**	exactly.		
21:46:55.6 **HOT-1**	you know home with your husband to to take care of all that kind of stuff.		
21:46:59.6 **HOT-2**	exactly yeah it's just gonna depend where we're at when that happens. but I— I mean I'm not— I'm not in such a hurry to upgrade. I've got very very very good connections at Alaska.		
21:47:10.4 **HOT-1**	oh cool.		
21:47:11.2 **HOT-2**	Alaska's the only major I'd want to go to.		
21:47:13.2 **HOT-1**	yeah.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:47:13.5 **HOT-2**	just because I don't want to commute my whole life...so um once I do upgrade you know once once Alaska starts hiring I don't— I mean I don't necessarily have to have a thousand hours PIC. I need to have some PIC.		
21:47:25.7 **HOT-1**	you don't have to with uh Alaska?		
21:47:26.8 **HOT-2**	um it it depends. you you you do and on paper you do but it just— it it depends who you know. if you know people then you can kind of sneak away with it a little bit. I definitely need to have you know the proper experience you need to be qualified. but if I have—.		
21:47:36.6 **HOT-1**	huh...sure.		
21:47:40.4 **HOT-2**	you know if at about five hundred hours they said to to go and interview and then I can interview and they can say we want you to have a thousand hours. so once you get a thousand hours um we're gonna put you into ground school. they'll say stuff like that.		
21:47:53.9 **HOT-1**	okay.		
21:47:54.3 **HOT-2**	so I mean it depends and I don't even know if that's the route I want to go anymore...you know the more I think about it. I wouldn't I wouldn't mind flying for FedEx or UPS.		
21:48:09.3 **HOT-1**	FedEx is still big on military time and the uh and the internal recommendations so those two things— I mean that knocks me out of FedEx for sure.		
21:48:10.5 **HOT-2**	yeah...yeah.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:48:18.0 **HOT-1**	but uh UPS like I said I got my cousin that uh flies seven fives seven six. he's based in Ontario.		
21:48:26.3 **HOT-2**	yeah.		
21:48:27.2 **HOT-1**	uh not too far from where he lives. but uh.		
21:48:36.3 **HOT-2**	yeah I wouldn't mind— you know I could even see myself doing like I mean for quality of life I could see myself doing cargo stuff and just I mean like small stuff like there's a company that flies right out of my hometown to Spokane Washington and back every night.		
21:48:36.7 **HOT-1**	that's just—.		
21:48:49.5 **HOT**	[tones similar to ACARS message reception]		
21:48:51.2 **HOT-2**	and I'd do that three nights a week and be home. I could have kids and raise a family. and I think that that might be more worth my while. something like that.		
21:48:58.5 **HOT-1**	yeah yeah.		
21:48:59.6 **HOT-2**	and it just depends. I don't even know. I'm I'm so in limbo right now it's actually kind of kind of interesting. like I don't know where I'll be in a year. I don't know where I'll be in—.		
21:49:05.4 **HOT-1**	well just keep your eyes open you know and and keep you know keep listening uhh and and something will come across er you know you'll know whenever it's time.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:49:18.2 **HOT-2**	yeah.		
21:49:18.3 **HOT-1**	I've gotta do this. I've gotta— I'm ready to move on. um [sound similar to yawn] excuse me. it's kind of like me. you know I started this this little gig late in life.		
21:49:28.7 **HOT-2**	yeah.		
21:49:28.9 **HOT-1**	oh it's like it's a second career for me basically because I— I was able to take that package with Verizon.		
21:49:34.1 **HOT-2**	yeah.		
21:49:35.5 **HOT-1**	but uh...you know it's...you know do I— g— at this point do I go to a major and you know not be able to be there for very long.		
21:49:48.8 **HOT-2**	yeah be an FO the rest of your life or...		
21:49:51.8 **HOT-1**	uhh which— that may not be a bad thing as long as I would be able to progress and and uh and be a lifetime FO if you will.		
21:50:02.9 **HOT-2**	yeah yeah.		
21:50:03.4 **HOT-1**	uh and just and and dwell upon the quality of life part of it or do I stay here with Colgan and uh...		
21:50:11.8 **HOT-2**	[sound of sneeze] excuse me.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:50:15.2 **HOT-1**	and you know likewise do the quality of life. I don't have to make two hundred thousand dollars a year er a hundred fifty thousand dollars a year whatever you know I could—.		
21:50:20.7 **HOT-2**	exactly.		
21:50:23.8 **HOT-1**	I can certainly be comfortable on on a hundred thousand. um you got traffic out there just it's crossing left to right.		
21:50:32.9 **HOT-2**	uh in sight.		
21:50:35.4 **HOT-1**	but uh—.		
21:50:41.8 **HOT-2**	um winds are at two fifty at fifteen gusting twenty three they're using runway—.		
