



Boeing 767 Strikes Mountain During Circling Approach

The flight crew did not maintain visual contact with the runway while circling to land outside the circling-approach area at an airport in South Korea. The controlled-flight-into-terrain (CFIT) accident occurred about five seconds after the first officer called for a missed approach.

FSF Editorial Staff

About 1121 local time April 15, 2002, a Boeing 767-200ER that was being operated as Air China Flight 129 struck a mountain 2.5 nautical miles (4.6 kilometers) north-northwest of the runway while being turned onto final approach during a circling approach in instrument meteorological conditions at Busan/Gimhae (South Korea [Korea]) International Airport. The aircraft was destroyed by the impact and post-impact fire. The first officer, second officer, six cabin crewmembers and 121 passengers were killed; the captain, two cabin crewmembers and 34 passengers received serious injuries.



- “The flight crew did not execute a missed approach when they lost sight of the runway during the circling approach to Runway 18R, which led them to strike high terrain (mountain) near the airport; [and,]
- “When the first officer advised the captain to execute a missed approach about five seconds before impact, the captain did not react, nor did the first officer initiate the missed approach himself.”

The accident occurred during a scheduled flight to Busan from Beijing, China.

In a final report issued in March 2005, the Korean Aviation-accident Investigation Board (KAIB) said that its findings related to probable cause were the following:

- “The flight crew of Flight 129 performed the circling approach not being aware of the weather minima of wide-body aircraft (B-767-200) for landing and, in the approach briefing, did not include the missed approach, etc., among the items specified in Air China’s operations [manual] and training [manual];
- “The flight crew exercised poor crew resource management and lost situational awareness during the circling approach to Runway 18R, which led them to fly outside the circling-approach area, delaying the base turn, contrary to the captain’s intention to make a timely base turn;

The captain, 30, was hired by Air China after he graduated from the Civil Aviation Flying University of China in July 1994. He held an airline transport pilot license (ATPL) and had 6,497 flight hours, including 6,287 flight hours in B-767s, with 290 flight hours as captain.

The first officer, 29, was hired by Air China after he graduated from the Korean Air Force Academy in September 1993. He held an ATPL and had 5,295 flight hours, including 1,215 flight hours in B-767s. The accident flight was his third flight as a first officer.

The second officer, 27, attended the Civil Aviation Flying University of China from September 1993 through June 1997 and was hired by Air China in August 1997. He held a

commercial pilot license and had 1,775 flight hours, including 1,078 flight hours in B-767s.

The report said that the second officer was assigned to the flight to observe, call out any deviations and to conduct radio communication with air traffic control (ATC). The first officer was the pilot flying. The flight crewmembers communicated in Chinese and in English.

About 1050, the first officer said that he could not hear clearly the automatic terminal information service (ATIS) radio broadcast. He conducted an approach briefing that “included the runway in use, type of approach, transition altitude, missed approach procedures, holding altitude, nav aids (VOR [very-high-frequency omnidirectional radio], ILS [instrument landing system]) in use and minimum sector altitude (MSA),” the report said.

The first officer said that the MSA north of the airport was 5,100 feet and that the MSA southwest of the airport was 3,700 feet.¹ (The MSA southeast of the airport was 3,200 feet. Airport elevation was 13 feet.)

The briefing did not include some required items, such as the decision altitude, and there was no discussion of the specific tasks for each flight crewmember, the report said.

The airport had one published instrument approach procedure: an ILS/DME (distance-measuring equipment) approach to Runway 36L. The crew used an approach chart that was published by Jeppesen and was based on U.S. Federal Aviation Administration terminal instrument procedures.

At 1057, the crew obtained ATIS Information Papa, which included surface winds from 220 degrees at seven knots and two statute miles (three kilometers) visibility in rain and fog. Sky condition was reported as three octas (3/8 cloud coverage [scattered clouds]) at 500 feet, six octas (6/8 cloud coverage [broken ceiling]) at 1,000 feet and eight octas (8/8 cloud coverage [overcast]) at 2,500 feet.

The report said that the mountainous terrain north of the airport was covered with clouds and fog.

