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Captain's Failure to Establish Stabilized Approach Results in Controlled-flight-into-terrain Commuter Accident

Inadequate grounding between radome and fuselage could have resulted in unreliable glideslope indications, official U.S. report says.

Editorial Staff Report

The twin-turboprop Beechcraft BE-1900C commuter aircraft was executing an instrument landing system (ILS) approach in instrument meteorological conditions (IMC) at night to Adirondack Regional Airport, Saranac Lake, New York, U.S. During the approach, the aircraft wandered back-and-forth across the localizer course, and descended at rates ranging from 1,000 feet to 2,000 feet (305 meters to 610 meters) per minute. The excessive descent rate was never arrested, and the aircraft crashed in mountainous terrain, 4.3 miles (6.9 kilometers) northeast of the airport.

The first officer and one passenger were killed in the Jan. 3, 1992, accident involving CommutAir Flight 4821. The captain and the second passenger were seriously injured.

The U.S. National Transportation Safety Board (NTSB) concluded in its final aircraft accident report that the probable causes of the accident were the "failure of the captain to establish a stabilized approach, his inadequate cross-check of [the] instruments, his descent below [the] specified minimum altitude at the final approach fix, and [the] failure of the co-pilot to monitor the approach."

The report said that factors related to the accident included "weather conditions and possible precipitation static interference, caused by inadequate grounding between the radome and the fuselage that could have resulted in unreliable glideslope indications."

CommutAir (owned by Champlain Enterprises Inc. and operating under contract to USAir Express) Flight 4821 was the first of six flights scheduled for the crew. The flight was operating under Federal Aviation Regulations (FARs) Part 135. Flight 4821 departed Clinton County Airport, Plattsburgh, New York, at 0533 local time for Newark, New Jersey, with intermediate stops in Saranac Lake and Albany, New York. The scheduled flying time to Saranac Lake was 15 minutes.

After leveling at 6,000 feet (1,830 meters), the first officer contacted the U.S. Federal Aviation Administration (FAA) Boston Air Route Traffic Control Center (ARTCC), the report said. At 0539, Boston ARTCC cleared the flight to cross Zecka Intersection at 6,000 feet, and cleared the flight for the ILS approach to the Adirondack Regional Airport. The crew acknowledged the clearance, and Boston ARTCC terminated radar service 6.5 miles (10.4 kilometers) east of Zecka, the report said.

"Due to the short flight time, the captain said that he maintained radio watch with Boston [ARTCC] while the first officer

performed nonflying duties, such as calling block times to Plattsburgh and in-range to Operations at Saranac Lake," the report said. "The USAir Express station agent at Saranac Lake reported that the flight called in-range at 0545, and was given the following weather observation: sky obscured at 500 feet [152 meters], visibility two miles [3.2 kilometers] limited by fog, temperature 29 degrees F [-2 degrees C], dewpoint 24 degrees F [-4 degrees C], wind calm, and the altimeter 30.28 inches [1025 millibars]."

The report said the crew was navigating to Zecka via the 274-degree radial of the Plattsburgh very high frequency omnidirectional radio range (VOR). The airplane maintained course through Zecka, and beyond the localizer course. The airplane then turned left, at which point it was approximately 15.8 nautical miles (25.4 kilometers) from the runway threshold, the report said.

"After the initial turn, radar data showed an intercept angle that re-entered the localizer limits approximately 11 miles [17.7 kilometers] from the runway, descending through 5,400 feet [1,647 meters] mean sea level (MSL)," the report said. "With a seven-second exception, the intercept course was maintained as the airplane passed through the localizer 9.4 miles [15.1 kilometers] from the threshold."

Airplane Crossed Localizer Path Repeatedly

The report continued: "The flight turned right as the airplane approached the 'fly right' localizer limit at 8.4 miles [13.5 kilometers] from the threshold, descending through 4,600 feet [1,403 meters]. The airplane turned left as it approached the full 'fly left' limit again at 7.5 miles [12.1 kilometers], and was descending through 4,000 feet [1,220 meters]. The localizer path was crossed twice more in the last three radar returns."

The report said the airplane descended through 3,600 feet (1,098 meters) before crossing the outer marker, 5.86 miles (9.4 kilometers) from the runway threshold. (The minimum crossing altitude at the outer marker is 3,600 feet.) The airplane was approximately 5.8 miles (9.3 kilometers) from the runway threshold, and to the right of the localizer when the last radar return was recorded, the report said.

"The radar profile of the descent showed a relatively straight path into the accident site for more than two minutes," the report said. "Indicated airspeed derived from radar data during the descent fluctuated between 174 and 212 knots. Rates of descent varied, but remained greater than 1,000 feet per minute (315 meters per minute) below 5,000 feet [1,525 meters] MSL altitude."

