



BY MARK LACAGNINA

The captain's inappropriate response to a stick shaker activation was the probable cause of an unrecoverable stall and the crash of a Colgan Air Bombardier Q400 on approach to Buffalo Niagara (New York, U.S.) International Airport the night of Feb. 12, 2009, according to the U.S. National Transportation Safety Board (NTSB).

All 45 passengers and four crewmembers in the airplane, plus one person on the ground, were killed, and the airplane was destroyed when it struck a house in Clarence Center, New York, about 5 nm (9 km) northeast of the airport.

In its final report on the accident, NTSB said that the captain caused the airplane to stall by pulling on his control column when the stick shaker activated at an artificially high airspeed — a reaction that was consistent with “startle and confusion” rather than with his training.

The report said that factors contributing to the accident were “the flight crew’s failure

to monitor airspeed in relation to the rising position of the low-speed cue [on their primary flight displays], the flight crew’s failure to adhere to sterile cockpit procedures,¹ the captain’s failure to effectively manage the flight, and Colgan Air’s inadequate procedures for airspeed selection and management during approaches in icing conditions.”

Fatigue also was a likely factor, but investigators could not determine conclusively the extent to which the pilots were impaired by fatigue or how it might have contributed to their “performance deficiencies” during the flight, the report said.

Flight 3407 Crew

The airplane was being operated as Continental Connection Flight 3407 to Buffalo from Liberty International Airport in Newark, New Jersey, the pilots’ home base.

The captain, 47, had 3,379 flight hours, including 3,051 hours in turbine airplanes and 111

Fatigue was a likely factor in the crash of this Q400.

STARTLED AND CONFUSED

A bad reaction to a stick shaker triggered a stall.



hours in type. He was a Beech 1900D first officer for Gulfstream International Airlines before being hired by Colgan in September 2005.

He received a DHC-8 type rating — a rating common for the Q400 and its predecessors — in November 2008. “The check airman who provided the captain with his IOE [initial operating experience] described the captain’s performance as good and indicated that his greatest strength was being methodical and meticulous,” the report said.

Q400 first officers who flew with the captain described him as competent. “These first officers also indicated that the captain created a relaxed atmosphere in the cockpit but adhered to the sterile cockpit rule,” the report said.

The report pointed out, however, that U.S. Federal Aviation Administration (FAA) records showed that the pilot had not passed initial flight checks for an instrument rating in 1991, a commercial license for single-engine airplanes in 2002, a commercial license for multiengine airplanes in 2004, and an airline transport pilot license in 2007, while at Colgan.

In addition, Colgan’s training records showed that the captain had to be retested on normal and abnormal procedures for a Saab 340 first officer check ride in 2006 and had received unsatisfactory grades for a 340 recurrent proficiency check in 2006 and a 340 upgrade proficiency check in 2007.

“The captain had not established a good foundation of attitude instrument flying skills early in his career,” the

report said. “His continued weaknesses in basic aircraft control and instrument flying were not identified and adequately addressed.”

The first officer, 24, worked as a flight instructor in piston airplanes before joining Colgan in January 2008 and received a DHC-8 second-in-command type rating in March 2008. She had 2,244 flight hours, including 774 hours in type.

One captain who had flown with the first officer rated her as average to above average for her level of experience. “Other captains indicated that, because of her abilities, the first officer could have upgraded to captain,” the report said.

Commuting Pilots

The report characterized the flight crew as “commuting pilots.” The

captain commuted to Newark from his home in Tampa, Florida; the first officer commuted from Seattle.

The captain had told another pilot that he wanted to get a “crash pad” near Newark but was trying to avoid the expense of temporary lodging by bidding trips with overnights in hotels or ending at locations with an easy commute home.

The first officer also tried to bid trips that would facilitate her commute.



Both pilots often slept in the Colgan crew room at Liberty International. The crew room had couches, recliners and a television. The airline’s regional chief pilot said, however, that the crew room was intended as a place for crewmembers to relax and that it was not adequate for rest between trips.

The captain had commuted by airline to Newark three days before the accident and had rested in hotels during overnight trips.

The first officer had arrived in Newark the morning before the accident. The night before, she had occupied the jump seat of a cargo airplane that departed from Seattle at 1951 local time and arrived in Memphis, Tennessee, at 2330 Seattle time, or 0230 Newark time. She slept for 90 minutes during the flight. “The captain [of the cargo airplane] 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,” the report said.