Because of high terrain to the north and east, the Gimhae airport was designated as a *special airport* by the Korean Ministry of Construction and Transportation (MOCT). The report said that MOCT requirements for operations at special airports included the following:

- “Takeoffs and landings should be attempted with [the] ceiling more than ... 1,000 feet above MEA [minimum en route altitude], MOCA [minimum obstruction-clearance altitude] or the initial approach fix altitude; and visibility more than ... three [statute] miles [five kilometers];
- “Captain must have takeoff and landing experience as an observer within the previous 12 months; [and,]

- “Captain must be qualified through an audiovisual training aid or special airport qualification requirements, etc., approved by the Minister of Construction and Transportation, within the previous 12 months.”

The Gimhae airport was not designated as a special airport by Air China.

“According to a specialist from the training department of Air China, since Gimhae airport was not categorized by the company as a special airport, no special education or training was given to flight crew, and no special flight experience was required,” the report said.

At 1101, the second officer said that he had not often flown at Busan and told the captain and first officer to “keep listening” to radio communications with ATC.

The aircraft was at 17,000 feet and about 32 nautical miles (59 kilometers) northwest of the airport at 1106, when the approach controller told the crew to turn to a heading of 190 degrees and descend to 6,000 feet. After confirming that the crew had obtained ATIS Information Papa, the controller told them that Runway 36L was in use and to expect clearance to conduct a straight-in approach.

The second officer said, “Confirm visual approach runway three six left?”

“Three six left,” the approach controller said. “Gimhae active runway three six left in use.” The controller then asked for the aircraft’s approach category.²

The control tower was operated by the South Korean air force, which required controllers to obtain information from flight crews about the approach category of their aircraft before issuing an approach clearance.

The first officer told the second officer that the aircraft’s approach category was “charlie” (Category C), and the second officer relayed the information to the approach controller.

The approach controller acknowledged the information and said that the surface winds were from 210 degrees at 17 knots and that the active runway had been changed to Runway 18R. The controller told the crew to expect clearance for the circling approach to Runway 18R.

The report said that none of the flight crewmembers previously had conducted the circling approach and that the crew did not have sufficient time to prepare for the approach.

“Since Gimhae airport was not classified as a special airport requiring additional training, the captain was probably unaware of the danger posed by terrain in the vicinity of the circling-approach area north of the runway during the circling approach,” the report said.

The flight crew had been trained in flight simulators to conduct the circling approach to Beijing Capital International Airport. They had not been trained to conduct the circling approach to the Gimhae airport.

The report said that the crew did not conduct a complete briefing of the circling approach.

“After the runway change to 18R, there was a discussion-type briefing between the captain and first officer on the MDA [minimum descent altitude], taxiway entry after landing, circling approach pattern and obstacles, etc.,” the report said. “However, no mention was made of ... items requiring special attention or crew coordination during [the] circling approach. The briefing was insufficient for the crew to be precisely aware of the overall circling-approach procedure and the items that they needed to be cautious of during [the] approach.”

At 1109, the approach controller said, “Air China 129, confirm your category is charlie or delta?”

The captain said “charlie,” and the second officer told the approach controller, “Charlie, Air China 129, charlie.”

The circling-approach area for a Category C aircraft was within a radius of 1.7 nautical miles (3.1 kilometers) from the center of the threshold of Runway 18R; the circling-approach area for a Category D aircraft was within a radius of 2.3 nautical miles (4.3 kilometers) from the center of the threshold of Runway 18R.

The Air China B-757/767 Flight Crew Training Manual says, “The 767 is classified as a category ‘C’ or [category] ‘D’ airplane, depending upon maximum landing weight, for straight-in approaches. For circling approaches, use category ‘D’ minima or the minima associated with the anticipated circling speed.”

The report said that weather conditions at the Gimhae airport were suitable for a Category C circling approach but were below the minimums required for a Category D circling approach.

At 1110, the approach controller told the crew to turn left to a heading of 180 degrees and to descend to 4,000 feet. The second officer acknowledged the instructions.

The aircraft was descending through 6,000 feet at 1113, when the approach controller told the crew to turn left to a heading of 160 degrees and to descend to 2,600 feet. The second officer acknowledged the instructions.