The wreckage of Flight 4821 was discovered at 0730 on the north slope of a hill, at an elevation of 2,280 feet (798 meters) MSL. The crash site was 1.43 nautical miles (2.3 kilometers) inside the outer marker. A path of cut trees and the wreckage were found on the right side of the localizer course, the report said.

When the wreckage path was examined, investigators noted the odor of fuel down a path from the first point of impact, along with an extensive burn area, the report said. "The main wreckage, including most of the fuselage skin, was consumed between the pressure bulkheads," the report said. The aircraft was destroyed by the impact, and postcrash fire.

CVR Tape Was Destroyed

The accident airplane was equipped with a Fairchild GA-100 cockpit voice recorder (CVR). The CVR tape was severely heat-damaged, and could not provide a recording from the flight, the report said. "The CVR had been installed under the aft cabin floor, where the airframe had been consumed in the postaccident fire," the report said.

The airplane was neither equipped with, nor was it required to have, a flight data recorder (FDR) or a ground-proximity warning system (GPWS), the report said.

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The report said that the captain and surviving passenger had lacerations and broken bones. "An autopsy showed that the first officer had multiple traumatic injuries associated with striking a tree," the report said. "The autopsy of the deceased passenger cited 'inhalation of burning fuel.'"

The seats occupied by the captain, the first officer and the surviving passenger "were found to the left of the debris trail, about 50 feet (15.3 meters) before reaching the main wreckage," the report said.

The report said the captain told NTSB investigators that he "apparently had lost consciousness for a brief period after the airplane hit the trees. When he regained consciousness, he was on the ground still strapped into his seat which was lying on its back. He saw fire all around and he believed that parts of the airplane were settling to the ground or into the trees."

The report added: "He [the captain] stated that the fire died down in about an hour and about 0645 he heard an airplane overhead which he assumed was another CommutAir airplane. The weather was cloudy and he could not see the airplane. He indicated that dawn arrived between 0715 and 0730. There was snow on the ground but it was not raining or snowing."

The captain, age 30, held an airline transport pilot (ATP) certificate with type ratings for BE-300 and BE-1900 airplanes. "He had flown the Model 1900 for Brockway Airlines,

