National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: January 27, 2000

In reply refer to: A-00-21

Honorable Jong-Hee Kim
Director General
Korean Civil Aviation Bureau
Republic of Korea

On August 6, 1997, about 0142:26 Guam local time,[1] Korean Air flight 801, a Boeing 747-3B5B (747-300), Korean registration HL7468, operated by Korean Air Company, Ltd., crashed at Nimitz Hill, Guam.[2] Flight 801 departed from Kimpo International Airport, Seoul, Korea, with 2 pilots, 1 flight engineer, 14 flight attendants, and 237 passengers[3] on board. The airplane had been cleared to land on runway 6L at A.B. Won Guam International Airport, Agana, Guam, and crashed into high terrain about 3 miles southwest of the airport. Of the 254 persons on board, 228 were killed,[4] and 23 passengers and 3 flight attendants survived the accident with serious injuries. The airplane was destroyed by impact forces and a postcrash fire. Flight 801 was operating in U.S. airspace as a regularly scheduled international passenger service flight under the Convention on International Civil Aviation and the provisions of 14 Code of Federal Regulations (CFR) Part 129 and was on an instrument flight rules flight plan.[5]

The National Transportation Safety Board determined that the probable cause of this accident was the captain's failure to adequately brief and execute the nonprecision approach and

[1] All times in this letter are Guam local time, based on a 24-hour clock.

[2] The island of Guam is a U.S. territory in the Pacific Ocean and is part of the Mariana Islands. Guam has an elected governor and a 21-member unicameral legislature. U.S. Naval and Air Force installations make up 35 percent of the island's area.

[3] Six of the passengers were Korean Air flight attendants who were "deadheading," that is, traveling off duty.

[4] Three passengers (including one deadheading flight attendant) initially survived the accident with serious injuries but died within 30 days after the accident. According to 14 Code of Federal Regulations (CFR) Section 830.2, such fatalities are to be included in the total number of fatal injuries. A passenger with serious injuries died at the U.S. Army Medical Center in San Antonio, Texas, on October 10, 1997, but is not officially listed as a fatality because the passenger's death occurred more than 30 days after the accident.

[5] For more detailed information, see National Transportation Safety Board. 2000. *Controlled Flight Into Terrain, Korean Air Flight 801, Boeing 747-300, HL7468, Nimitz Hill, Guam, August 6, 1997.* Aircraft Accident Report NTSB/AAR-00/01. Washington, DC.

the first officer's and flight engineer's failure to effectively monitor and cross-check the captain's execution of the approach. Contributing to these failures were the captain's fatigue and Korean Air's inadequate flight crew training. Contributing to the accident was the Federal Aviation Administration's (FAA) intentional inhibition of the minimum safe altitude warning (MSAW) system[6] at Guam and the agency's failure to adequately manage the system.

Description of the Approach

The instrument landing system (ILS)[7] glideslope inoperative,[8] or localizer-only, approach to runway 6L at Guam International Airport required the flight crew to maintain at least 2,000 feet from the FLAKE intersection (7 DME from the UNZ VOR)[9] to the GUQQY (outer marker) final approach fix, which was located 1.6 DME from the UNZ VOR. After passing GUQQY, the crew was required to maintain at least 1,440 feet mean sea level until passing the UNZ VOR. After passing the UNZ VOR, the next step-down fix was to 560 feet (the minimum descent altitude), and the flight crew was required to maintain at least this altitude while counting up to 2.8 DME (the missed approach point) from the UNZ VOR.

The Captain's Performance of the Approach

Approach Briefing

Korean Air cockpit procedures call for an approach (landing) briefing[10] before descent. Also, company training instructs the flying pilot to conduct an approach briefing before descent. According to the Korean Air 747 landing briefing checklist card and testimony by Korean Air officials during the Safety Board's public hearing,[11] this briefing should include a discussion of weather conditions, a review of the instrument approach procedure, details of the approach's execution (including the minimum safe altitude, approach frequency and approach course, the

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[6] The purpose of the ground-based MSAW system is to provide air traffic controllers with a visual and an aural warning whenever an airplane descends, or is predicted to descend, below a prescribed minimum safe altitude. This information can then be relayed to the pilots so they can take remedial action.

[7] The ILS is a precision approach system that provides lateral guidance (localizer) and vertical alignment (glideslope) with the runway. The system uses ground-based radio transmitters that provide both the localizer and the glideslope signals.