		21:50:45.0 **ZNY-C**	Colgan three four zero seven contact Cleveland Center one two four point three two.
		21:50:48.8 **RDO-2**	one two four point three two Colgan three four zero seven.
21:50:53.1 **HOT-2**	one two four thirty two.		
		21:50:58.5 **RDO-2**	Cleveland Center Colgan thirty four zero seven sixteen thousand.
		21:51:02.1 **ZOB**	Colgan thirty four zero seven Cleveland Center roger.
21:51:05.4 **HOT-2**	alright so it's the winds are at two five zero fifteen gusting twenty three and they're using three two and two three. do you want to use uh—.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:51:11.7 **HOT-1**	uh two three.		
21:51:12.5 **HOT-2**	two three.		
21:51:13.2 **HOT-1**	yeah.		
21:51:13.7 **HOT-2**	okay.		
21:51:13.8 **HOT-?**	[sound of sniffle]		
21:51:16.3 **HOT-1**	and flaps fifteen.		
21:51:18.3 **HOT-2**	okay.		
21:51:21.7 **HOT-2**	uh it's runway two three.		
21:51:23.8 **HOT-1**	ouch.		
		21:51:26.1 **ZOB**	Southwest six fifteen cleared direct to the Buffalo airport.
21:51:35.8 **HOT-2**	that us?		
21:51:37.0 **HOT-1**	nope.		
21:51:37.4 **HOT-2**	I didn't think so.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:51:38.6 **HOT-1**	yeah.		
21:51:39.1 **HOT-2**	[sound of laughter] I just heard direct Buffalo.		
21:51:42.0 **HOT-2**	uh does this look good to you? um...we've got TRAVA ILS two three TRAVA KLUMP runway two three.		
21:51:43.3 **HOT-?**	[sound of sniffle]		
21:51:50.7 **HOT-1**	yeah TRAVA.		
21:51:51.9 **HOT-2**	yeah here you go. and the EOA is in there.		
21:51:53.0 **HOT-?**	[sound of sniffle]		
21:51:59.4 **HOT-1**	thirty three.		
21:52:03.7 **HOT-?**	[sound of sniffle]		
21:52:05.1 **HOT-1**	try not to be dyslexic.		
21:52:07.8 **HOT-2**	[sound of laughter]		
21:52:08.2 **HOT-1**	last time I flew in here two thirty uh— two thirty three's the uh inbound course. I put two twenty three.		
21:52:14.2 **HOT-2**	oh geez. two thirty thirty three— no * it's runway— oh it is two thirty three?		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:52:19.6 **HOT-1**	it's two thirty three.		
21:52:21.3 **HOT-2**	runway two three. oh yeah no that makes sense. now you got me confused.		
21:52:26.2 **HOT-1**	well I— well I didn't mean to confuse you now. two three three.		
21:52:29.9 **HOT-2**	two three three.		
21:52:31.0 **HOT-1**	and I'll brief it that way too.		
21:52:32.6 **HOT-2**	alright it's two three three. [sound of laughter] we're good.		
21:52:34.2 **HOT-1**	that's two three three.		
21:52:53.2 **HOT-?**	[sound of sniffle]		
21:52:57.2 **HOT-2**	alrighty and for the rest of that weather uh three miles. it's snowing with some mist.		
21:53:03.5 **HOT-1**	alright.		
21:53:05.7 **HOT-2**	it didn't give me an RVR.		
21:53:07.5 **HOT-1**	good...it's good.		
21:53:10.9 **HOT-2**	that means it's far enough right?		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:53:13.9 **HOT-1**	yeah.		
21:53:20.3 **HOT-2**	runway five then what do we have? one two nine two five.		
21:53:30.4 **HOT-?**	[sound of sniffle]		
21:53:40.2 **HOT-2**	alrighty your numbers. for flaps fifteen runway two three are eighteen and fourteen.		
21:53:43.1 **HOT-?**	[sound of sniffle]		
21:53:47.5 **HOT-1**	alrighty eighteen and fourteen.		
21:53:49.7 **HOT-2**	we have to go around it's gonna be twenty five and forty five.		
21:54:05.5 **HOT-?**	[sound of sniffle]		
21:54:06.7 **HOT-2**	alrighty. I don't think we had any specials did we?		
21:54:12.0 **HOT-1**	uh I don't believe we did.		
21:54:13.6 **HOT**	[sound of double chime]		
21:54:16.9 **INT-3**	hello.		
21:54:17.2 **INT-2**	hey any specials?		

INTRA-AIRCRAFT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
21:54:18.6 **INT-3**	uh no we don't.		
21:54:19.8 **INT-2**	no specials.		
21:54:20.6 **INT-3**	nope.		