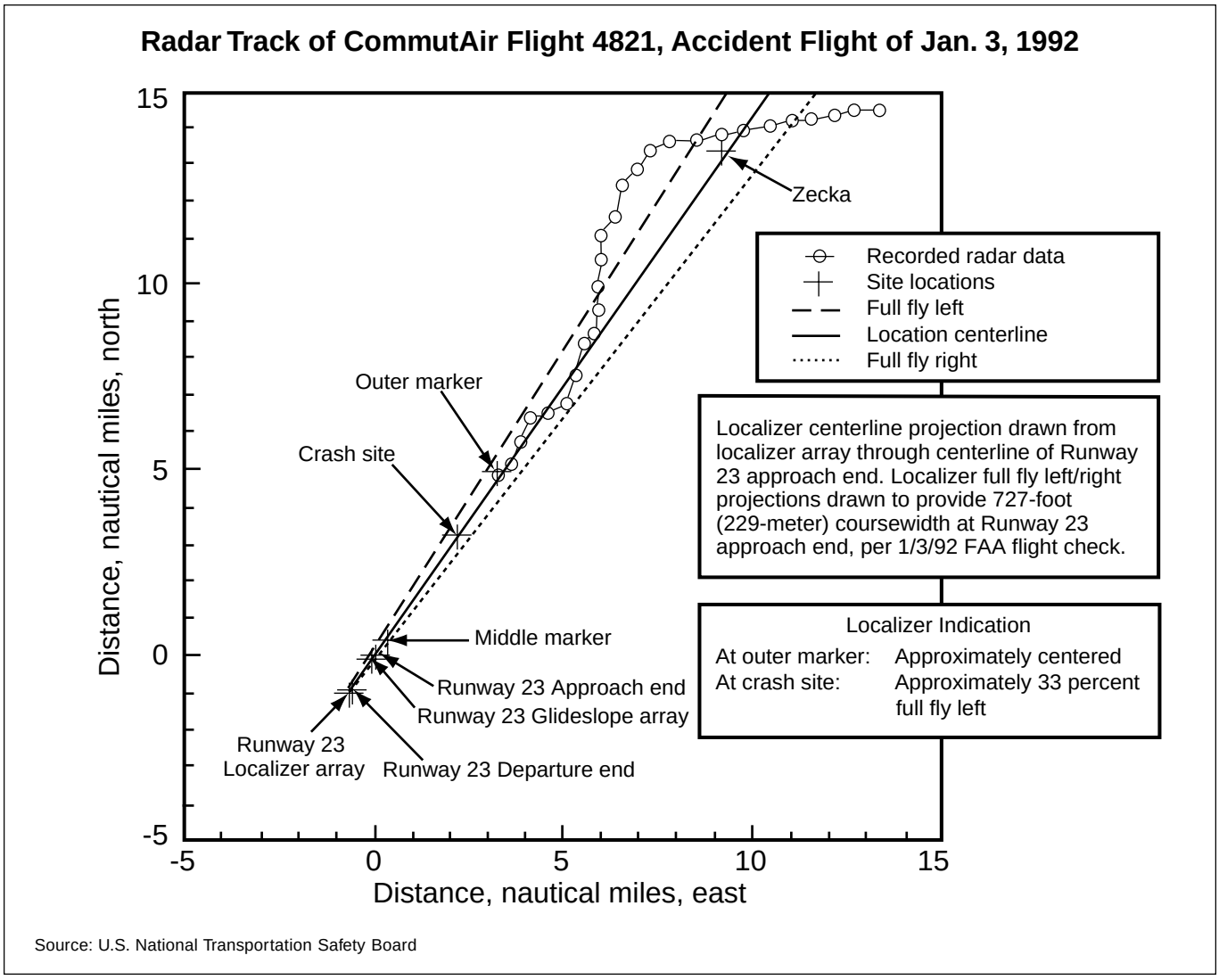

Figure 1

beginning in 1985, and became a captain in 1987," the report said. "Brockway had been purchased by Metro Airline of Texas, and the captain had worked for Metro in the Plattsburgh area. In 1989, he had been hired by CommutAir with 5,500 hours of flight experience." At the time of the accident, the captain had logged 7,700 total flight hours, with 3,700 hours in the BE-1900C, the report said.

The captain was a company flight instructor and check airman with no recorded accidents, incidents or violations, the report said. Records indicated that, in 1987, he failed an ATP certificate test in the BE-1900. "The disapproval notice stated that he would require retesting for '[1] NDB approach not satisfactory, [2] area arrival procedures unsatisfactory, [3] recommend additional practice in nonprecision approaches and ATC procedures," the report said. The captain was retested two days later, and was issued an ATP certificate, the report said.

The report noted that "past performance and training records at CommutAir were kept as pass/fail criteria, without instructor comments. However, a written recurrency test answer sheet [for the captain], dated July 27, 1991, showed that 12 of 33 answers had been amended to become 100 percent correct."

The first officer, age 22, held a commercial pilot certificate, with an instrument rating for single- and multi-engine airplanes. He had no recorded accidents, incidents or violations, the report said. In 1990, he was hired by CommutAir, and qualified in the BE-1900C. At the time of the accident, the first officer had logged 2,930 total flight hours, with 1,430 hours in the BE-1900C, the report said.

"A pilot evaluation form for upgrade, dated Oct. 3, 1991, stated that he [the first officer] would 'make an excellent captain, however, maturity will be the key to his success,'" the report said. "The commenter did not note whether this was meant in a positive or negative connotation. A second evaluator stated that 'he has grown up a lot … . Sometimes he's a little overconfident, but that's understandable, taking into consideration the time he has in the airplane,'" the report said.

The report said that a training record test answer sheet for the first officer from 1990 was found, with 36 of 94 qualification test answers corrected.

Investigators conducted two postaccident interviews with the captain, the report said. The first interview was held in the hospital, two days after the accident. A second interview was held 16 months later.

The captain told investigators that, during climb-out from Plattsburgh, they entered the clouds at 3,000 feet (915 meters), and that "he believed they remained in the clouds until the time of the accident," the report said. Although icing conditions were forecast, the captain told investigators that no ice was encountered, and he had no problems with the airplane, the report said.

Investigators asked the captain to describe the procedures used while he was flying the ILS into Saranac Lake. "I believe they clear you to 5,800 [feet (1,769 meters)]," the report quoted the captain as saying. "I stay at 6,000 feet [1,890 meters] until I intercept the glideslope, and just ride it down to the 1,863-foot [568-meter] decision height. And that's basically it. When we came on down, I mean everything was just normal, both needles showed on course, there were variations of course, but nothing more than just a dot. At no time did I see the glideslope go high, if anything, I saw it go down, indicating a high position on the glideslope. I don't know [how] long [we] were into it, but we were doing the approach, and he [the first officer] briefed the people in the back as part of our before-landing checklist, and then a scraping noise, and then instant deceleration, and I was there in the wreckage," the captain said, as quoted in the report.