At 1114, the captain said, “I will take off my sunglasses, let my sight adjust to outside. The visibility is not so good.”

At 1115, the approach controller told the crew to turn left to a heading of 090 degrees. The second officer acknowledged the instruction.

The captain called for “flaps five” and said, “The wind is so strong.”

At 1116, the approach controller said, “Air China 129, turn left heading 030, cleared for the ILS DME Runway 36 left, then circle to Runway 18 right. Report field in sight.” With prompting by the captain and first officer, the second officer read back the instructions.

At 1117, the first officer said, “Little more descent. Position almost reached. ILS captured.”

“Do we have to maintain this altitude?” the captain said.

The first officer said that they could “continue down to 700 feet.” He then said that the wind was “too strong” and asked the captain if he wanted the landing gear extended.

The captain told the first officer to extend the landing gear and select flaps 20. The aircraft was descending through 2,208 feet with a calibrated airspeed of 175 knots; groundspeed was 222 knots.

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circling approach.***

At 1118, the approach controller confirmed that the crew had the airport in sight and told them to establish radio communication with the tower. The report said that the instruction was not acknowledged. Instead, the second officer replied, “Circle, circle, 18 right.”

The captain told the first officer to disconnect the autopilot and turn left. (Circling was authorized only west of Runway 36L.) The first officer disconnected the autopilot and began to hand-fly the aircraft.

“OK, maintain 700 feet,” the captain said. “Watching the altitude.”

At 1119, the captain said, “Twenty seconds. ... Keep watching the runway.”

The report said that the captain’s reference to 20 seconds was related to timing the turn from final approach onto the right downwind leg.

“Turning,” the first officer said. He then re-engaged the autopilot and selected the heading mode.

The primary local controller attempted twice to establish radio communication with the crew and then asked the approach controller to tell the crew to change radio frequencies. The approach controller again told the crew to establish radio communication with the tower. The second officer

acknowledged the instruction but did not establish radio communication with the tower.

At 1120:00, the captain said, “Can you see abeam end of runway?”

“Abeam runway end,” the first officer said.

The captain later told investigators that, although he had seen the runway lights on final approach to Runway 36L, he did not see the runway lights while on right downwind to Runway 18R. He said that the cloud bases gradually became lower as the aircraft was flown on downwind.

The report said that the aircraft was flown at airspeeds between 150 knots and 160 knots on downwind, which exceeded the maximum speed of 140 knots for a circling approach flown in a Category C aircraft.

The minimum safe altitude warning (MSAW) system at the airport had been programmed to generate a visual warning — the letters “LA” on the controllers’ radar displays — when an aircraft was below a predetermined minimum safe altitude. The system had not been programmed to also provide an aural warning, as recommended by the International Civil Aviation Organization.

The report said that the local controllers would have had to monitor continuously their bright radar indicator tower equipment (BRITE) display to observe MSAW system warnings.

The local controllers told investigators that they had observed the aircraft on their BRITE display when the aircraft was nearing the airport from about 20 nautical miles (37 kilometers) northwest.

“But thereafter, they did not use the BRITE in providing control services to the aircraft through the circling maneuver,” the report said.

At 1120:01, the local controller, on the emergency radio frequency (121.5 megahertz), told the crew, “This is Gimhae tower on guard, Air China 129. If you hear me, contact one one eight point one.”

At 1120:02, the captain told the first officer that he had begun timing for the turn from the downwind leg to the base leg. The circling-approach procedure used in Air China B-767 flight simulator training called for flight crewmembers to begin timing when abeam the approach threshold of the landing runway and to begin the turn to base after 20 seconds.

At 1120:13, the second officer established radio communication with the tower.

At 1120:14, the captain said, “Turning base. . . I have control.”

The report said that the aircraft had been flown nearer than normal to the runway during the downwind leg, and the captain initially turned left to “widen the pattern.”

“Simulation results showed that turning base on the downwind width that Flight 129 had flown would have caused the aircraft to overshoot the final approach course,” the report said.

At 1120:24, the first officer said, “Turn quickly, not too late.”