She then flew aboard another cargo airplane that departed from Memphis at 0418 and arrived in Newark at 0623. “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 report said. “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.’ [He] stated that she did not appear to be tired and showed no symptoms of being sick.”

Both accident pilots were seen in the Colgan crew room before their scheduled report time of 1330.

First Flights Canceled

High winds and ground delays at Newark that afternoon prompted the cancellation of several Colgan flights, including the flight crew’s first two scheduled flights — to Rochester, New York, and return. The estimated departure time for Flight 3407 to Buffalo was 1917.

The captain spent the afternoon doing office work — inserting revisions in airplane manuals — and relaxing 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,” the report said.

The cockpit voice recorder (CVR) picked up several sounds of the first officer sneezing and sniffing. While waiting for takeoff clearance, she told the captain, “I’m ready to be in the hotel room. This is one of those times that, if I felt like this at home, there’s no way I would have come all the way out here. ... 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 report concluded, however, that the first officer’s illness likely did not directly affect her performance during the flight.

Deicing Equipment On

The crew received takeoff clearance at 2118 and activated the propeller and airframe deicing equipment while climbing to their assigned cruise altitude, 16,000 ft.

“The cruise portion of flight was routine and uneventful,” the report said. “The CVR recorded the captain and the first officer engaged in an almost continuous conversation, but these conversations did not conflict with the sterile cockpit rule.”

Weather conditions at Buffalo included surface winds from 240 degrees at 15 kt, gusting to 22 kt, 3 mi (4,800 m) visibility in light snow and mist, a few clouds at 1,100 ft, a broken ceiling at 2,100 ft and an overcast at 2,700 ft.

At 2156, the first officer said, “Might be easier on my ears if we start going down sooner.” On the captain’s instructions, she requested clearance to descend. The Cleveland Center controller cleared the crew to descend to 11,000 ft.

The crew established radio communication with Buffalo Approach Control at 2203 and were told to expect the instrument landing system (ILS) approach to Runway 23. They briefed for

Bombardier Aerospace Q400

The Bombardier Q400 is the latest in the line of DHC-8, or Dash 8, commercial twin-turboprops launched by de Havilland Canada in 1980. The Q400 entered service in 2000 with a stretched fuselage and seating for up to 78 passengers.

The airplane has Pratt & Whitney Canada PW150A engines, each flat-rated to 5,070 shp (3,782 kW), and Dowty R408 six-blade composite propellers that turn at 1,020 rpm for takeoff and 850 rpm for cruise. Maximum fuel capacity is 1,724 gal (6,526 L).

Maximum weights are 64,500 lb (29,257 kg) for takeoff and 61,750 lb (28,010 kg) for landing. Sea-level field lengths at the maximum weights are 4,265 ft (1,300 m) for takeoff and 4,223 ft (1,287 m) for landing. Maximum cruising speed is 360 kt. Maximum altitude is 25,000 ft, and service ceiling with one engine out is 17,500 ft. Maximum range with 70 passengers and reserves is 1,360 nm (2,519 km).

Source: *Jane’s All the World’s Aircraft*



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the approach and calculated a reference landing speed (V_{REF}) of 118 kt.

Reference Speed Riddle

The crew set the V_{REF} “bugs” on their airspeed indicators to 118 kt. This value was appropriate for an uncontaminated airplane. However, when the crew activated the deicing equipment during departure from Newark, they also set the “REF SPEEDS” switch on the ice-protection panel to “INCR” (increase).

This action is required by the Q400 airplane flight manual (AFM) before entering icing

conditions and results in activation of the stick shaker at a lower angle-of-attack — thus, at a higher airspeed. The AFM also specifies that on approach, the flight crew must increase V_{REF} by 15 to 25 kt, depending on flap setting, to remain above the stall-warning threshold.

Colgan's company flight manual for the Q400, however, provided inadequate guidance for the use of the "REF SPEEDS" switch and did not require crews to cross-check the switch position against their V_{REF} bugs on approach, the report said.

The result during the approach to Buffalo was that the stick shaker activated about 13 kt higher than the V_{REF} value set by the crew.

Unsterile Cockpit

The approach controller cleared the crew to 6,000 ft, and the Q400 descended through 10,000 ft at 2206. "From that point on, the flight crew was required to observe the sterile cockpit rule," the report said.