21:54:20.8 **INT-2**	we should be there in about twenty twenty five minutes.		
21:54:23.0 **INT-3**	fantastic.		
21:54:23.9 **INT-2**	alright		
21:54:24.1 **INT-3**	thanks bye.		
21:54:58.5 **HOT-2**	yeah I kind of like that I'm so flexible with what I'm doing.		
21:55:01.3 **CAM**	[sound similar to seat track movement]		
21:55:03.0 **HOT-2**	* I have goals but I have such a wide range of goals I don't know exactly what I want.		
21:55:05.3 **HOT**	[sound similar to double chime]		
		21:55:25.0 **ZOB**	Colgan thirty four zero seven Cleveland.
		21:55:28.1 **RDO-2**	thirty four zero seven go ahead.

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
		21:55:30.2 **ZOB**	Colgan thirty four zero seven reset your transponder. squawk seven— er uh two seven six two.
		21:55:35.6 **RDO-2**	two seven six two Colgan thirty two— thirty four zero seven.
21:55:39.9 **HOT-2**	oops I think I had two seven six two I think I put half and half. two seven six two yeah. twenty five and then I switched that one. oops.		
21:55:56.8 **HOT-?**	[sound of sniffle]		
21:56:08.0 **HOT-1**	it's just like we're in I don't know just just a light haze or type cloud. I don't know just we can see things out in front of us.		
21:56:17.4 **HOT-2**	do you want to go down?		
21:56:18.6 **HOT-1**	huh? ohh. I was thinking about that.		
21:56:26.4 **HOT-2**	might be easier on my ears if we start going down sooner.		
21:56:28.9 **HOT-1**	yeah we could do it. that's fine.		
		21:56:31.6 **RDO-2**	and Center Colgan thirty four zero seven.
		21:56:35.6 **ZOB**	Colgan thirty four zero seven uh say again?
21:56:35.9 **HOT-1**	get discretion to twelve.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
		21:56:38.7 **RDO-2**	oh yeah just can we get PD down to twelve thousand for Colgan thirty four zero seven.
		21:56:42.6 **ZOB**	uhh standby.
21:56:44.9 **HOT-1**	I got your standby.		
21:56:46.5 **HOT-2**	[sound of laughter]		
21:56:49.5 **HOT-?**	[sound of sniffle]		
21:57:07.1 **HOT-1**	we may have to wait for separation on this guy over here.		
21:57:10.0 **HOT-2**	yeah.		
		21:57:10.8 **ZOB**	Colgan thirty four zero seven cross BENEE at maintain one one thousand.
		21:57:15.7 **RDO-2**	BENEE at one one eleven thousand Colgan thirty four zero seven.
21:57:20.5 **HOT-2**	BENEE at eleven.		
21:57:21.3 **HOT-1**	tooo what was it?		
21:57:23.2 **HOT-2**	BENEE.		
21:57:23.4 **HOT-1**	oh BENEE.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:57:25.4 **HOT-1**	BENEE at one one thousand.		
21:57:27.2 **HOT-2**	yes sir.		
21:57:34.9 **HOT-1**	yeah that works.		
21:58:28.0 **HOT-?**	[sound of sniffle]		
21:58:31.1 **HOT-1**	you know we had a a controller down in Houston. uh he was known as Mister Happy.		
21:58:37.7 **HOT-2**	oh yeah.		
21:58:38.4 **HOT-1**	guy was just he was— had a perfect personality for the being a controller. he never let anything rattle him. and he just all just all bubbly type a type a guy. he retired— just to let you know how he— how well respected he was um he retired and he had they published where his retirement party was. there was pilots from Continental Colgan pilots Chautauqua Expressjet you know the main carriers there in Houston.		
21:58:56.8 **HOT-?**	[sound of sniffles]		
21:59:09.2 **HOT-2**	oh that's cool.		
21:59:12.3 **HOT-1**	they all went to go see you know Mister Happy and everything but but that's where I got the bent wing pencil jet.		
21:59:19.6 **HOT-2**	it's where what?		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
21:59:20.6 **HOT-1**	that's where I got the bent wing pencil jet uh name from.		
21:59:24.7 **HOT-2**	he calls them that?		
21:59:26.4 **HOT-1**	yeah it was uh Jet Lincoln instead of Jetlink. called em Jet Lincoln and we were Cold One.		
21:59:29.0 **HOT-2**	uh-huh...oh.		
21:59:32.4 **HOT-1**	Cold One nintey five sixty five you'll be following a bent wing pencil jet at your one oh clock. two miles or whatever it was.		
21:59:40.9 **HOT-2**	that's funny.		
21:59:42.1 **HOT-1**	either that or you're following the lawn dart today. let's see uh if it was a CRJ we're following the Barbie Jet.		
