FLIGHT SAFETY FOUNDATION
HELICOPTER SAFETY
Vol. 21 No. 3 *For Everyone Concerned with the Safety of Flight* May–June 1995

Failure to Intercept Final Approach Course, Improperly Performed IFR Approach Cited in Fatal Collision with Terrain

The U.S. National Transportation Board (NTSB) report on the accident found that although the pilot had accurately followed ATC radar vectors, pilot error was the cause of the accident.

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At 1445 hours local time on April 22, 1994, an emergency medical services (EMS)-configured twin-engine turbine-powered Bell 412, while being radar vectored for an instrument landing system (ILS) approach to the Bluefield/Mercer County Airport (BLF) in Bluefield, West Virginia, U.S., collided with mountainous terrain. The four occupants of the helicopter, two pilots and two flight nurses, were killed and the aircraft was destroyed. The flight had originated approximately one hour earlier in Winston-Salem, North Carolina and was en route to pick up a patient.

The U.S. National Transportation Safety Board's (NTSB's) accident investigation report[1] said that at 1250 on the day of the accident, the hospital in Winston-Salem received a telephone request to air-transport a patient with acute renal (kidney) failure from Bluefield to the hospital in Winston-Salem. The flight crew checked the weather and filed an instrument flight rules (IFR) flight plan to BLF, about 100 nautical miles northwest of Winston-Salem.

Using the callsign "Lifeguard" to designate an emergency medical flight, N70AM lifted off at 1347 from the hospital in Winston-Salem. The flight crew estimated time of arrival (ETA) at BLF one hour later. The Bluefield hospital staff planned to transport the patient by ambulance to BLF, the NTSB report said.

The report included a transcript of helicopter-to-ground communications. At 1400, the flight crew made a position report to the hospital in Winston-Salem and said that the ETA was now 1435.

At 1417, the Indianapolis Air Route Traffic Control Center (Indianapolis Center) radar controller for the Bluefield area went on break. His replacement, just returning from his own 30-minute break, had reported to work at 0700. He was in the last hour of his shift on the last day of a four-day work week, and he was scheduled to start annual vacation the next day.

At 1420 the controller telephoned the flight service station (FSS) specialist at BLF, advising him of inbound traffic. "Lifeguard Seven Zero Alpha Mike B-H-T-H you familiar with that?" he asked. The specialist replied, "Ah, helicopter."

Shortly afterward, a controller from Atlanta Center (which had original responsibility for tracking the flight) called the Indianapolis controller to advise him that N70AM was "requesting priority handling into Bluefield," and that another aircraft,

Carolina 5156, was going to be arriving four or five minutes ahead of N70AM. The Atlanta controller told his Indianapolis colleague, "I told him [N70AM] he might have to have a delay or else he could hurry and get in there quick. It will be your choice ... they're both [your] control, whatever you want to do with him."

At 1421, the Atlanta controller advised Indianapolis Center, "Yeah that Lifeguard said that he wouldn't mind a couple minute delay if you wanted to take the Carolina in before him ... ."

At 1425, the flight crew of N70AM made initial radio contact with Indianapolis Center, and the controller replied with the BLF altimeter setting. About two minutes later the controller transmitted a special BLF weather observation taken at 1408. The ceiling was estimated to be five hundred feet (153 meters) broken, with a three thousand foot (915 meters) overcast. Visibility was three miles (4.8 kilometers) in fog. Wind direction was 050 at 9 knots (almost a direct tail wind) and the altimeter setting was 30.10.

The crew replied, "(Unintelligible) sir we stepped on part of your transmission. Understand five hundred broken three hundred overcast two miles with fog wind zero five (unintelligible)." The controller transmitted, "Lifeguard seven zero alpha mike it was, ah, estimated ceiling of five hundred broken and three thousand overcast."

At about the same time that the flight crew was receiving the BLF weather, hospital records indicated, the pilot-in-command (PIC) was making a position report to the hospital in Winston-Salem. He reported the helicopter's position to be 20 minutes southeast of BLF.

The report's radar data show that N70AM was northeast of the airport and less than one mile (1.6 kilometers) east of the outer marker at BLF.

At 1428, the Indianapolis controller advised N70AM that Carolina 5156 was ahead of them and said, "He's already joined the arc on the ILS approach to Bluefield, and what type of approach are you requesting." The flight crew replied, "OK understand about the other aircraft and no problem with that, like to proceed on the ILS runway two three approach, vectors please." The controller said, "Lifeguard seven zero alpha mike, roger."