[8] FAA Form 6030-1, "Air Traffic Control Facility Maintenance Log," showed that the glideslope portion of the ILS was taken out of service on July 7, 1997, for extensive reconstruction. The reconstruction work included the replacement of the glideslope's equipment shelter and all cabling and the upgrade of the power systems and grounding. A Notice to Airmen issued by the FAA that same day indicated that the glideslope would remain out of service until September 12, 1997. The complete ILS system was flight checked, certified, and returned to service on August 31, 1997. The Safety Board's review of the facility maintenance log revealed no entries of pilot reports regarding the ILS or related navigation systems from July 7 to August 6, 1997.

[9] DME stands for distance measuring equipment and is expressed in miles. VOR stands for very high frequency omnidirectional radio range.

[10] The approach briefing is called a "landing briefing" on the Korean Air checklist card.

[11] The Safety Board held a public hearing on this accident from March 24 to 26, 1998, in Honolulu, Hawaii. Five issues were addressed at this hearing: controlled flight into terrain accidents, operation of navigational devices at the Guam airport, MSAW systems and practices related to these systems, search and rescue operations, and U.S. and foreign government oversight of foreign air carriers operating into the United States.

runway touchdown zone elevation, and the missed approach procedure), crew actions and callouts, and any abnormal configurations or conditions.

Cockpit voice recorder (CVR) information indicated that the captain briefed a visual approach in his approach briefing, which he referred to as a "short briefing." However, the captain also briefed some elements of the localizer-only ILS approach, indicating that he intended to follow that approach as a supplement or backup to the visual approach. Specifically, the captain's briefing included a reminder that the glideslope was inoperative,[12] some details of the radio setup, the localizer-only minimum descent altitude, the missed approach procedure, and the visibility at Guam (stated by the captain to be 6 miles). However, the captain did not brief other information about the localizer-only approach, including the definitions of the final approach fix and step-down fixes and their associated crossing altitude restrictions or the title, issue, and effective dates of the approach charts to be used. The Safety Board notes that the landing briefing checklist did not specifically require the captain to brief the fix definitions, crossing altitudes, or approach chart title and dates,[13] although it would have been good practice to do so.

Further, according to public hearing testimony by a Korean Air instructor pilot, company pilots were trained to conduct a more detailed briefing than the one specified in the landing briefing checklist for a nonprecision approach, such as the localizer approach to runway 6L at Guam. According to the instructor pilot, this more detailed briefing included a discussion of the "instrument approach in detail" and a discussion of the "step-down altitudes and how they were determined." The Safety Board notes that this information is essential for a nonprecision approach briefing.

The Safety Board also notes that the captain did not brief the first officer and flight engineer on how he would fly the descent (including his planned autopilot/flight director modes and his plan to fly either a constant angle of descent or a series of descents and level-off altitudes associated with the step-down fixes), and he did not discuss go-around decision criteria. Further, although not specifically required, it would have been prudent for the captain to note the need for special caution in the UNZ VOR area (which he had described as a "black hole" in his approach briefing to another first officer on a July 4, 1997, flight into Guam).

The Safety Board further notes that, in this case, a thorough briefing was especially important because the accident captain and first officer were flying together for the first time, which is a situation that has been linked to flight crew-involved accidents.[14] According to recent

[12] FAA Form 6030-1, "Air Traffic Control Facility Maintenance Log," showed that the glideslope portion of the ILS was taken out of service on July 7, 1997, for extensive reconstruction. The reconstruction work included the replacement of the glideslope's equipment shelter and all cabling and the upgrade of the power systems and grounding. A Notice to Airmen issued by the FAA that same day indicated that the glideslope would remain out of service until September 12, 1997. The complete ILS system was flight checked, certified, and returned to service on August 31, 1997. The Safety Board's review of the facility maintenance log revealed no entries of pilot reports regarding the ILS or related navigation systems from July 7 to August 6, 1997.

[13] Testimony by Korean Air officials at the Safety Board's public hearing indicated that these items were taught in company flight crew training.

[14] National Transportation Safety Board. 1994. *A Review of Flightcrew-Involved Major Accidents of U.S. Air Carriers, 1978 Through 1990.* Safety Study NTSB/SS-94/01. Washington, DC, pp. 40-41.

human factors research, a good briefing is important to develop a "shared mental model" to ensure "that all crew members are solving the same problem and have the same understanding of priorities, urgency, cue significance, what to watch out for, who does what, and when to perform certain activities."[15] The Safety Board concludes that, by not fully briefing the instrument approach, the captain missed an opportunity to prepare himself, the first officer, and the flight engineer for the relatively complex localizer-only approach and failed to provide the first officer and flight engineer with adequate guidance about monitoring the approach; therefore, the captain's approach briefing was inadequate.