21:59:45.6 **HOT-2**	[sound of laughter]		
21:59:52.2 **HOT-2**	the Barbie Jet.		
21:59:59.5 **HOT-1**	or he would say you're following Chi-tak-wa.		
22:00:03.3 **HOT-1**	[sound of laughter]		
22:00:04.1 **HOT-2**	[sound of laughter]		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:00:05.9 **HOT-2**	the guys that have fun and enjoy their jobs are so much more pleasant to work with.		
22:00:09.4 **HOT-1**	oh yeah.		
22:00:10.8 **HOT-2**	yeah.		
22:00:14.6 **HOT-?**	[sound of sniffle]		
22:00:16.2 **HOT-1**	College Station Texas was a a contract control tower.		
22:00:23.0 **HOT-2**	yeah.		
22:00:23.2 **HOT-1**	had a guy that worked in there. had an odd accent to begin with. and uh College Station Airport is uh owned and operated by the university— uh the Texas A and M university.		
		22:00:37.8 **ZOB**	Mesaba thirty forty five contact Cleveland Center one two zero point six.
22:00:39.7 **HOT-2**	uh-huh.		
		22:00:43.2 **RDO-2**	one two zero point six Colgan thirty four zero seven.
		22:00:46.2 **ZOB**	nope Colgan thirty four zero seven you stay here. that was for Mesaba.
22:00:49.8 **HOT-2**	oh.		

INTRA-AIRCRAFT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
22:00:51.7 **HOT-2**	I'm not doing very good by * tonight.		
22:00:52.7 **HOT-1**	it's alright.		
		22:00:54.0 **ZOB**	Colgan thirty four zero seven you still here?
		22:00:56.3 **RDO-2**	yes sir thirty four zero seven.
22:00:59.5 **HOT-1**	sorry about that. oh anyway he would say Eeeeeeeeastwood information echo.		
22:01:08.9 **HOT-2**	[sound of laughter]		
22:01:11.3 **HOT-1**	and he'd give us he'd give us same type of uh clearance to Houston. Colgan ninety five twenty six you're cleared to the George Herbert Walker er yeah George Herbert Walker Bush Intergalactical Airport.		
22:01:27.6 **HOT-2**	[sound of laughter]		
22:01:28.1 **HOT-1**	instead of Intercontinental. Intergalactical Airport via the College Station zero seven six. baaaseball Rice won. climb maintain seven thousand. departure frequency is Houston Center one two three point seven. squawk whatever you know.		
22:01:36.8 **HOT-2**	[sound of laughter]		
22:01:47.6 **HOT-2**	yeah.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:01:48.0 **HOT-1**	and I would try to read it back exactly the same way. went in there I don't know you know about three or four months before I left and he was just all calm and quiet. you know I could tell it was him said hey man what happened to that Eeeeeeastwood Airport information echo. he said yeah they clipped my wings.		
22:02:09.7 **HOT-2**	oh no. they didn't like him doing that?		
22:02:12.3 **HOT-1**	I said well uh if if you need uh if you need any help on that one you just let me know who to call and I'll uh be glad to put in a good word for ya. and he he chuckled. he said uh he said awww let it blow over for a little while and I'll be back I'll be back to my regular self later.		
22:02:32.1 **HOT-2**	[sound of laughter]		
22:02:32.9 **HOT-1**	yeah.		
22:02:36.4 **HOT-1**	I just like the flying down there a whole lot better.		
22:02:39.1 **HOT-2**	yeah.		
22:02:39.6 **HOT-1**	see and and in the Saab in the northeast uh you * there's no FMS there's no glass.		
22:02:46.9 **HOT-2**	yeah.		
22:02:47.5 **HOT-1**	and you're you're asses and elbows all the time.		
22:02:51.5 **HOT-2**	yeah.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:02:52.4 **HOT-1**	uh because uh you're flying the the victor airways. the uh the VORs are so close together and you're having to go to intersections.		
22:03:00.3 **HOT-2**	yeah.		
22:03:00.7 **HOT-1**	cross radials and all that kind of stuff. and uh it's it's hard work.		
22:03:04.8 **HOT-2**	yeah.		
22:03:05.3 **HOT-1**	down in Houston y— you're more spread out. uh the flying is a whole lot nicer down there the controllers are a whole lot nicer. in Florida the same way.		
22:03:18.6 **HOT-2**	yeah Phoenix is like that.		
22:03:20.3 **HOT-?**	[sound of sniffle]		
22:03:21.2 **HOT-1**	man I— it's just all the pressure of all the the congestion and the the volume and weather and anything and everything. the the controllers uh they just it's like they uh constantly have their—.		
		22:03:38.1 **ZOB**	Colgan thirty four zero seven contact Buffalo Approach one two six point one five.
