The CRJ crew lined up for takeoff on the wrong runway.

MISTAKEN

In pre-dawn darkness, the Comair pilots chatted with each other as they inadvertently taxied their regional jet onto a runway that was half as long as the runway assigned for takeoff. The Bombardier CRJ100ER was destroyed in the subsequent overrun at Blue Grass Airport in Lexington, Kentucky, U.S. The captain, flight attendant and 47 passengers were killed; the first officer was seriously injured.

In its final report on the Aug. 27, 2006, accident, the U.S. National Transportation Safety Board (NTSB) said that the probable causes were "the flight crewmembers' failure to use available cues and aids to identify the airplane's location on the airport surface during taxi and their failure to cross-check and verify that the airplane was on the correct runway before takeoff."

Contributing factors were "the flight crew's nonpertinent conversation during taxi, which resulted in a loss of positional awareness, and the Federal Aviation Administration's [FAA's] failure to require that all runway crossings be authorized only by specific air traffic control (ATC) clearances," the report said.

The CRJ was being operated as Flight 5191. At the time, Comair served 97 cities in the United States, Canada and the Bahamas. The all-jet airline was conducting an average of 772 flights daily and employed more than 6,400 people, including 1,631 pilots.

The captain, 35, had 4,710 flight hours, including 3,082 flight hours in type. He had flown various general aviation airplanes before attending Comair Aviation Academy. After he was graduated in August 1998, the academy employed him as a flight instructor. He was hired by Comair in November 1999 and upgraded from first officer to captain when he earned his type rating in January 2004. He had 1,567 flight hours as a CRJ pilot-in-command.

The check airman who administered a line check of the captain in May 2006 said that he received standard scores. First officers who recently had flown with the captain said that he followed standard operating procedures (SOPs), called for checklists at the appropriate time, established a good working environment in the cockpit and demonstrated good crew resource management (CRM).

The first officer, 44, had 6,564 flight hours, including 3,564 flight hours in type. He had been a Beech 1900 captain for Gulfstream International Airlines before being hired by Comair in March 2002. The report said that he earned a CRJ second-in-command type rating in November 2005.

The check airman who administered a line-oriented evaluation of the first officer in April 2006 said that he "met standards and that nothing stood out regarding his performance during the evaluation," the report said. Captains who had recently flown with the first officer said that he had good situational awareness, was articulate in conducting checklists and demonstrated good CRM. "Pilots who had flown with the first officer stated that he was looking forward to upgrading to captain," the report said.

The captain had conducted six previous flights at the Lexington airport, and the first officer had conducted 12 previous flights at the airport. The pilots had not flown together before the accident flight.

The report said that the pilots had rest periods that were longer than required by federal aviation regulations or company policy before they arrived at the airport at 0515. They picked up their flight release paperwork, which included the flight plan, weather information, notices to airmen (NOTAMs) and the airplane's registration number.

Two CRJs were parked on the terminal ramp. The crew boarded one of the airplanes and started the auxiliary power unit (APU). After being told by a Comair ramp agent that they were in the wrong airplane, the crew shut down the APU and proceeded to the CRJ assigned to the flight.

One Controller on Duty

The cockpit voice recorder (CVR) recording began at 0536. The crew conducted the preflight checklists while engaged in a nonpertinent conversation, the report said.

The first officer established radio communication with the airport traffic control tower at 0549. He requested clearance to Atlanta and said that they had received automatic terminal information service (ATIS) information "alpha," which indicated that Runway 22 was in use. The runway is 7,003 ft (2,135 m) long and 150 ft (46 m) wide.

ATIS information alpha also indicated that winds were from 190 degrees at 8 kt, visibility was 8 mi (13 km) and that there were a few clouds at 6,000 ft and a broken ceiling at 9,000 ft. Temperature was 24 degrees C (75 degrees F), and dew point was 19 degrees C (66 degrees F).

One controller was on duty. He was handling all tower and radar approach and departure services, as well as recording ATIS broadcasts and attending to other operational and administrative tasks. He had been assigned to the Lexington airport in 1989, one year after being hired by the FAA.

The report noted that one controller frequently was assigned to the midnight shift at Lexington despite verbal guidance issued by the FAA in April 2005 to all facilities providing tower and radar service; the agency said that two controllers should be assigned to midnight shifts, so that tower and radar responsibilities could be split. Nevertheless, the report said that NTSB could not determine if the Lexington air traffic manager's decision to assign only one controller to the midnight shift contributed to the accident.

After receiving their clearance to Atlanta, the captain made a public address system announcement, welcoming the passengers and providing brief details about the flight. He then told the first officer, "Run the checklist at your leisure."