The crew received further descent clearance to 4,000 ft.

At 2210, the captain said that there was ice on his side of the windshield and asked the first officer if there was ice on her side. "Lots of ice," she replied.

The captain then said, "That's the most ... ice I've seen on the leading edges in a long time — in a while anyway, I should say."

Despite these statements, the report said that recorded flight data showed the ice accumulation had a minimal effect on the airplane's performance and did not affect the crew's ability to fly and control the airplane.

The pilots continued their conversation about previous experiences in icing conditions. "During that conversation, the first officer indicated that she had accumulated more actual flight time

in icing conditions on her first day of [IOE] with Colgan than she had before her employment with the company," the report said.

At 2212, the approach controller cleared the crew to descend to 2,300 ft, the initial approach altitude. "Afterward, the captain and the first officer performed flight-related duties but also continued the conversation that was unrelated to their flying duties," the report said.

The crew conducted the descent and approach checklists while being vectored to the final approach course, 233 degrees.

The maximum allowable approach speed was 138 kt, but airspeed was 184 kt when the crew was cleared for the approach about 3 nm (6 km) from the outer marker. "The captain slowed the airplane by extending flaps to 5 degrees, reducing power to near idle, extending the landing gear and moving the condition levers to maximum rpm," the report said.

At 2216, the approach controller told the crew to establish radio communication with the Buffalo airport traffic controller. The first officer's acknowledgement of the instruction was the last communication between the crew and air traffic control.

Missed Cues

Neither pilot responded to cues of an impending stall warning. Among the cues were indications on the primary flight displays (PFDs) of an excessive nose-up pitch attitude.

Other cues were provided by the airspeed data on the PFDs. Each display has a vertical airspeed scale with a trend vector, a white arrow, that indicates increasing or decreasing airspeed. The tip of the arrow indicates what the airspeed will be in 10 seconds if the trend continues. The trend vector in Figure 1, for example, shows that

airspeed is increasing from 260 kt and will be about 278 kt in 10 seconds.

A red and black vertical bar appears next to the airspeed scale to warn that airspeed is too low. The stick shaker activates when the indicated airspeed drops below the top of the bar. In addition, the displayed airspeed changes from white to red to provide another warning that airspeed is too low.

These low-speed cues were presented on the PFDs "with adequate time for the pilots to initiate corrective action, but neither pilot responded to the presence of these cues," the report said. "The failure of both pilots to detect this situation was the result of a significant breakdown in their monitoring responsibilities and workload management."

Seconds to Impact

About 20 seconds after the first officer's last radio transmission, the stick shaker activated and the autopilot automatically disengaged. When the stall warning occurred, the landing gear was extended, the flaps were being extended through 10 degrees to 15 degrees, and airspeed was about 131 kt.

"The airplane was not close to stalling at the time," the report said. "However, because the ref speeds switch was selected to the increase (icing conditions) position, the stall warning occurred at an airspeed that was 15 kt higher than would be expected for a Q400 in a clean (no ice accretion) configuration."

Flight data recorder (FDR) data indicated that the captain increased power as he pulled his control column back with 37 lb (17 kg) of force. "The captain's inappropriate aft control column inputs in response to the stick shaker caused the airplane's wing to stall," the report said.² Angle-of-attack increased to 13 degrees, load factor increased from 1.0 g to about 1.4 g, and