22:03:41.8 **HOT**	[sound similar to altitude alert]		
		22:03:42.7 **RDO-2**	one two six one five Colgan thirty four zero seven.
22:03:45.4 **HOT-1**	twelve eleven alt sel.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:03:46.5 **HOT-2**	twelve eleven alt sel.		
22:03:50.0 **HOT-?**	[sound of sniffle]		
		22:03:53.0 **RDO-2**	Buffalo Approach Colgan thirty four zero seven twelve for eleven thousand with romeo.
		22:03:59.2 **APP**	Colgan forty four zero seven Buff Approach good evening. Buffalo altimeter's two niner eight zero. plan ILS approach runway two three.
		22:04:05.1 **RDO-2**	two niner eight zero and ILS two three Colgan thirty four zero seven.
22:04:09.1 **HOT-2**	*.		
22:04:09.3 **HOT-1**	two niner eight zero.		
22:04:11.6 **HOT-2**	eight.		
22:04:12.4 **HOT-1**	and we'll expect two three.		
22:04:15.1 **HOT-2**	yup.		
22:04:15.5 **HOT-1**	and if you've got your charts handy I'll brief it real quick.		
22:04:17.7 **HOT-2**	IIII do.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:04:19.4 **HOT-1**	**. alright it's uh gonna be the ILS to uh runway two three at Buffalo. chart eleven two twenty April oh seven.		
22:04:28.9 **HOT-2**	yes sir.		
22:04:29.7 **HOT-1**	got uh eleven three's the frequency set both sides. two thirty three set on my side I saw you set yours. uh glideslope uh final approach fix uh glideslope intercept is at the—.		
		22:04:39.9 **APP**	Colgan thirty four zero seven proceed direct TRAVA.
		22:04:43.2 **RDO-2**	direct TRAVA Colgan thirty four zero seven.
22:04:45.8 **HOT-2**	direct—.		
22:04:46.2 **HOT-1**	direct TRAVA.		
22:04:50.6 **HOT-1**	oooh let's see I forget. do I do the do the first one?		
22:04:54.8 **HOT-2**	I did the first one. it doesn't matter you could do either one. there's no hold in there so—.		
		22:05:00.6 **APP**	Colgan thirty four zero seven descend and maintain six thousand.
		22:05:03.8 **RDO-2**	sorry about that down to six thousand Colgan thirty four zero seven.
22:05:08.2 **HOT-2**	cranky old guy.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:05:08.9 **HOT-1**	six thousand alt sel. that's something I you in in the Saab whoever if the autopilot's engaged you know the pilot flying manipulates that #.		
22:05:17.0 **HOT-2**	yeah...oh yeah.		
22:05:20.7 **HOT-1**	I don't know why we don't do that here but we don't.		
22:05:23.2 **HOT-2**	yeah.		
22:05:24.3 **HOT-1**	alright well if you don't mind I'm gonna go ahead and push her on down at a thousand feet a minute.		
22:05:27.0 **HOT-2**	oh that's okay.		
22:05:29.5 **HOT-1**	uh continuing on glideslope intercept's the outer marker twenty two oh six that's fourteen uh seventy eight above the ground. DA's nine twenty eight we'll put nine thirty in...it's also two hundred above the ground. touchdown zone elevation is seven twenty eight. highest MSA's south of the outer marker at thirty nine hundred north of the marker is twenty seven. and ALSF two lighting uh missed approach is up to twenty three hundred climbing right turn to three thousand via three hundred heading uh on the uh two six seven radial to BUF VOR. and er outbound on VOR out to WELLA uh which is DME twenty three point one uh hold uh this thing'll probably do a parallel entry. uh we got the weather. bugs are set eighteen fourteen flaps fifteen. uh off of twenty three I forget let me look it up.		
22:06:05.0 **HOT-?**	[sound of sniffles]		
22:06:31.0 **HOT-2**	left.		
22:06:32.6 **HOT-1**	oh sure. I'll do it left turn.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:06:36.9 **HOT-2**	left turn.		
22:06:37.6 **HOT-1**	first available.		
22:06:38.7 **HOT-2**	I think so.		
22:06:39.9 **HOT-1**	can I make echo?		
22:06:41.3 **HOT-2**	um I think so.		
22:06:42.9 **HOT-1**	okay.		
22:06:45.3 **HOT-1**	we'll do it. oh #.		
22:06:48.7 **HOT-2**	[sound of laughter]		
22:06:50.5 **HOT-1**	going too far off.		
22:06:55.6 **HOT-2**	yeah you can make echo.		
22:06:55.8 **HOT-1**	*.		
22:07:14.2 **HOT-2**	[sound similar to yawn] alright I'm gonna call in range. I'll be off one for a second.		