The crew had agreed that the first officer would conduct the takeoff and the flight to Atlanta. While conducting a departure briefing, the first officer asked, "He said what runway? One of them. Two four?" The captain replied, "It's two two."

"The first officer continued the departure briefing, which included three additional references to Runway 22," the report said. Flight data recorder (FDR) data indicated that both pilots later set the heading bugs in their flight displays to 227 degrees, the magnetic heading for Runway 22.

'Short Taxi'

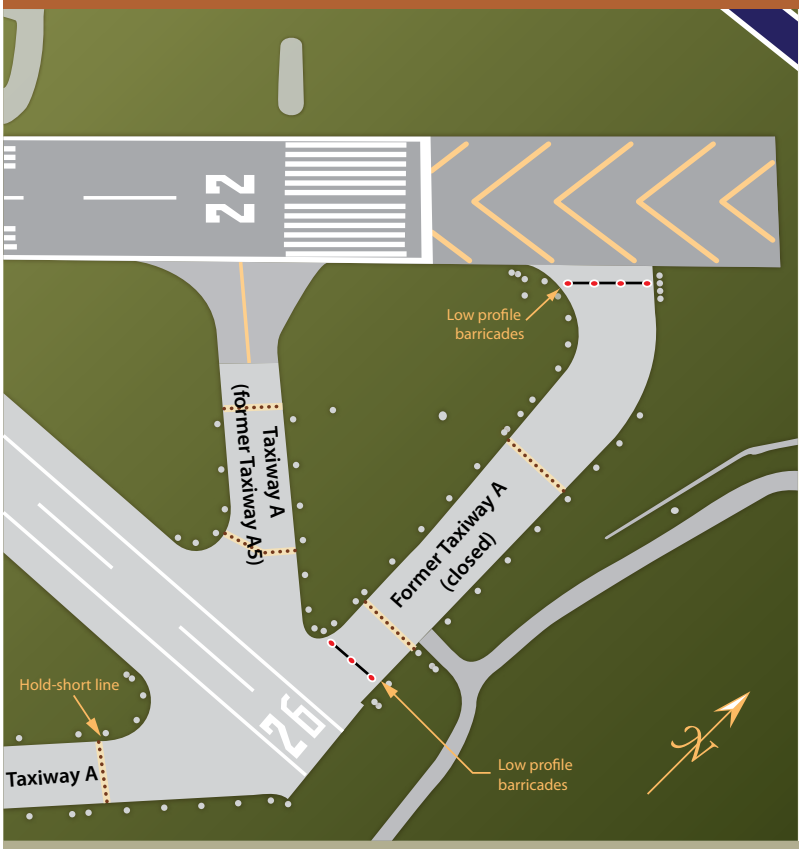
During the departure briefing, the first officer told the captain that "lights were out all over the place" when he arrived on a positioning flight the night before. The first officer said that they would taxi

U.S. Geological Survey

BY MARK LACAGNINA

IDENTITY

Lexington Taxiways



Source: Susan Reed, based on U.S. National Transportation Safety Board report

Figure 1

on Taxiway Alpha and added, "Two two's a short taxi." Noting that the crew had not yet received taxi instructions from ATC, the report said that the first officer's comment indicated that he likely was referring to an airport diagram during the departure briefing.

The report said that because of ongoing construction at the airport, there were discrepancies in the airport diagrams produced by the FAA and by Jeppesen. The diagrams did not show that Taxiway A north of Runway 26 had been closed and barricaded, or that Taxiway A5 had been redesignated as Taxiway A (Figure 1). The closure of Taxiway A also was the subject of a NOTAM that was not included in the crew's flight release paperwork. However, the report said that these factors did not affect the crew's ability to find their way to the correct runway. "The navigational task … was straightforward and inherently simple," the report said.

The engines were started, and the first officer told the controller at 0602 that they were ready to taxi. The controller told the crew to taxi to Runway 22. "This instruction authorized the airplane to cross Runway 26 (the intersecting runway) without stopping," the report said.

The report noted that among recommendations issued in 2000 to prevent runway incursions, NTSB called on the FAA to require controllers to issue explicit clearances to flight crews to cross each runway as they taxi to the assigned departure runway. "If these safety recommendations had been implemented before this accident, the controller would have been required to issue a specific taxi clearance for the airplane to cross Runway 26 and then issue a specific taxi clearance for the airplane to continue taxiing to Runway 22," the report said. "These procedures would have provided the flight crew with better awareness of the airplane's position along the taxi route and would have required the controller to visually observe the airplane's position and monitor the taxi as the airplane progressed toward the departure runway. Thus, the flight crew's surface-navigation error might have been prevented."

