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National Transportation Safety Board

Washington, D.C. 20594
Safety Recommendation

Date: June 20, 1989
In reply refer to: A-89-44 through -49

Mr. Robert Whittington
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

On September 19, 1986, an Atlantic Southeast Airlines (ASA) Embraer EMB-120 Brasilia, on a ferry flight conducted under 14 Code of Federal Regulations (CFR) Part 91, from Sao Jose dos Campos, Brazil, to Atlanta, Georgia, with an en route stop in Brasilia, Brazil, crashed while on climbout from Sao Jose dos Campos. The airplane was destroyed and all 5 persons onboard, 3 flight crewmembers and 2 passengers, were killed in the accident. The investigation, which was conducted by the Brazilian Director General for Civil Aviation, with the cooperation of the United States National Transportation Safety Board under the provisions of Annex 13 of the International Civil Aviation Organization (ICAO) treaty, revealed that the airplane struck the side of a mountain, which had a peak of about 5,300 feet mean sea level (msl), at an approximate altitude of 5,175 feet msl. Instrument meteorological conditions were believed to have prevailed at the accident site at the time of the accident.

The investigation found that the airplane struck the mountain at cruise speed, in straight and level flight. The cause of the accident was determined to have been the failure of the flightcrew to comply with a clearance that had been issued by the Sao Jose dos Campos tower; investigators concluded that the crew did not adequately read back the clearance. The tower had directed the flight to: Intercept a radial of the Sao Jose dos Campos VOR,¹ climb without restriction to flight level 280,² and contact the Brasilia Air Route Traffic Control Center. Although the crew did contact the Center, they did not fly as cleared and shortly thereafter collided with the mountain. Due to the lack of a cockpit voice recorder, which was not required under existing Federal Aviation Regulations (but will be so required in the near future), the investigators could not determine why the crew failed to comply properly with the clearance. The Brazilian government's report of the investigation stated that the crew may have misunderstood the clearance, perhaps due to the accented English of the air traffic controllers. However, the report presented the following, as the most likely hypothesis to explain the crew's actions:

¹VOR--very high frequency omnidirectional radio range.

²28,000 feet based on a standard altimeter setting.

Considering that both pilots were experienced and had mutual trust in their skills, it is probable that each one of them concentrated exclusively in their specific duties. As the pilot [in command] did not have experience in the Brazilian air traffic procedures (ICAO standard), he might have expected for a co-pilot's monitoring in order to accomplish the "climbing," since the co-pilot was experienced in that kind of mission. Furthermore, the normal procedure adopted in Atlanta-USA (where the pilots frequently operated) for the climbing of turboprop aircraft - maintenance at 4,000 feet after the takeoff for approximately ten minutes, may have generated conditioning in the pilot.

On February 8, 1989, Independent Air flight 1851, a Boeing 707-331B on a charter flight operated under 14 CFR Part 121 from Bergamo, Italy, to the Dominican Republic, with a refueling stop at the island of Santa Maria in the Azores, crashed while on descent to Santa Maria. There were 137 passengers, 4 flight attendants, and 3 flight crewmembers onboard. The airplane struck the side of a mountain, which had a peak of about 1,750 feet msl, at an approximate altitude of 1,730 feet. Instrument meteorological conditions prevailed at the mountaintop, day visual conditions prevailed at the airport. The airplane was destroyed and all 144 persons onboard were killed in the accident. The airplane was on its appropriate course, in straight and level flight, with its flaps retracted and its landing gear up.

The investigation, which is continuing, is being conducted by the Portuguese Director General of Civil Aviation, with the cooperation of the United States National Transportation Safety Board under the provisions of Annex 13 of the ICAO treaty. The investigation found that the Santa Maria tower, in giving the crew a descent clearance, reported the local QNH, i.e., altimeter setting, as 1027 millibars, when the correct setting was 1018.7. This would result in the airplane flying about 250 feet lower than the altitude displayed on the altimeter. The flightcrew of Independent Air 1851 then misunderstood a clearance by the tower to descend to 3,000 feet msl, believing instead that they were cleared to 2,000 feet msl. Although the flightcrew read back the clearance as a descent to 2,000 feet, the tower was unaware of the misunderstanding due to overlapping radio communications between them. The crew descended to what they believed to be 2,000 feet msl, 1,000 feet below the minimum sector altitude.

On February 18, 1989, a Flying Tigers Boeing 747-200 freighter with 4 crewmembers onboard, on a flight conducted under 14 CFR Part 121 from Singapore to Hong Kong, with an en route stop in Kuala Lumpur, Malaysia, crashed while on approach to Kuala Lumpur. Night, marginally visual conditions prevailed around the airport at the time. The airplane was destroyed and all 4 persons onboard were killed as a result of the accident.