22:07:16.8 **HOT-1**	I got one.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:07:18.3 **HOT-2**	* two five right? yup.		
22:07:21.2 **HOT-?**	[sound of sniffle]		
		22:07:22.1 **RDO-2**	Ops Colgan thirty four zero seven's in range.
22:07:29.9 **HOT-?**	[sound of sniffle]		
		22:07:30.6 **OPS**	thirty four zero seven go for Buffalo ops.
		22:07:33.4 **RDO-2**	yeah we're just letting you know we're in range. uh let's see here looks like we're ten maybe fifteen minutes out.
		22:07:39.2 **OPS**	we'll see you in about ten fifteen minutes. gate twenty six. um we do actually have another Colgan turn we're trying to get out uh because they have the adapter we need to meet you guys. um so it might be just a couple minutes when you get here before we can actually bring the jetbridge up to ya.
		22:07:54.2 **RDO-2**	alrighty uh thirty four zero seven we'll be we'll be ready for that thanks.
		22:07:58.6 **OPS**	thank you see you then.
22:07:59.9 **HOT-1**	is the other Colgan in?		
22:08:02.3 **HOT-2**	the other Colgan's there right now. and they're trying to turn him and we may have to sit and wait for them to turn him.		

INTRA-AIRCRAFT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
22:08:07.4 **HOT-1**	yeah.		
22:08:08.4 **HOT-2**	that's what she said.		
22:08:09.1 **HOT-1**	how'd they beat us?		
22:08:11.8 **HOT-2**	I don't— they must have taken runway two niner. 'cause they— we we sat there for like forty five minutes without anybody taking off two two.		
22:08:26.4 **HOT-?**	[sound of sniffle]		
22:08:27.5 **HOT-1**	alrighty.		
22:08:37.4 **HOT-?**	[sound of sniffle]		
22:08:41.0 **HOT-2**	alrighty **.		
		22:08:41.4 **APP**	Colgan thirty four zero seven descend and maintain five thousand.
		22:08:45.0 **RDO-2**	five thousand Colgan thirty four zero seven.
22:08:47.9 **HOT-1**	five thousand alt sel.		
22:08:48.9 **HOT-2**	five thousand alt sel I'm off one.		
22:08:50.2 **HOT-1**	I've got one.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:08:51.1 **PA-2**	folks from the flight deck your first officer speaking uh it looks like at this time we're about ten maybe fifteen minutes outside of Buffalo. weather in Buffalo is uh pretty foggy. uh snowing a little bit there it's not too terribly cold uh but uh at this time I'd like to make sure everybody remains in their seats so the flight attendants can prepare the cabin for arrival. thank you.		
22:09:10.6 **HOT-2**	[sound of sniffles] alrighty I'm back on one.		
		22:09:12.1 **APP**	Colgan thirty four zero seven descend and maintain four thousand.
		22:09:15.6 **RDO-2**	and four thousand Colgan thirty four zero seven.
22:09:15.9 **PA-3**	ladies and gentlemen in preparation for landing in Buffalo please be certain your seatback is straight up and your seatbelt is fastened. please pass any remaining service items and unwanted reading materials to us as we pass through the cabin. please turn off all portable electronic devices and stow them until we have reached the gate. after landing Continental Connection allows passengers to use cell phones. I will make an announcement when it is safe to use this device. if you plan to use your cell phone please ensure it's accessible since personal items must be stowed until we reach the gate.		
22:09:17.8 **HOT-1**	four thousand alt sel.		
22:09:18.8 **HOT-2**	four thousand.		
22:09:26.0 **HOT-1**	how's the ears?		
22:09:27.3 **HOT-2**	uh they're stuffy.		
22:09:31.6 **HOT-1**	are they poppin?		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:09:32.7 **HOT-2**	yeah.		
22:09:33.3 **HOT-1**	okay. that's a good thing.		
22:09:35.7 **HOT-2**	yeah I wanna make em pop. [sound of laughter]		
22:10:20.6 **HOT-?**	[sound of sniffle]		
22:10:22.6 **HOT-2**	is that ice on our windshield?		
22:10:25.6 **HOT-1**	got it on my side. you don't have yours?		
22:10:28.7 **HOT-1**	* [sound of whistle]		
22:10:29.2 **HOT-?**	[sound of sniffle]		
22:10:30.5 **CAM**	[sound of click]		
22:10:32.3 **HOT-2**	oh yeah oh it's lots of ice.		
22:10:39.5 **HOT-?**	[sound of sniffle]		
22:10:47.5 **HOT-1**	oh yeah that's the most I've seen— most ice I've seen on the leading edges in a long time. in a while anyway I should say.		