Nonpertinent Conversation

While taxiing, the crew resumed the nonpertinent conversation they had begun earlier. The report noted that nonpertinent conversations during critical phases of flight are prohibited by federal aviation regulations and by company policy.[1]

"The captain had the responsibility to assert both his leadership role and command authority to stop the discussion [but] allowed the conversation to continue," the report said. "Also, instead of initiating the nonpertinent conversation, the first officer should have been monitoring the captain's actions and independently assessing the airplane's location along the taxi route."

The captain stopped the airplane at the hold-short line for Runway 26, which was about 560 ft (171 m) from the hold-short line for Runway 22. "The controller did not notice that the flight crew had stopped the airplane short of the

wrong runway because he did not anticipate any problems with the airplane's taxi to the correct runway and thus was paying more attention to his radar responsibilities than his tower responsibilities," the report said.

The CRJ was motionless for 50 seconds. "[This] should have provided the flight crew with ample time to look outside the cockpit and determine the airplane's position on the airport," the report said. "At this position, the flight crew would have been able to see the Runway 26 holding position sign, the '26' painted runway number, the Taxiway Alpha lights across Runway 26, and the Runway 22 holding position sign in the distance."

At 0605, the first officer used an incorrect flight number when he told the controller, "At your leisure, Comair one twenty-one ready to go." Nevertheless, the controller said, "Comair one ninety-one, Lexington tower. Fly runway heading. Cleared for takeoff." Taking over the task of radio communication, the captain replied, "Runway heading. Cleared for takeoff. One ninety-one." The report noted that the runway number was not mentioned in any of these radio transmissions.

The captain began to taxi the airplane across the Runway 26 hold-short line and called for the "Line Up" checklist. While the first officer was conducting the checklist, the captain taxied the airplane onto Runway 26, which was 3,501 ft (1,067 m) long and 150 ft wide, and had painted markings limiting usable width to 75 ft (23 m). The runway was designated for use only by light aircraft in daytime visual meteorological conditions. The runway centerline lights were out of service, and the edge lights had been disconnected in 2001.

Back to the Window

The report said, "The controller did not detect the flight crew's attempt to take off on the wrong runway because, instead of monitoring the airplane's departure, he performed a lower-priority administrative task that could have waited until he transferred responsibility for the airplane to the next air traffic control facility."

The controller performed the task — recording an hourly traffic count — at the tower cab's center console, with his back to the window overlooking the runways. "The controller stated that it might have been possible for him to detect that the accident airplane was on the wrong runway if he had been looking out the tower cab window," the report said. "In addition, the controller stated that, in his 17 years working at [Lexington], an air carrier airplane had never departed from Runway 26."

The report noted that the controller had reported for duty about 2330 the night before the accident and likely was experiencing fatigue. "But the extent that fatigue affected his decision not to monitor the airplane's departure could not be determined, in part because his routine practices did not consistently include the monitoring of takeoffs," the report said.

Completing the "Line Up" checklist, the first officer said, "Transponder's on. Packs on. Bleeds closed. Cleared for takeoff. Runway heading. Six grand. Anti-ice off. Lights set. Takeoff config's okay. Line-up check's complete."

Bombardier CRJ100ER

© Josh Akbar

The Canadair Group of Bombardier in 1987 began design studies based on the Challenger business jet for the Canadair Regional Jet (CRJ). The first model, the CRJ100, entered service in 1992. The 50-passenger airplane is powered by General Electric CF34-3A1 engines flat-rated at 9,200 lb (41 kilonewtons).

The CRJ100ER, the extended-range version, has a higher maximum takeoff weight — 51,000 lb (23,134 kg) versus 47,450 lb (21,523 kg) — which allowed an increase in fuel capacity to 14,305 lb (6,489 kg) from 9,380 lb (4,255 kg). Maximum landing weight is 47,000 lb (21,319 kg).

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

At 0605:57, the captain said, "All yours." The first officer replied, "My brakes, my controls."

'Weird With No Lights'

Figure 2 is an approximation of the captain's primary flight display when the takeoff was begun. The display likely showed a nearly 40-degree difference between the heading-bug setting and the indicated magnetic heading. "The CVR did not record any awareness by the flight crewmembers about this offset … or any discussion about the need to cross-check the airplane's position on the runway," the report said.

At 0606:05, the CVR recorded a sound similar to increasing engine power. The first officer said, "Set thrust, please." The captain replied, "Thrust set."

The airplane was crossing the intersection of the runways at 0606:16, when the first officer said, "[That] is weird with no lights." The captain said, "Yeah." Six seconds later, the captain said, "One hundred knots." The first officer said, "Checks."

The report said that there were numerous cues, including the absence of runway lighting, that the airplane was on the wrong runway, but the crew did not correctly interpret the cues or notice them until it was too late to successfully reject the takeoff. Accelerate-stop performance data provided by Bombardier indicated that the crew would have had to reject the takeoff when the captain made the 100-kt airspeed callout to bring the airplane to a stop on the runway with maximum braking.