At 1429, the flight crew of N70AM transmitted: "And ah (unintelligible) no need to ah bring us in [too] close to the outer marker." The controller replied, "Lifeguard seven zero alpha mike, roger, turn right heading of three four zero vectors for the approach." The flight crew said, "Roger, three four zero, seven alpha mike." (The transcript contained in the report included a note that "seven alpha mike" was not entirely clear, but was the best interpretation possible.)

At 1430, the PIC advised the hospital in Winston-Salem of his position and estimated the flight's arrival at BLF in seven more minutes. He said that he would be speaking with air traffic control (ATC) and that he would not be able to give further position reports.

At 1434, the controller transmitted, "Lifeguard seven zero alpha mike descend and maintain seven thousand." The flight crew said, " … out of 8,000 for 7,000." Shortly after that transmission, the controller gave instructions to turn left to a heading of 330, then two minutes later a left turn to a heading of 300. A minute later the controller instructed the crew to turn left to a heading of 270.

At 1438, the controller said, "Lifeguard seven zero alpha mike, seven miles east of Bluefield Airport, maintain 7,000 [feet (2,135 meters)] until established on approach, fly heading two four zero and, ah, cleared ILS runway two three approach to Bluefield." The crew replied "OK turning left heading two four zero ... maintain 7,000 until established, cleared for the approach."

The report's radar data show that N70AM was northeast of the airport and less than one mile (1.6 kilometers) east of the outer marker at BLF (Figure 1, page 3).

Shortly after issuing the approach clearance, the controller transmitted, "Lifeguard zero alpha mike frequency change approved, good day."

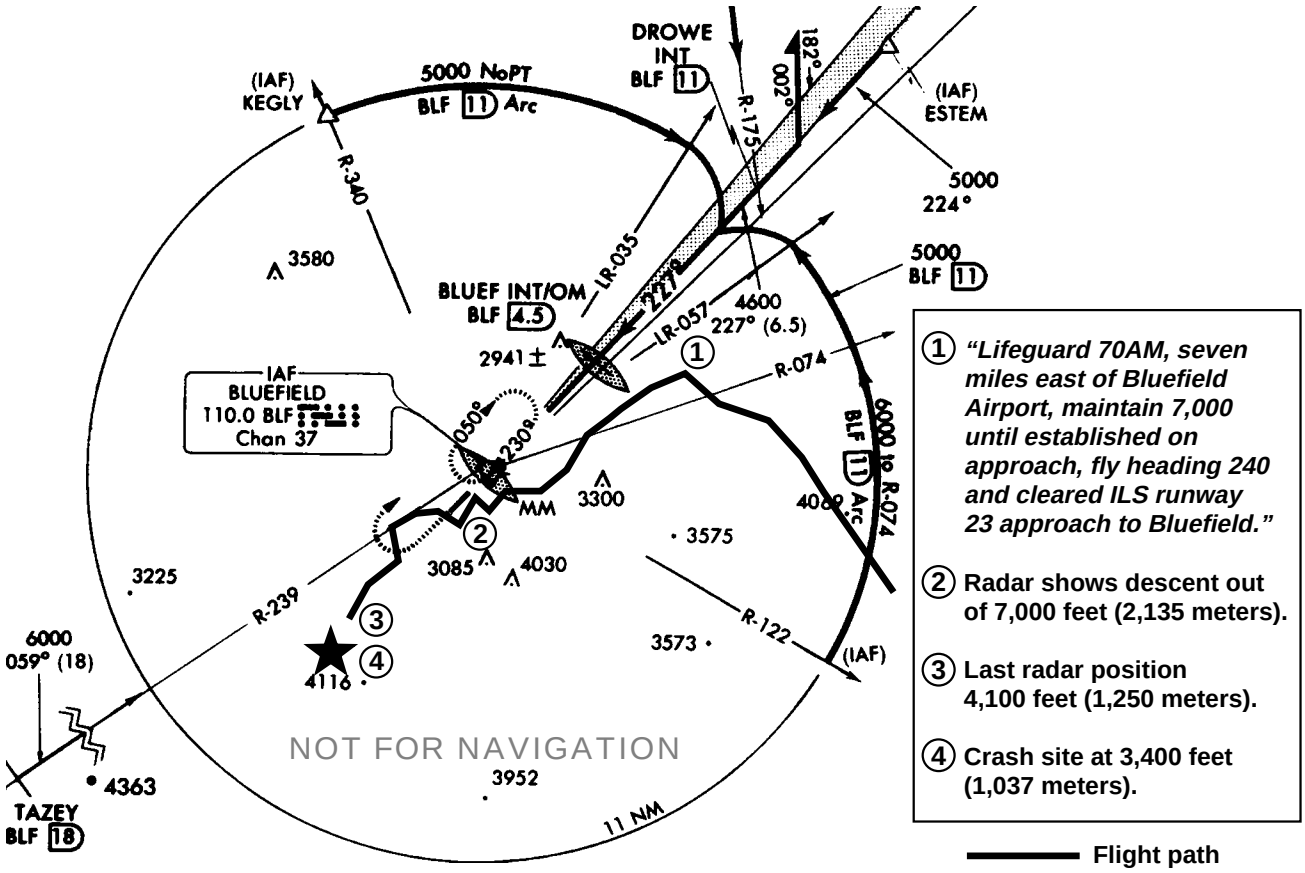
The crew of N70AM then made initial contact with the FSS specialist at BLF and received a wind check. Because the airport is Class E (general controlled) airspace, no landing clearance was required.