22:10:51.4 **HOT-2**	oh *.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:10:56.8 **HOT-?**	[sound of sniffle]		
22:10:57.7 **HOT-2**	yeah that's another thing. all the guys— @ came in to our when we interviewed and he said oh yeah you'll all be upgraded in six months into the Saab and blah ba blah ba blah and I'm thinking you know what. flying in the northeast I've sixteen hundred hours. all of that in Phoenix how much time do you think actual I had or any in in ice. I had more actual time on my first day of IOE than I did in the sixteen hundred hours I had when I came here.		
22:11:14.8 **HOT-?**	[sound of sniffle]		
22:11:21.0 **HOT-1**	[sound of laughter]		
22:11:22.2 **HOT-2**	I'm not even kidding. the first day.		
22:11:25.7 **HOT-1**	well that sounds— well I mean I didn't have sixteen hundred hours.		
22:11:27.5 **HOT**	[sound similar to altitude alert]		
22:11:28.9 **HOT-1**	five for four alt sel.		
22:11:29.8 **HOT-2**	five four alt sel.		
22:11:31.1 **HOT-?**	[sound of sniffle]		
22:11:31.5 **HOT-1**	but uh as a matter of fact I got hired with about six hundred and twenty five hours here.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:11:37.6 **HOT-2**	oh wow.		
22:11:39.4 **HOT-1**	uh.		
22:11:39.9 **HOT-2**	that's not much for uh back when you got hired.		
22:11:42.5 **HOT-1**	no but uh out of that six and a quarter two hundred fifty hours was uh part one twenty one turbine. multi engine turbine.		
22:11:50.0 **HOT-2**	oh that's right yeah.		
22:11:54.3 **HOT-2**	no but all these guys are complaining they're saying you know how we were supposed to upgrade by now and they're complaining I'm thinking you know what? I really wouldn't mind going through a a winter in the northeast before I have to upgrade to captain.		
22:12:04.0 **HOT-1**	no no.		
22:12:05.0 **HOT-2**	I've never seen icing conditions. I've never deiced. I've never seen any—I've never experienced any of that. I don't want to have to experience that and make those kinds of calls. you know I'dve freaked out. I'dve have like seen this much ice and thought oh my gosh we were going to crash.		
		22:12:17.7 **APP**	Colgan thirty four oh seven descend and maintain two thousand three hundred.
		22:12:21.8 **RDO-2**	okay down to two thousand three hundred Colgan thirty four zero seven.
22:12:25.1 **HOT-2**	um two three alt sel.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:12:27.4 **HOT-2**	I've got you in pitch pitch hold. I don't know if that's what you want.		
22:12:27.6 **HOT-1**	two three alt sel.		
22:12:29.6 **HOT-1**	yeah that's alright. let's uh— we'll do vertical speed back.		
22:12:33.3 **HOT-2**	but I'm glad to have seen oh— you know now I'm so much more comfortable with it all.		
22:12:37.6 **HOT-1**	yeah uh I I spent the first three months in uh Charleston West Virginia and uh flew—.		
		22:12:43.5 **APP**	Colgan thirty four zero seven turn left heading three three zero.
		22:12:47.0 **RDO-2**	left heading three three zero Colgan thirty four zero seven.
22:12:49.3 **HOT-1**	left three three zerooo. we're in heading mode now. go to blue needles.		
22:13:01.2 **HOT-1**	but I— first couple of times I saw the amount of ice that that Saab would would pick up and keep on truckin'.		
22:13:05.9 **HOT-2**	yeah.		
22:13:06.7 **HOT-?**	[sound of sniffle]		
22:13:08.0 **HOT-1**	saw it out on the spinner. ice comin' out about that far my eyes about that big around. I'm going gosh. I mean Florida man— barely a little you know out of Pensacola.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:13:09.3 **HOT-2**	yeah.		
22:13:14.2 **HOT-2**	holy cow...oh my gosh...oh yeah.		
22:13:18.0 **HOT**	[sound similar to altitude alert]		
22:13:21.4 **HOT-1**	that's uh thirty three for twenty three alt sel.		
22:13:24.1 **HOT-2**	thirty three for twenty three alt sel.		
22:13:24.8 **HOT-1**	let's do a descent checklist please.		
22:13:25.9 **HOT-2**	do a descent checklist. altimeters two niner eight zero set crosschecked.		
22:13:29.1 **HOT-1**	twenty nine eighty set crosschecked.		
22:13:30.8 **HOT-2**	fuel balance check. pressurization set and cabin PA complete. descent checklist complete.		
22:13:35.7 **HOT-1**	alright if you want to go ahead we can do the approach checklist along with it.		
22:13:37.4 **HOT-2**	yeah sure. um approach checklist approach and landing brief complete.		
22:13:41.6 **HOT-1**	uh complete.		
22:13:42.3 **HOT-2**	bugs set.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:13:43.3 **HOT-1**	set.		