The investigation, which is continuing, is under the direction of the Department of Civil Aviation of the government of Malaysia, with the cooperation of the United States National Transportation Safety Board under the provisions of Annex 13 of the ICAO treaty.

The investigation has revealed that the airplane struck the ground about 8 miles short of the runway while the crew was executing a nonprecision approach. Examination of the tape recordings of air traffic control transmissions and cockpit voice recorder communications indicates that the Kuala Lumpur controller cleared the airplane to descend "Two four zero zero," which the crew read back as "O.K. Four Zero Zero" and apparently descended to 400 feet msl rather than the appropriate altitude of 2,400 msl. There was no correction to this readback by the tower.

All three accidents shared many characteristics. They involved United States operators conducting either all or most of their operations under the provisions of 14 CFR Part 121. The ASA accident flight had been conducted under 14 CFR Part 91 because it was a nonrevenue, nonscheduled, ferry flight. The accidents occurred in foreign airspace that was either not radar equipped or equipped with primary radar only, under the control of air traffic controllers whose native language was not English. Misunderstandings or communication deficiencies between flightcrews and air traffic controllers occurred in all three accidents. In addition, the evidence suggests that the flightcrews in the three accidents lacked awareness of the proximity of their airplanes to terrain. In the B-707 and the B-747 accidents, the flightcrews descended below minimum safe altitudes that were published on their approach charts. In the EMB-120 accident, the crew flew a flightpath that took them directly into the mountain.

The Safety Board recognizes the difficulties that United States trained flightcrews may face when flying overseas. Even flightcrews that are fairly experienced in overseas operations, such as the Flying Tigers crew was, may fail to recognize the often subtle differences in procedures used in domestic airspace and in foreign airspace. For example, despite the almost universal adherence to ICAO standards for air traffic control phraseology and procedures, many countries employ their own unique phrases and procedures. The Navigational Aids are often fewer in number and less reliable than are Navigational Aids in the United States. The English of the air traffic controllers, while fluent, may be accented and difficult for a United States crew to understand, particularly if their international operating experience is limited. The accents may be such as to prevent controllers from pronouncing common English sounds, such as the "th" in the word three. Moreover, domestic operators may communicate with the air traffic controllers in the language of the country in which they are operating and as a result, United States pilots who do not understand that language may be unaware of the actions of other aircraft in the airspace.

As a result of the differences in foreign operating environments, the Safety Board recently issued two Safety Recommendations to the Federal Aviation Administration (FAA), A-89-22 and A-89-23, which urged the FAA to require that their principal operations inspectors (POIs) emphasize to carriers engaging in foreign operations the need for increased vigilance by flightcrews when operating at foreign airports, and to review the training programs of operators engaged in international operations to verify that they are adequate to safely conduct instrument flight operations at foreign airports.

Subsequent to the issuance of these Safety Recommendations, and as a part of the continuing investigations of the Independent Air B-707 and the Flying Tigers B-747 accidents, the Safety Board has learned that FAA inspectors may themselves lack the necessary training or experience to properly oversee a carrier's international operations. At present, air carrier inspectors receive no special training in international operations other than in areas such as overwater navigation procedures. Thus, inspectors may perform en route inspections of flights to foreign destinations, but without sufficient training or expertise, they may be unable to recognize and address potential subtle deficiencies in a carrier's international operations.

The FAA provides many types of guidance to operators, manufacturers, and inspectors. For example, it publishes an Advisory Circular suggesting data input and en route verification procedures for operators engaged in overwater electronic navigation. It gives guidance to manufacturers seeking FAA certification of new aircraft. It tells its inspectors what material they are required to review and what they must observe before they can grant a carrier an operating certificate. It supplies questions from previous written tests for airman certificates to individuals preparing for those tests. It provides proficient, type-rated, air carrier inspectors to assist POIs who are not type rated in aircraft of the carriers they oversee. The FAA has even established a special team of experts to provide a POI with the finding of whether a simulator possesses the necessary fidelity and handling characteristics to serve as an adequate training device in place of the aircraft. This team, the National Simulation Evaluation Program, determines whether a flight simulator meets FAA standards. After the team has completed the determination and so informed the POI, the POI can then approve the use of the simulator in accordance with a carrier's accepted operating and training procedures.