The CRJ was 236 ft (72 m) from the departure end of the runway when the captain said, "V one, rotate." FDR data indicated that these callouts were made when airspeed was 131 kt, which was 6 kt below the calculated V_1 speed and 11 kt below the calculated rotation speed, VR.[2] Soon thereafter, he said, "Whoa."

"The captain's early VR callout and subsequent 'whoa' exclamation indicated that he recognized that something was wrong with the takeoff," the report said. "FDR data showed that, in response, the first officer pulled the control column full aft and that the airplane rotated at a rate of about 10 degrees per second, which is three times the normal rotation speed. The abnormal column input showed that the first officer also recognized that something was wrong with the takeoff."

The CVR recorded an unintelligible exclamation by one of the pilots just before the airplane struck a berm about 265 ft (81 m) beyond the end of the runway at 0606:33. "FDR airspeed and altitude data showed that the airplane became temporarily airborne after impacting the berm but climbed less than 20 feet off the ground," the report said.

The CVR recorded another unintelligible exclamation soon before the airplane struck trees 900 ft (274 m) from the end of the runway. "This impact caused the cockpit to break open and the left wing fuel tank to rupture, allowing a fuel-air mixture to ignite," the report said.

The airplane struck the ground and slid 400 ft (122 m) before striking two large trees. "The impacts breached the passenger cabin, separating it into two sections and allowing a large amount of fuel, fuel vapor and fire to enter the cabin," the report said. "The fuselage traveled another 150 feet [46 m] before coming to a stop [photograph, p. 43]. The airplane structure continued to burn, and the fire eventually consumed the entire fuselage and cabin interior."

The first officer received serious blunt-force injuries. "The first officer's survival was directly attributable to the prompt arrival of the first responders, their ability to extricate him from the cockpit wreckage and his rapid transport to the hospital, where he received immediate treatment," the report said.

Heading-Bug Setting

Source: U.S. National Transportation Safety Board

Figure 2

Investigators were not able to interview the first officer. "His attending physician stated that the first officer was 'medically unfit' to be interviewed," the report said. "The first officer's wife stated that he did not remember the accident."

'Uncharacteristic Performance'

Based on the findings of the investigation, NTSB made several recommendations to the FAA for reducing the risk of aircraft departing on the wrong runway (*ASW*, 10/07, p. 8).

The report said that the flight crew's performance during the accident flight appeared to have been uncharacteristic. "The captain and the first officer were described favorably by company personnel, and pilots who had flown with them described both as competent pilots," the report said.

"The captain was described as someone who managed the cockpit well, adhered to SOPs and demonstrated good CRM. The first officer was preparing for an opportunity to upgrade to captain and was described as someone who would have made a good captain because of his adherence to SOPs."

The report said that there was insufficient evidence to determine that the crew's performance was affected by fatigue.

Investigators searched the U.S. Aviation Safety Reporting System database and found 114 reports of "wrong-runway" incidents from March 1988 to September 2005. The report noted some more recent incidents. On Oct. 30, 2006, for example, a Boeing 737 departed from the wrong runway in Seattle. On April 18, 2007, an Airbus A320 crew, assigned to depart from Miami on Runway 30, began the takeoff roll on Runway 27, which was closed; they rejected the takeoff after seeing a truck on the runway.

"The Comair Flight 5191 accident and other wrong-runway takeoff events demonstrate that all pilots are vulnerable to this and other types of surface navigation errors," the report said. "Even when navigation tasks are straightforward and simple, there is a potential for a catastrophic outcome resulting from human error if available cues are not observed and considered during taxi and the airplane's position is not cross-checked at the intended runway." ●

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The CRJ struck a berm and several trees before coming to a stop about 1,800 feet (549 m) from the runway.

This article is based on NTSB Aviation Accident Report NTSB/AAR-07/05, *Attempted Takeoff From Wrong Runway; Comair Flight 5191; Bombardier CL-600-2B19, N431CA; Lexington, Kentucky; August 27, 2006*. The 173-page report contains illustrations and appendixes.

Notes

1. Commonly called the *sterile cockpit rule*, U.S. Federal Aviation Regulations Part 121.542, "Flight crewmember duties," prohibits flight crewmembers from engaging in "any activity during a critical phase of flight which could distract any flight crewmember from the performance or his or her duties." The rule also states, in part, that "nonessential conversations in the cockpit … are not required for the safe operation of the aircraft."

2. The FAA defines V_1 in part as "the maximum speed in the takeoff at which the pilot must take the first action (e.g., apply brakes, reduce thrust, deploy speed brakes) to stop the airplane within the accelerate-stop distance."