The primary local controller had briefly observed the aircraft when it was on downwind and abeam the midpoint of the runway. At 1120:25, the primary local controller mistakenly cleared the crew to land on Runway 36L and said that the aircraft was not in sight. A few seconds later, the secondary local controller corrected the primary local controller’s mistake by telling the crew that they were cleared to land on Runway 18R.

The report said that because the local controllers did not use their BRITE displays to determine the aircraft’s position, they did not observe any of the five MSAW low-altitude warnings that were displayed after the aircraft was flown beyond the circling-approach areas.

“An aural [MSAW] warning would have been useful to alert the controllers to the situation,” the report said.

The aircraft was on a heading of 350 degrees, airspeed was 158 knots, and groundspeed was 170 knots at 1120:32,

when the captain disconnected the autopilot, hand-flew the aircraft into a right bank and told the first officer to “reduce speed.”

“Not until 1120:42, after approximately 40 seconds elapsed [from the captain’s announcement that he was beginning the timing for the turn to base], did the aircraft heading finally pass through 360 degrees toward the south,” the report said. “This was a decisive factor in the aircraft flying outside the circling-approach [areas] for both categories ‘C’ and ‘D.’”

The secondary local controller, who did not have the aircraft in sight, asked the crew if they could land the aircraft. The second officer said, “Roger.”

At 1120:51, the secondary local controller said, “Air China 129, say again your intention.” There was no reply from the flight crew.

The aircraft was on a heading of 007 degrees and in a right bank of 24 degrees at 1120:54, when the first officer said, “Pay attention to the altitude-keeping.”

“Assist me to find the runway,” the captain said.

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“The first officer did not respond whether the runway or the other references were in sight, but at 1120:59, the first officer said, ‘It’s getting difficult to fly,’” the report said. “It cannot be determined why the first officer made this remark, but, presumably, it might have been when the flight entered the clouds.”

At 1121:02, the first officer said, “Pay attention to the altitude.”

The secondary local controller told the crew to report their position. The second officer said that they were turning base. The first officer corrected him, and the second officer told the controller that they were turning final.

The report said that because the captain was in the left seat, he likely would have had difficulty keeping the runway in sight during the right turn.

“As the first officer, seated on the right side, was in a better position than the captain to have the runway in sight during the downwind leg and base turn, he should have been more intent to keep the runway in sight and aggressively advise the captain,” the report said “But he said nothing about whether the runway was in sight or [not in sight].”

At 1121:09, the captain said, “Have the runway in sight?”

“No, I cannot see out,” the first officer said. “Must go around.”

The report said that the captain did not respond to the first officer.

“The captain later stated that during the base turn, they entered the clouds but did not execute an immediate go-around, having thought that he would go around after they rolled out on final,” the report said.

At 1121:15, the first officer said, “Pull up. Pull up.”

Flight data recorder (FDR) data indicated that the aircraft’s pitch attitude was increased to 11.4 degrees nose-up; engine power was not increased. The aircraft struck Mount Dotdae at 1121:17.

“The last data about the status of the aircraft recorded on the FDR showed altitude 704 feet, airspeed 125 knots, groundspeed 133 knots, heading 149 degrees, right bank 26.8 degrees, and pitch angle 11.4 degrees,” the report said.

Investigators interviewed all 37 survivors and sent questionnaires to 34 surviving passengers, nine of whom responded.

“The interviews and responses to the questionnaire revealed that the accident occurred suddenly, with loud noise and violent shaking of the aircraft at the point of impact,” the report said. “All items inside the aircraft fell down, seats were thrust forward, and all lights went out, making it dark inside the aircraft, except for light streaming in through the broken fuselage. There was

fire erupting throughout the cabin, filling it with heavy smoke and making it difficult to breathe, and people were screaming. Most of the passengers briefly lost consciousness during impact, with feet and legs of some passengers stuck under the seats in front of them. ... Most of the survivors escaped by walking or crawling through the gaps in the broken fuselage.”

The first rescue personnel to arrive at the accident site at 1158 said that thick fog covered the top half of the mountain.

“The fuselage was engulfed in flames, and there were continual explosions from the front of the fuselage, with pillars of fire rising,” the report said. “It was raining at the accident site, with the visibility about 10 meters [33 feet] due to a dense fog.”