At 1442, approximately one-quarter mile (0.4 kilometer) south of the Bluefield Vortac [VOR (very high frequency omnidirectional radio range) plus Tacan (tactical air navigation, an ultra-high frequency navigation aid)]/middle marker, N70AM began a descent from 7,000 feet. The flight's last recorded radar position was approximately two miles southwest of the airport at an altitude of 4,100 feet (1,250 meters).

At 1450, the FSS specialist inquired of the Indianapolis Center controller, " ... you got anything on that, ah, Lifeguard seven zero alpha mike?" The controller replied that he had cleared Lifeguard for approach and given him a frequency change.

The specialist responded that he had talked to N70AM, " ... but I haven't heard from him in the last seven, eight minutes and I can't raise him now." The FSS specialist then stated that he was not sure whether the helicopter was planning to land at the airport or break off the approach and proceed to the local hospital. The controller said that according to his "strip" [paper showing information concerning an aircraft's flight] on N70AM, the final destination was the airport. Following this exchange, both the FSS specialist and the controller, on their respective frequencies, tried unsuccessfully to contact the helicopter crew.

Flight Path of N70AM



Source: National Track Analysis Program/Joel S. Harris

Figure 1

About 1445, a 67-year-old homemaker was looking out her kitchen window, seven miles (11.3 kilometers) southwest of BLF. According to her written statement in the report, it was "so foggy I couldn't see anything. Then I heard this low noise, I thought maybe it was going to land — I still couldn't see it." She said that she ran out to her driveway and that "the noise made a different sound, then all I heard was trees or bushes breaking off — then a big loud explosion. It was very foggy." In an addendum to her statement, she emphasized that before the explosion "it made a different sound, one I can't describe."

Also about 1445, an employee of the Virginia Department of Transportation was outside his home, according to his written statement in the report, when he "heard the helicopter flying parallel with the mountain. It sounded like it was very low. The fog was below the tree line on the mountain. The helicopter flew directly over my house but I couldn't see it through the fog. It sounded like it turned toward the mountain. I said to myself 'you better get it up if you plan to clear the mountain.' Then I heard a tree break, then an explosion."

The accident site was seven miles (11.3 kilometers) southwest of BLF on a magnetic heading of 230 degrees. The initial point of impact was with trees on a 30- to 40-degree slope at the 3,400-foot (1,037-meter) level on East River Mountain. Wreckage was oriented on a magnetic heading of 335 degrees and strewn a distance of about 200 feet (61 meters).

Control continuity of the drive train, including the tail rotor, was confirmed, according to the report. The engines were examined and there was no evidence of any mechanical malfunction that would have precluded operation, the report said.

The PIC, 45 years old, held an airline transport pilot (ATP) certificate for helicopter operations. At the time of the accident, his company records indicated, he had accumulated approximately 4,094 total flying hours, of which 969 were in the Bell 412. Although he had recorded 339 hours of instrument flight time, he had logged only two hours of instrument flight in the preceding 90 days. He held a first-class medical certificate, issued in December 1993, with no limitations. He

satisfactorily completed his last FARs Part 135.293, .297 and .299 checks in November 1993, and he received his last recurrent training in February 1994.

The first officer, 32, held a commercial pilot certificate for helicopter operations, and a private pilot certificate with single-engine land ratings for airplanes. According to company records, he had accumulated approximately 1,412 total flying hours, of which 712 were in the Bell 412. His records indicated that he had a total of 28 hours of simulated instrument-flight time, with none logged in the previous 90 days, and no actual instrument time logged. His U.S. Army records indicated that he had successfully completed a military instrument-evaluation check ride on Dec. 21, 1993. [The report makes no mention of his having, or not having, a civil helicopter instrument rating.] He was issued a first-class medical certificate with no limitations in April 1993.