Expectation of a Visual Approach and Role of the Guam Airport Familiarization Video

The Safety Board notes that, when the captain flew to Guam about 1 month before the accident, he executed a routine ILS approach to runway 6L in good visibility, with a scattered cumulous buildup. Further, the most current automatic terminal information service (ATIS) information available to the accident flight crew indicated that visual conditions (scattered cloud decks and 7-mile visibility) existed at the airport.[16] Korean Air's Guam airport familiarization video,[17] which the captain and first officer had viewed in July 1997, noted that weather conditions in Guam allowed visual approaches most of the year and that, even though instrument meteorological conditions are likely during the rainy season from June to November, "you [the pilot] will be guided from over Apra Harbor to the localizer. You will then perform a visual approach…." Thus, the captain may have assumed that conditions for the flight 801 approach would be similar to those he experienced about 1 month earlier. The captain's anticipation of a visual approach probably became a strong expectation after the flight crew's early visual sighting of Guam.[18] Although the captain would likely have recognized the possibility of flight through clouds as the airplane descended from its cruise altitude, he may have assumed that the visual approach slope indicator (VASI) system would be in sight after the flight was vectored onto final approach by the Guam Combined Center/Radar Approach Control controller. The VASI system would have provided visual guidance for a constant angle of descent that safely cleared obstacles.

As previously discussed, the captain's landing briefing included references to his expectation of visual conditions at the airport as well as an abbreviated and inadequate briefing for the localizer-only approach. The Safety Board concludes that the captain's expectation of a visual approach was a factor in his incomplete briefing of the localizer approach.

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[15] Orasanu, J. "Decision-making in the Cockpit." In *Cockpit Resource Management.* 1993. Ed. E.L. Weiner, B.G. Kanki, and R.L. Helmreich. San Diego: Academic Press, p. 159.

[16] The CVR indicated that, about 0122:06, the Combined Center/Radar Approach Control controller informed the flight 801 crew that ATIS information Uniform was current.

[17] Korean Air stated that, in June 1997, it established an airport familiarization program that used audio-visual presentations (purchased from Japan Airlines) to prepare pilots for operations into designated airports. Korean Air requires pilots to view an airport familiarization videotape if the company or the FAA list that airport as a special airport. Title 14 CFR Section 121.445 defines special airports as those that require a special airport qualification for pilots in command because of "surrounding terrain, obstructions, or complex approach or departure procedures." Guam International Airport was not classified by Korean Air or the FAA as a special airport; thus, the accident flight crew was not required to view this familiarization tape.

[18] According to the CVR, the flight engineer stated "it's Guam, Guam" about 0126:25.

The Safety Board notes that, although Guam was not a designated special airport requiring special training or familiarization by flight crews,[19] Korean Air encouraged its flight crews to view the airport familiarization video. However, the Guam familiarization video gave only a generalized description of the topography of the island of Guam. Although the video mentioned some of the obstacles near the approach course, it did not specifically state that the VOR was located on a hill, the DME was not colocated with the localizer, or the final approach segment was over hilly or mountainous terrain.

Even though the airport familiarization video accurately identified some landmarks and advised pilots not to fly over a residential area and a Naval hospital (for noise abatement), the Safety Board also notes with concern that the video contained no discussion of factors that made operations into Guam challenging, such as the high terrain along the approach course or in the vicinity of the airport. Further, the presentation did not describe the complexity of the Guam nonprecision approaches, including the use of multiple step-down fixes, two separate navigation facilities (the localizer and the VOR), and a countdown/count up DME procedure.

The Safety Board concludes that the Korean Air airport familiarization video for Guam, by emphasizing the visual aspects of the approach, fostered the expectation by company flight crews of a visual approach and, by not emphasizing the terrain hazards and offset DME factors, did not adequately prepare flight crews for the range of potential challenges associated with operations into Guam.

Therefore, the National Transportation Safety Board makes the following recommendation to the Korean Civil Aviation Bureau:

> Require Korean Air to revise its video presentation for Guam to emphasize that instrument approaches should also be expected and describe the complexity of such approaches and the significant terrain along the approach courses and in the vicinity of the airport. (A-00-21)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

[19] In its report on this accident, the Safety Board recommended that the FAA consider designating Guam International Airport as a special airport requiring special pilot qualifications.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "...to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation A-00-21 in your reply.

Original Signed

By: Jim Hall
Chairman