22:13:44.3 **HOT-2**	GPWS landing flaps selected fifteen degrees. fuel transfer off hydraulic pressure and quantity check. caution warning lights check seatbelt sign on and external lights on. approach checklist complete.		
22:13:54.5 **HOT-2**	[sound of sniffle]		
22:13:54.7 **HOT-1**	rock and roll.		
22:13:58.4 **HOT-2**	oh yeah— I'm so glad. I would've— I w— I mean—. I would've been been fine. I would have survived it. there wasn't— we n— never had to make decisions that I wouldn't have been able to make but...now I'm more comfortable.		
		22:14:08.5 **APP**	Colgan thirty four zero seven turn left heading three one zero.
		22:14:12.1 **RDO-2**	left heading three one zero for Colgan thirty four zero seven.
22:14:12.7 **CAM**	[sound similar to engine power increase]		
22:14:14.6 **HOT-1**	three one zero.		
22:14:16.6 **HOT-2**	yeah.		
22:14:21.9 **HOT-?**	[sound of sniffles]		
22:14:22.6 **HOT-1**	alright let's see if I can get this seat...siteated...that's alright there.		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:14:24.7 **CAM**	[sound similar to seat track movement]		
22:14:32.7 **HOT-1**	still trying to find that sweet spot I guess there *.		
22:14:39.8 **CAM**	[sound similar to engine power increase]		
22:14:56.7 **HOT-?**	[sound of sniffle]		
22:15:06.3 **HOT-1**	flaps five. [covered by background radio transmissions]		
22:15:08.1 **HOT-2**	what?		
22:15:08.8 **HOT-1**	flaps five please.		
22:15:10.0 **HOT-2**	oh *.		
22:15:11.2 **CAM**	[sound similar to flap handle movement]		
22:15:13.2 **HOT-?**	[sound of sniffle]		
		22:15:13.5 **APP**	Colgan thirty four zero seven three miles from KLUMP turn left heading two six zero maintain two thousand three hundred until established localizer. cleared ILS approach runway two three.
		22:15:22.2 **RDO-2**	left two sixty two thousand three hundred 'til established and cleared ILS two three approach Colgan thirty four zero seven.
22:15:31.7 **HOT-1**	alright approach is armed.		

INTRA-AIRCRAFT COMMUNICATION TIME and SOURCE	CONTENT	AIR-GROUND COMMUNICATION TIME and SOURCE	CONTENT
22:15:32.8 **HOT-2**	roger.		
22:15:38.8 **HOT-?**	[sound of sniffle]		
22:15:59.5 **CAM**	[sound similar to decrease in engine power]		
22:16:04.1 **HOT-1**	gear down...loc's alive.		
22:16:06.2 **CAM**	[sound similar to landing gear handle movement]		
		22:16:06.4 **APP**	Colgan thirty four zero seven contact tower one two zero point five. have a good night.
22:16:07.4 **CAM**	[sound similar to landing gear deployment]		
		22:16:11.5 **RDO-2**	over to tower you do the same thirty four zero seven.
22:16:14.9 **HOT**	[sound of two double chimes]		
22:16:19.2 **HOT-?**	[sound of sniffle]		
22:16:21.2 **HOT-2**	gear's down.		
22:16:23.5 **HOT-1**	flaps fifteen before landing checklist.		
22:16:26.0 **CAM**	[sound similar to flap handle movement]		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:16:26.6 **HOT-2**	uhhh.		
22:16:27.4 **CAM**	[sound similar to stick shaker lasting 6.7 seconds]		
22:16:27.7 **HOT**	[sound similar to autopilot disconnect horn repeats until end of recording]		
22:16:27.9 **CAM**	[sound of click]		
22:16:31.1 **CAM**	[sound similar to increase in engine power]		
22:16:34.8 **HOT-1**	Jesus Christ.		
22:16:35.4 **CAM**	[sound similar to stick shaker lasting until end of recording]		
22:16:37.1 **HOT-2**	I put the flaps up.		
22:16:40.2 **CAM**	[sound of two clicks]		
22:16:42.2 **HOT-1**	[sound of grunt] *ther bear.		
22:16:45.8 **HOT-2**	should the gear up?		
22:16:46.8 **HOT-1**	gear up oh #.		
22:16:50.1 **CAM**	[increase in ambient noise]		

INTRA-AIRCRAFT COMMUNICATION		AIR-GROUND COMMUNICATION	
TIME and SOURCE	**CONTENT**	**TIME and SOURCE**	**CONTENT**
22:16:51.9 **HOT-1**	we're down.		
22:16:51.9 **CAM**	[sound of thump]		
22:16:52.0 **HOT-2**	we're [sound of scream]		
22:16:53.9 **END OF TRANSCRIPT** **END OF RECORDING**			