… "the first indication of the airplane's improper position on the approach was tree branches scratching the front of the airplane."

The captain told investigators that he did not remember passing the outer marker, and that the last altitude he remembered seeing was either 2,980 feet or 2,890 feet (909 meters or 881 meters), the report said.

The captain was then presented with performance data from air traffic control (ATC) radar that showed the accident flight descending from 1,000 feet to 2,000 feet per minute during the approach, the report said. "He [the captain] said that he could not remember an alert from the first officer that the descent rate was in excess of 1,000 fpm [feet per minute]," the report said. "The alert was called for by the company training program, although the program also called for normal use of a 1,500 feet [457 meters] per minute descent rate."

Captain Had "Faith" in Glideslope

The captain also told investigators "that he could not cite a 'typical' descent rate to Runway 23, and that he had faith in the glideslope," the report said. "At a later point, the captain again focused on the DH [decision height], citing a procedure to maintain DH awareness."

During the second interview, conducted on May 13, 1993, the captain told investigators that "the first indication of the airplane's improper position on the approach was tree branches scratching the front of the airplane," the report said.

In a handwritten response at the end of a transcript of the May 1993 NTSB interview, the captain wrote that he felt that the NTSB investigator was "fishing for information that just plainly wasn't there and his attitude was such to lay blame on someone during this interview rather than address the problem at hand. All the charts in the world cannot explain why this happened, so I believe other avenues need to be addressed."

Investigators examined the possibility that airframe icing could have affected the performance of the accident flight during the approach. Satellite infrared imagery showed areas of probable freezing drizzle in east central New York, including a small area southeast of Saranac Lake, the report said. Ground-based weather radar showed an area of freezing drizzle about 27 miles (43 kilometers) south of Saranac Lake, and another area 40 miles (64 kilometers) north-northeast of Saranac Lake.

The captain told investigators "that during the flight, he had detected no ice on the windshield wiper located before him, and that he had visually checked the wing," the report said. "He said he had not noticed any changes in the handling of the airplane that he would have attributed to ice accumulation."

ILS Was Functional

Investigators reviewed the possibility that a malfunction occurred, either in the ground-based ILS equipment at Adirondack Regional Airport, or in the avionics of the accident aircraft. "The Saranac Lake ILS was functioning on the day of the accident, according to FAA records and personnel," the report said. "System flight test data were obtained for checks performed before and after the accident. The most recent pre-accident flight test was passed on Sept. 19, 1991. A post-accident flight test was passed on the day of the accident."

The report added: "The maintenance records for the facility showed that the Runway 23 ILS outer marker had been periodically removed from service for maintenance. Frequent nonmaintenance outages of the outer marker were not found in the FAA records."

The report also said that investigators received reports of misleading glideslope indications after the accident by two

CommutAir flights, which could not be verified. "All CommutAir approaches were found to have been made in snow," the report said. "After deviating for an unknown time, described as 'seconds,' the pilots reported in each case that both glideslopes returned to normal operation."

The avionics in the accident airplane were examined. "The captain and first officer each had independent localizer and glideslope displays that were driven by separate Collins Avionics VIR-32 Pro-Line II receivers," the report said. "The two independent glideslope displays shared only an antenna, a cable, and a signal splitter. Both receivers passed functional tests after the accident (with tolerance allowances made for impact damage that crushed the end of one receiver)."

Both the captain's and the first officer's navigation displays were recovered from the wreckage, and sent to a laboratory for examination. "Marks found that aligned with display needles in both glideslope indicators were found in the central ('on-path') area of the scales," the report said.

The investigation then focused on whether static interference could have caused erroneous course indications on the crew's navigation displays. The accident flight was in visible moisture for almost the entire flight. The report cited a National Aeronautics and Space Administration (NASA) document that described precipitation static (p-static) "as an electrical charging that occurs as atmospheric moisture rubs on conductive surfaces, or the airplane flies in charged clouds," the report said. "The document states that 'electrically isolated metallic sections on the aircraft exterior [may] … spark over to the airframe.'"

The p-static testing … found that errors could develop that would "drive the localizer display toward the center ('on-path') indication."

The report said that the design of the Beechcraft Model 1900C radome specified a coating of conductive, antistatic paint. Investigators found two pieces of the accident airplane's radome in the wreckage. "In each [radome piece], the screw holes were electrically isolated from the antistatic paint on the surface," the report said. "The antistatic paint on the radome that covered the glideslope antenna was designed to pass electrical charges to radome mounting screws that held the radome to the metal airframe."