By contrast, the FAA offers no guidance and provides no expertise in international operations to operations inspectors who are responsible for the oversight of air carriers engaged in international operations, other than on overwater navigation procedures. Given the variations in radar services, Navigational Aids, controller accents and air traffic control phrases and procedures, the Safety Board believes that the FAA, to properly exercise its responsibility to oversee the flight operations of United States air carriers operating overseas, should establish within the agency a unit with expertise in international operations, to provide to inspectors who are responsible for overseeing air carriers engaged in international operations, guidance and assistance in performing surveillance of such operations. The Safety Board also believes that the FAA should provide to air carriers who are engaged in international operations, guidance on the conduct of international operations and information on factors that could affect the safety of such operations. The Safety Board also believes that a unit within the FAA, with the proper expertise in international operations, should periodically review the operating procedures and training programs of air carriers engaged in international operations, to verify that the procedures and training programs adequately address factors that could affect the safety of such operations.

The investigations of the Independent Air B-707 and the Flying Tigers B-747 accidents have revealed that in both accidents, the airplanes had been equipped with required ground proximity warning systems (GPWS) which provided aural alerts to the crew when approaching terrain in a potentially dangerous manner. The ASA airplane was not required to be and was not so equipped. In both the Independent Air B-707 and the Flying Tigers B-747 accidents the GPWS sounded before impact. The GPWS on the B-707 sounded over 7 seconds and the B-747 GPWS sounded over 17 seconds before impact. Had the flightcrews of the two airplanes taken immediate action to alter their respective flight profiles, the accidents may have been avoided. Even allowing for time for the crews to perceive and to react to the GPWS alerts, the Safety Board believes that there was sufficient time available to the crews to alter their altitudes sufficiently to avoid the terrain.

Following several accidents in which flightcrews descended prematurely, the Safety Board, in 1981, issued two Safety Recommendations to the Federal Aviation Administration (FAA) dealing with the installation and use of GPWS in transport category aircraft. The Safety Board recommended that the FAA:

A-81-19

Instruct all air carriers to include in their flightcrew procedures instructions which require an immediate response to the ground proximity system's terrain closure "pull-up" warning when proximity to the terrain cannot be verified instantly by visual observation. The required response to this warning should be that the maximum available thrust be applied and that the aircraft be rotated to achieve the best angle climb without delay.

A-81-20

Instruct air carriers to include in their initial and recurrent simulator training curricula situations involving radar controlled as well as noncontrolled flight wherein ground proximity warning system alarms are given and flightcrew response to those warning system alarms are evaluated.

The FAA responded to both recommendations by issuing, on August 12, 1981, a change to its Air Carrier Operations Bulletin (ACOB). The change to the ACOB said, in part:

In its analysis of two air carrier accidents, the NTSB discovered a potentially dangerous syndrome ingrained in the responses of some pilots to terrain closure "pull-up" alarms from the GPWS ... named "The Delayed Response Syndrome." The procedures regarding GPWS alarms in many air carrier airplane flight manuals do not discourage this syndrome. [Therefore,] review your carrier's airplane flight manuals to ensure compliance with FAR 121.360(c)(1)(ii) which requires that

these manuals contain proper flightcrew action with respect to GPWS equipment [and] review your carrier's initial and recurrent simulator training programs to ensure that appropriate guidance is provided to instructor/check airman personnel concerning flightcrew response to GPWS alarms.

As a result of the FAA action, the Safety Board closed both recommendations and classified them "Acceptable Action." The relevant change to the ACOB remains current as part of the FAA's Air Carrier Operations Bulletins. However, the Safety Board has learned that operations inspectors assigned to Independent Air were unaware of the relevant change to the ACOB.

The investigation into the B-707 accident in the Azores has revealed that Independent Air trained its flightcrews in a B-707 simulator that sounded a GPWS alert when a normal approach was flown, because the simulator was not programmed for the approach speeds and flap settings used in the airplane. Independent Air modified the flap settings and approach speeds of its B-707 airplanes, in accordance with FAA accepted procedures, after the airplanes had been modified with "hush-kits" or noise attenuated engines. The programs of the B-707 simulator, which had not been so modified, presented the flight characteristics of an unmodified B-707. As a result, instructors routinely inhibited the GPWS or told the flightcrews to ignore it during the training. The simulator that the crew of the Flying Tigers airplane flew was not equipped with a functioning GPWS. Consequently, flightcrews could not be presented with GPWS alerts in their simulator training on the B-747.

The Safety Board is concerned that such training not only defeats the purpose of the FAA's own directives to its POIs but creates a potentially dangerous situation in which flightcrews are taught, either explicitly or implicitly, to disregard GPWS alerts. The Safety Board believes that the FAA should review the flight training programs and FAA-accepted manuals of air carriers operating under 14 CFR Part 135 and 14 CFR Part 121 with GPWS-equipped aircraft, and verify that flightcrews are trained and are required to immediately execute a terrain avoidance maneuver when a GPWS alert is sounded, and terrain cannot be visually identified or a safe distance from terrain cannot be assured by other means.