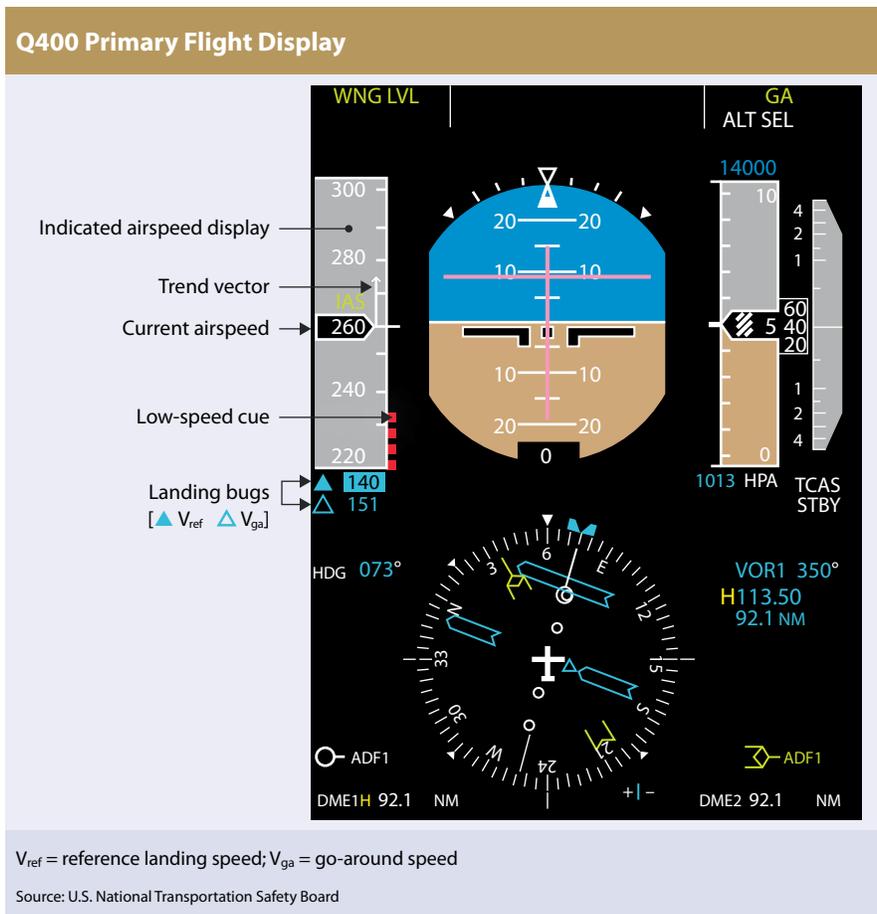


Figure 1

airspeed decreased to 125 kt, the stall speed under these conditions.

The airplane rolled left 45 degrees and was rolling back to the right when the stick pusher activated.³

Airspeed was 100 kt when the first officer retracted the flaps without consulting the captain. The report said that this action was inconsistent with Colgan's stall-recovery procedures and training.

"The roll angle reached 105 degrees right-wing-down before the airplane began to roll back to the left, and the stick pusher activated a second time," the report said. "FDR data showed that the roll angle had reached about 35 degrees left-wing-down before the airplane began to roll again to the right."

The first officer asked the captain if she should retract the landing gear. The captain replied, "Gear up," and voiced an expletive. "The airplane's pitch and roll angles had reached about 25 degrees airplane-nose-down and 100 degrees right-wing-down, respectively, when the airplane entered a steep descent," the report said.

Among the last sounds recorded by the CVR were the captain saying, "We're down," and the first officer screaming.

The Q400 struck the house about 27 seconds after the first activation of the stick shaker. There was a post-impact fire fed by fuel from the airplane and by natural gas from a severed pipe in the house (see article, p. 26).

Based on the findings of the investigation, NTSB issued 25

recommendations to the FAA. They included leadership training for upgrading captains, fatigue risk management for commuting pilots, and improved stall recognition and recovery training for pilots. ➔

This article is based on NTSB Accident Report NTSB/AAR-10/01, "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." The full report is available from the NTSB Web site, <www.ntsb.gov/publictn/2010/AAR1001.pdf>.

Notes

1. Sterile cockpit procedures are mandated by U.S. Federal Aviation Regulations Part 121.542(b) and (c), which state: "No flight crewmember may engage in, nor may any pilot-in-command permit, any activity during a critical phase of flight which could distract any flight crewmember from the performance of his or her duties or which could interfere in any way with the proper conduct of those duties. Activities such as eating meals, engaging in nonessential conversations within the cockpit and nonessential communications between the cabin and cockpit crews, and reading publications not related to the proper conduct of the flight are not required for the safe operation of the aircraft. For the purposes of this section, critical phases of flight include all ground operations involving taxi, takeoff and landing, and all other flight operations below 10,000 ft, except cruise flight."
2. The report said that the Q400 is not prone to tailplane stall and that it is unlikely the captain was deliberately attempting to perform a tailplane-stall recovery.
3. The stick pusher activates when stall angle-of-attack has been reached. The report said that it provides a tactile cue to push on the control column to gain airspeed and alleviate the stall condition. The stick pusher also positions the elevator to 2 degrees nose-down.