Autopsies of the captain and the first officer revealed no pre-existing conditions that contributed to the accident, the report said. Toxicological tests did not detect alcohol, drugs or carbon monoxide in either crew member; no ATC personnel were tested for drugs following the accident, said the report.

The Bell 412/SP, manufactured in 1989, was equipped with two Pratt & Whitney PT6-3B engines rated at 1,800 horsepower. Maximum certified gross weight was 11,900 pounds. No maintenance irregularities were noted, the report said.

The IFR-certified aircraft was equipped with VOR/localizer receivers, glide slope receivers, flight director, loran, distance measuring equipment (DME), automatic direction finder (ADF) and marker beacons receivers. It also had a radar altimeter and color weather radar. No outstanding maintenance discrepancies were noted by the report.

After-accident checks of the navigational aids found that all parameters were within established standards and tolerances.

The navigation instruments for the pilot and copilot, including the VOR/localizer and marker-beacon receivers, were examined. The examination included retrieving the frequencies from non-volatile memory. VOR/localizers for both the pilot and copilot were tuned to the localizer frequency of 109.5, with 110.0 for the Bluefield Vortac in the standby mode, the report said.

The investigation did not address whether or not any radio was in the DME "hold" position at the time of the accident. [Placing the DME in "hold" would have made distance information from the Bluefield Vortac continue to be available to the crew.]

The marker-beacon receiver sensitivity in the LO sense mode was within specifications. The sensitivity in the HI sense mode was 300 microvolts instead of the specified 200 microvolts. In HI sense mode, the marker beacon would have been more sensitive than normal. A label on the case of the unit indicated that the HI sensitivity was set to 300 microvolts. The examination could not reveal the position of the marker beacon switch at the time of the accident because of impact damage, the report said.

There were no reported or known difficulties with the airport navigational aids at the time of the accident. After-accident checks of the navigational aids found that all parameters were within established standards and tolerances, the report said.

There was no automatic terminal information system (ATIS) at BLF, the report said. About 1427, the Indianapolis radar controller issued the following weather information to the flight crew of N70AM: "One eight zero eight observation. Estimated ceiling 500 broken, 3,000 overcast. Visibility three with fog. Wind 050 at nine. Altimeter 30.10 inches."

According to the report, the 1450 surface weather observation for the Bluefield FSS was, "Sky condition, 500 feet [153 meters] overcast; visibility two miles [3.2 kilometers] in fog and drizzle; temperature 44 degrees (F) [6.7 degrees C]; dew point 44 degrees (F); wind condition 010 degrees at five knots; altimeter 30.10 inches."

The ATC Report included in the NTSB report stated: "A weather observation update taken at 1850 UTC (1450 local) indicated the following information: 200 [feet (61 meters)] scattered, estimated ceiling 500 [feet (153 meters)] broken, 2,000 [feet (610 meters)] overcast, visibility one mile [1.6 kilometers], light drizzle, fog, temperature 44 [degrees F (6.7 degrees C)], dewpoint 42 [degrees F (5.6 degrees C)]. Wind 070 at 28 [knots], altimeter 30.09. Drizzle began at 48, broken variable overcast. It is believed that the flight crew was not provided this weather."

According to the ATC Report, the Indianapolis Center controller who handled N70AM began service with the FAA in late 1990. He attended the FAA Academy in Oklahoma City, Oklahoma, and at the time of the accident he was a full-performance level controller for his area of responsibility.

On Feb. 2, 1994, two months prior to the accident, the controller made an "operational error" while he was working a flight of two military tankers that were flying in an assigned altitude block, the ATC Report said. The ATC Report said that he issued a descent clearance to another aircraft, resulting in a traffic-alert and collision avoidance system (TCAS) resolution advisory (RA) prompted by loss of standard separation. As a result, said the ATC report, he attended and successfully completed a recertification program of computer-based instruction (CBI) and "over the shoulder" evaluations conducted on Feb. 5 and March 4, 1994.

In a postaccident interview, recounted in the ATC Report, the controller said that the radar display he was using at the time of the accident was set to a range of 100 miles (160 kilometers). When asked to respond to specifics of the ATC transcript, he said that when the pilot of N70AM said, "you don't have to bring us in too close to the outer marker," the statement had no particular significance to him. He said his response, "roger," was meaningless other than to acknowledge the transmission from the flight crew. He said that "roger" was not said in response to a specific request, only to a request to get the crew started on the approach.