The investigations into the ASA EMB-120 accident and the Independent Air B-707 accident have found that in both flights, flight crewmembers lacked operating experience in either international operations or in the airspace in which the accidents occurred. The pilot-in-command of the EMB-120 was on his first trip to Brazil for the ferry flight of the airplane involved in the accident. The first officer of the B-707 had just completed his initial line training and had been released for line flying 3 weeks before the accident. The accident flight was his first flight to the Azores. The pilot-in-command had flown to Santa Maria once before the accident, but from the west where he would not have overflown the island and its only mountain.

The Safety Board has previously addressed the importance of experience in all flight crewmembers. Following an accident involving a DC-9 in scheduled revenue passenger service,³ in which the Safety Board concluded that both flight crewmembers were relatively inexperienced in the DC-9, the Safety Board issued the following Safety Recommendation to the FAA:

A-88-137

Establish minimum experience levels for each pilot-in-command and second-in-command pilot, and require the use of such criteria to prohibit the pairing on the same flight of pilots who have less than the minimum experience in their respective positions.

The Safety Board concludes that a similar need for flightcrew experience should be established for operators engaged in international operations. The Safety Board urges the FAA to develop minimum levels of experience in international operations for each pilot-in-command and second-in-command pilot and prohibit the operation of an international flight in which both pilots fail to meet the established minimum levels of experience in such operations.

The Safety Board believes that members of the aviation community can learn from the experiences of those engaged in international flight operations. The National Aeronautics and Space Administration (NASA) maintains the Aviation Safety Reporting System (ASRS) to provide aviators with a vehicle for communicating their experiences in the aviation system without fear of retaliation. The Safety Board contends that the ASRS would be an excellent means for pilots who are new to international operations to learn from the experiences of those who are already familiar with those operations. However, not all pilots take the opportunity to report their experiences to the ASRS. Consequently, the Safety Board urges the FAA to encourage pilots to report flying experiences that are unique to international flight operations to NASA's Aviation Safety Reporting System.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Establish within the agency a unit with expertise in international operations, to provide to inspectors who are responsible for overseeing air carriers engaged in international operations, guidance and assistance in performing surveillance of such operations. (Class II, Priority Action) (A-89-44)

³ Aircraft Accident Report--Continental Airlines, Inc., Flight 1713, McDonnell Douglas DC-9-14, N626TX, Stapleton International Airport, Denver, Colorado, November 15, 1987 (NTSB/AAR-88/09).

Provide to air carriers engaged in international operations, guidance on the conduct of international operations and information on factors that could affect the safety of such operations. (Class II, Priority Action) (A-89-45)

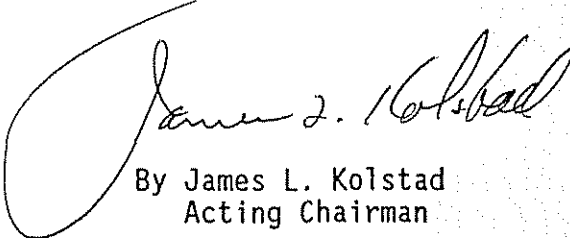
Conduct periodic reviews of the operating procedures and training programs of air carriers engaged in international operations, by a unit with expertise in international operations, to verify that the procedures and training programs adequately address factors that could affect the safety of such operations. (Class II, Priority Action) (A-89-46)

Review the flight training programs and FAA-accepted manuals of air carriers operating under 14 CFR Part 135 and 14 CFR Part 121 with GPWS-equipped aircraft, and verify that flightcrews are trained and are required to immediately execute a terrain avoidance maneuver when a GPWS alert is sounded, and terrain cannot be visually identified or a safe distance from terrain cannot be assured by other means. (Class II, Priority Action) (A-89-47)

Develop minimum levels of experience in international operations for each pilot-in-command and second-in-command pilot, and prohibit the operation of an international flight in which both pilots fail to meet the established minimum levels of experience in such operations. (Class II, Priority Action) (A-89-48)

Encourage pilots to report flying experiences that are unique to international flight operations to NASA's Aviation Safety Reporting System. (Class II, Priority Action) (A-89-49)

KOLSTAD, Acting Chairman, and BURNETT, LAUBER, NALL, and DICKINSON, Members, concurred in these recommendations.



By James L. Kolstad
Acting Chairman