The report said that the accident aircraft was equipped with a “first-generation” digital ground-proximity warning system (GPWS) that was designed in the 1970s. The system had not generated warnings because the aircraft was configured for landing and the terrain-closure rate (1,800 feet per minute) was insufficient to trigger a Mode 2 warning (“terrain, terrain”).

The report discussed the findings and recommendations of the Flight Safety Foundation (FSF) Approach-and-landing Accident Reduction (ALAR) Task Force.

“The ambitious objectives of the task force require the support of the entire aviation industry,” the report said. “The *FSF ALAR Tool Kit* is among the products developed by the task force to help reach the objectives.”³

The report included comments by the General Administration of Civil Aviation of China (CAAC) on the KAIB’s draft report on the accident. CAAC said that its investigation team concluded that the possible causes of the accident were the following:

- “At the time of the accident, weather condition[s] were poor, with low cloud, precipitation and low visibility. There was a strong tail wind on the downwind leg, and the mountainous area north of the airport was covered by cloud;
- “The flight crew mishandled ... the circling approach to Runway 18R. The flight crew did not make the base-leg turn at the proper time, thus [causing] the aircraft to fly outside the circling-approach protection area. The flight crew didn’t execute [a missed] approach when they lost sight of the runway during the visual maneuvering of the circling approach; [and,]
- “When [an] MSAW warning appeared on the radar display, the controller failed to provide [a] safety warning to the flight crew; unintelligible frequency-transfer instruction and frequent communication with

the flight crew had an impact on the flight crew's operation of [the] base turn and final approach."♦

[FSF editorial note: This article, except where noted, is based on the English version of Korean Aviation-accident Investigation Board (KAIB) Aircraft Accident Report KAIB/AAR FO201, *Controlled Flight Into Terrain, Air China International Flight 129, B767-200ER, B2552, Mountain Dotdae, Gimhae, April 15, 2002*. The 251-page report contains illustrations and appendixes.]

Notes

1. The U.S. Federal Aviation Administration *Aeronautical Information Manual (AIM)* says that a *minimum sector altitude (MSA)* "provides at least 1,000 feet of obstacle clearance within a 25-mile [46-kilometer] radius of the navigation facility upon which the procedure is predicated." The MSAs shown on the Jeppesen approach chart for Busan, South Korean, were predicated on the Gimhae very-high-frequency omnidirectional radio, which was about three nautical miles (six kilometers) south of the Runway 36L threshold.
2. The *United States Standard for Terminal Instrument Procedures (TERPS)* specifies five aircraft approach categories based on airspeed (calculated as 1.3 times stall speed) and maximum landing weight. Pertinent to the accident were Category C and Category D. Category C includes airspeeds of 121 knots or more but less than 141 knots and

maximum landing weights of 60,001 pounds (27,216 kilograms) or more but less than 150,001 pounds (68,040 kilograms). Category D includes airspeeds of 141 knots or more but less than 166 knots and a maximum landing weight of 150,001 pounds or more. The *AIM* says, "An aircraft shall fit in only one category. However, if it is necessary to operate at a speed in excess of the upper limit of the speed range for an aircraft's category, the minimum for the category for that speed shall be used."

3. The Flight Safety Foundation (FSF) *Approach-and-landing Accident Reduction (ALAR) Tool Kit* provides on compact disc (CD) a unique set of pilot briefing notes, videos, presentations, risk-awareness checklists and other tools designed to help prevent approach-and-landing accidents (ALAs) and controlled flight into terrain (CFIT). The tool kit is the culmination of the Foundation-led efforts of more than 300 safety specialists worldwide to identify the causes of ALAs and CFIT, and to develop practical recommendations for prevention of these accidents."

Further Reading From FSF Publications

Flight Safety Foundation. "Approach-and-landing Accident Reduction (ALAR) Briefing Notes." *Flight Safety Digest* Volume 19 (August–November 2000).

Flight Safety Foundation (FSF) Approach-and-landing Accident Reduction (ALAR) Task Force. "Killers in Aviation: FSF Task Force Presents Facts About Approach-and-landing and Controlled-flight-into-terrain Accidents." *Flight Safety Digest* Volume 17 (November–December 1998) and Volume 18 (January–February 1999).

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