The ATC Report said that when the controller was asked where was the approach gate [an imaginary point used in ATC as a basis for vectoring aircraft to the final approach course], "he replied that it was a mark depicted on the radar display that, 'I'm vectoring the aircraft toward on the approach.'" As it pertained to N70AM, he believed that the approach gate had been "about 6.5 miles out."

The report said that when asked if the depiction was from the VOR or from the airport, the controller responded that there would be a difference of about one-half mile but that he did not know and that he would "have to go downstairs and measure to give you a good answer on that." The controller said that "in a generic sense, the gate is depicted about two miles from the outer maker for an ILS approach," the ATC Report said. [According to the *Airman's Information Manual* (*AIM*), the approach gate is established one mile (1.6 kilometers) from the outer marker.]

When asked by investigators if any conditions existed at the time of the accident that would have allowed an early turn onto final (closer than two miles [3.2 kilometers] from the approach gate), he replied in the negative, the ATC Report said.

Later in the interview, the controller stated that his last observation of the aircraft was "about three miles [4.8 kilometers] from the airport or at the airport at an altitude of 7,000 feet." The ATC report added: "When asked why it did not seem unusual to him when he observed N70AM so near the airport at an altitude of 7,000 feet, he said that it did not trigger anything that would make him do 'anything special.' He said that in his mind, if the aircraft did not intend to make the approach, the flight crew should have called him on a missed approach." He described his workload at the time as "light to moderate," the ATC report said.

The ATC Report also summarized an interview conducted with the controller's supervisor, who stated that he was aware of N70AM prior to being notified that the helicopter was overdue. The controller told the supervisor that the only thing he [the controller] noticed unordinary was that, after being cleared for the approach, the aircraft was at an altitude of 7,000 feet over the Bluefield Vortac. The ATC report said, "After being told this he [the supervisor] advised [the controller] that because the aircraft was a helicopter, it would be capable of going over the airport and making a vertical descent to land."

The NTSB report found that the probable cause of the accident was "the pilot's failure to intercept the final approach course, and his improper execution of the instrument approach procedure." The report said that factors that contributed to the accident were "the weather conditions and the failure of the Air Traffic Controller to adequately vector the flight crew to intercept the final approach course at the approach gate, as specified in the *ATC Handbook*." ♦

Author's Note: N70AM impacted terrain seven miles (11.3 kilometers) southwest of BLF, in the vicinity of the extended back course centerline, and 100 feet (31 meters) above localizer minimums.

The NTSB found that the probable cause of the accident was "the pilot's failure to intercept the final approach course, and his improper execution of the instrument approach procedure."

Both the ATC Report and radar data show that N70AM was not vectored to intercept the final approach course "at least two miles [3.2 kilometers] outside the approach gate" as required by *ATC Handbook* paragraph 5-120. In fact, when the controller advised the crew of N70AM that they were "seven miles east of the airport ... fly heading 240 and cleared ILS 23 approach ... ," they were already less than a mile from the outer marker. With no wind, a 130-degree intercept such as that issued by the controller could not place an aircraft on the final approach course for another four miles to five miles (6.4 kilometers to 8 kilometers).

Paragraph 5-120 in the *ATC Handbook* also states, " ... vector arriving aircraft to intercept the final approach course ... at an altitude not above the glide slope." According to the instrument approach chart for the ILS 23 at BLF, the glide slope intercept altitude just outside the outer marker is 4,600 feet (1,403 meters). N70AM was well above the glide slope at 7,000 feet (2,135 meters).

Instructors often urge pilots to maintain positional awareness independently of ATC. Nevertheless, it is not uncommon for pilots to believe that radar vectors are a reliable substitute for positional awareness, especially in the heavy work-load environment of an instrument approach.

Pilots are required by FARs Part 91.123 to adhere to ATC clearances and instructions. This can create a sense that ATC is assuming responsibility for the flight. But Part 91.3 states, "The pilot in command of an aircraft is directly responsible for, and the final authority as to, the operation of that aircraft."

References

1. U.S. National Transportation Safety Board. Accident report No. BF094FA071 (unbound). This report includes: the NTSB Factual Report and Accident Brief; the Air Traffic Control Group Chairman's Factual Report of Investigation; National Track Analysis Program (NTAP) radar data; hospital records; handwritten witness statements; pilot training records; and other documents.

About the Author

Joel S. Harris holds an airline transport pilot certificate and a flight instructor certificate with ratings in both helicopters and airplanes. He is an instructor, supervisor and courseware developer at FlightSafety International's West Palm Beach Learning Center in Florida, U.S. He has given more than 10,000 hours of flight, simulator and ground school training to professional helicopter pilots. Harris is the author of numerous articles about helicopter flight.

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