Carrier's Other Airplanes Were Examined

Investigators examined eight other CommutAir airplanes, and found the radome screw holes worn to bare fiberglass in five of the eight airplanes, the report said. This condition electrically isolated the radomes from the airframes. The radomes of three BE-1900C aircraft from other operators were also examined, the report said.

Investigators found that, on all 11 BE-1900C aircraft inspected, "every radome exhibited a line of sharply defined deposits that resembled black soot," the report said. "The deposits were uniformly 1/16 inch [1.5 millimeters] aft of a black abrasion cap on the nose of each radome. When the deposit marks were wiped off, the underlying paint frequently had a tan discoloration. Closer visual investigations were not able to determine whether the discolorations were the result of staining or heat."

The report added: "Beechcraft and Collins engineering personnel stated that although possibly the residue of p-static corona, the source of the residue was indefinite. A U.S. Navy engineer participating in the tests described the black deposits as similar to p-static corona streamers seen in previous investigations."

BE-1900C radomes were tested, creating a steady electrical discharge arc from the radome to the airframe, the report said. "Pin-hole burn marks found in operational Model 1900C radomes were identical to those created during the p-static testing," the report said. "Testing repeatedly found that the first indication of the discharge arc was a squelch-break that created hissing noises from the speakers."

Ungrounded Radomes Were Tested

P-static testing of ungrounded radomes was conducted at Plattsburgh and at the Beechcraft factory in Wichita, Kansas, U.S. During these tests, it was found that once arcing had begun because of an ungrounded radome, "a glideslope display error could develop that would drive the pilot's glideslope displays toward the center ('on-glidepath') indication," the report said. "The displays showed the airplane within the glideslope path limits when the test signal being sent was below those limits."

The p-static testing also found that errors could develop that would "drive the localizer display toward the center ('on-path') indication," the report said. "When the electrical arc was masked from the localizer antenna, located on the vertical tail, over 50 feet [15 meters] aft of the glideslope antenna, no localizer error was induced. Without masking, the localizer display showed the airplane within the localizer path limits, when the test signal being sent was outside of those limits."

The report said p-static testing was also conducted on a Cessna Conquest equipped with ARC Gold 1000 radios. "In the Cessna, the localizer was found more sensitive to induced error than the glideslope," the report said. "Cessna glideslope and localizer warning flags also came into view at earlier points than in the Beechcraft, covering the scales as the needles began traveling toward the center 'on-path' indications."

The report said that the following changes were made as a result of the investigation:

- "Collins Service Information Letter VIR-32 SIL 1-92, dated 1/92, applicable to the VIR-32 (Pro-Line II) avionics in any airplane, discusses circuit abnormalities and identifies 'motionless [centered] deviation indicators as suspect';

- "Maintenance manuals for the [Beechcraft] 1900C and 1900D airplanes have been revised to more clearly describe the installation of spare radomes;

- "Beechcraft quality and manufacturing procedures regarding mounting of avionics ground blocks are being reviewed for proper electrical bonding in turboprop twin-engine airplanes;

- "[Beechcraft] Model 1900C and 1900D radome grounding techniques for production airplanes are in review;

- "Hartzell has issued Alert Service Bulletin No. A180, applicable to propellers installed on the Model 1900D, which provides for modification of the propeller assemblies to improve p-static protection; [and,]

- "After the CommutAir Flight 4821 accident, another operator found that p-static could indirectly affect the electronic flight instrument systems (EFIS) in the Model 1900D, eliminating primary displays of attitude and heading information. Beechcraft Mandatory Service Bulletin 2466 was issued, June 1992, applicable to Model 1900D airplanes. This service bulletin improved inverter system wiring."

The report said that CommutAir had made the following changes:

- "Enhanced altitude awareness and FAR [Federal Aviation Regulations Part] 135.299 (Pilot in Command Line Checks, Route and Airport) by presenting a three-hour class and assigning tasks to management, instructors and line check airmen;

- "Worked with FlightSafety International to develop a cockpit resource management program; [and,]

- "Rewritten the company training manual, completely, including detailed procedures for pre-approach briefings and approach phases of flight."

The report also noted:

- "CommutAir had already initiated replacement of the complete Beechcraft Model 1900C fleet with 1900D airplanes. The 1900D airplane order now includes dual flight directors, GPWS [ground-proximity warning system] and flight data recorders." ♦

Editorial note: This article was adapted from a factual aviation report prepared by the U.S. National Transportation Safety Board (NTSB) on Beechcraft Model 1900C, N55000, Gabriels, New York, Jan. 3, 1992.

ACCIDENT PREVENTION

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