National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 26, 2005
In reply refer to: A-05-30 through -32

Honorable Marion C. Blakey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On May 9, 2004, about 1450 Atlantic standard time,[1] Executive Airlines (doing business as American Eagle) flight 5401, an Avions de Transport Regional (ATR) 72-212, N438AT, skipped once, bounced hard twice,[2] and then crashed at Luis Muñoz Marin International Airport, San Juan, Puerto Rico. The airplane came to a complete stop on a grassy area about 217 feet left of the runway 8 centerline and about 4,317 feet beyond the runway threshold. The captain was seriously injured; the first officer, 2 flight attendants, and 16 of the 22 passengers received minor injuries; and the remaining 6 passengers received no injuries. The airplane was substantially damaged. The airplane was operating under the provisions of 14 *Code of Federal Regulations* (CFR) Part 121 as a scheduled passenger flight. Visual meteorological conditions prevailed for the flight, which operated on an instrument flight rules flight plan.[3]

The National Transportation Safety Board determined that the probable cause of this accident was the captain's failure to execute proper techniques to recover from the bounced landings and his subsequent failure to execute a go-around.

Bounced Landing Recovery Guidance and Training

The first officer was the pilot flying when the airplane skipped on initial contact with the runway. After the initial touchdown, the captain took control of the airplane. Flight data recorder (FDR) data indicated that, after taking control, the captain made several abrupt changes in pitch and power, which led to two bounces and the accident.

[1] Unless otherwise indicated, all times in this report are Atlantic standard time.

[2] For the purposes of this letter, the term "skip" refers to a landing airplane that momentarily becomes airborne after contact with the runway. A bounce is similar to a skip; however, the airplane reaches a higher altitude after contact with the runway. A skip or a bounce is typically caused by excessive airspeed or excessive back pressure being applied to the flight controls by the pilot.

[3] For more information about this accident, see National Transportation Safety Board, *Crash During Landing, Executive Airlines Flight 5401, Avions de Transport Regional 72-212, N438AT, San Juan, Puerto Rico, May 9, 2004*, Aircraft Accident Report NTSB/AAR-05/02 (Washington, DC: NTSB, 2005).

Postaccident interviews with the first officer, two company check airmen, and three company simulator instructors revealed that Executive Airlines did not have standardized guidance regarding bounced landing recovery. For example, one of the check airmen and one of the simulator instructors stated that, if the airplane bounced, they would execute a go-around. The other three company personnel indicated that, if possible, they would try to correct the bounce and land and that, if not possible, they would execute a go-around.

Further, Executive Airlines' manager of training and standards stated that, before the accident, the company did not teach its pilots bounced landing recovery techniques. The manager also stated that he would not want to conduct bounced landing recovery training in the simulator because it was very difficult to demonstrate. However, he stated that, after the accident, the president and the vice president of operations asked him to look into the feasibility of conducting bounced landing recovery flight training and incorporating bounced landing recovery techniques in company manuals. The Safety Board concludes that written company guidance on bounced landing recovery techniques would have increased the possibility that the captain could have recovered from the bounced landings or handled the airplane more appropriately by executing a go-around. On September 25, 2004, Executive Airlines incorporated bounced landing recovery techniques in its Airplane Operating Manual.

In its final report on the July 31, 1997, accident involving Federal Express flight 14, a McDonnell Douglas MD-11 that bounced once and then crashed while landing at Newark International Airport, Newark, New Jersey,[4] the Safety Board concluded that the captain's overcontrol of the elevator during the landing and his failure to execute a go-around from a destabilized flare were causal to the accident. As a result, the Board issued Safety Recommendation A-00-93 to the Federal Aviation Administration (FAA), which required, in part, that a syllabus for simulator training be developed that addressed how to recover from unstabilized landing flares, including techniques for avoiding and recovering from overcontrol in pitch before touchdown and techniques for avoiding overcontrol and premature derotation during a bounced landing. In a May 15, 2002, letter, the FAA stated that an industry taskforce had been convened and that the taskforce had produced several significant training materials, including an Approach and Landing Accident Reduction Training Guide, to address the safety recommendation. On October 22, 2002, the Board classified Safety Recommendation A-00-93 "Closed—Acceptable Action."

The training materials produced in response to Safety Recommendation A-00-93 do not specifically address bounced landing recovery techniques. Further, an informal Safety Board survey of six airlines, an airplane manufacturer, and a pilot training facility revealed that only some of the companies included bounced landing recovery techniques in their flight manuals and discussed these techniques during training. The Board is concerned that the lack of guidance on bounced landing recovery techniques could contribute to similar landing accidents.

The Safety Board concludes that the performance of air carrier pilots would be improved if additional guidance and training in bounced landing recovery techniques were available.

[4] For more information about this accident, see National Transportation Safety Board, *Crash During Landing, Federal Express, Inc., McDonnell Douglas MD-11, N611FE, Newark International Airport, Newark, New Jersey, July 31, 1997,* Aircraft Accident Report NTSB/AAR-00/02 (Washington, DC: NTSB, 2000).

Therefore, the Safety Board believes that the FAA should require all 14 CFR Part 121 and 135 air carriers to incorporate bounced landing recovery techniques in their flight manuals and to teach these techniques during initial and recurrent training.

Quality of Data Provided by Flight Data Recorder Potentiometer Sensors

The Safety Board determined that the left aileron surface position data recorded by the accident airplane's FDR were invalid even though the accident airplane had been modified on August 7, 2001, with the position sensors and associated hardware required by Supplemental Type Certificate (STC) No. ST01310NY. Executive Airlines stated that the first and last FDR parameter readout since the installation of the sensors occurred on January 3, 2003, about 1 year and 5 months after the installation and 1 year and 4 months before the accident. Executive Airlines stated that it had replaced 47 aileron surface position sensors in the last 3.5 years. However, the company indicated that, because the sensors are not tracked, the times from installation to failure could not be determined.

During its investigation of the August 21, 1995, accident involving Atlantic Southeast Airlines flight 529, an Embraer EMB-120RT that crashed on approach to West Georgia Regional Airport, Carrollton, Georgia,[5] the Safety Board determined that the airplane's two flight control position sensors had malfunctioned, preventing the required data from being accurately recorded, and that the lack of data hindered the investigation. The Board's report on the accident noted that tests could be conducted to ensure timely identification and repair of potentiometer malfunctions, including FDR parameter readouts. The report also noted that malfunctions that occur between readouts are typically not detected.

As a result of the flight 529 investigation and six other investigations involving EMB-120s in which potentiometer malfunctions prevented accurate data from being recorded on the EMB-120, the Safety Board issued Safety Recommendations A-96-33 and -34. Safety Recommendation A-96-33 asked the FAA, in part, to conduct a design review of the EMB-120 FDR system, emphasizing potentiometer failures, and mandate design, installation, and/or maintenance changes, as necessary. In December 2002, the FAA issued an STC that authorized the replacement of the potentiometer sensors for the EMB-120 FDR system with more reliable sensors. The Safety Board classified Safety Recommendation A-96-33 "Closed—Acceptable Action" in October 2004.

Safety Recommendation A-96-34 asked the FAA, in part, to require EMB-120 operators to perform an FDR readout or a potentiometer calibration test every 6 months until FDR sensor design, installation, and/or maintenance improvements are incorporated. In September 1997, the FAA issued Flight Standards Handbook Bulletin for Airworthiness 97-14B, "Embraer EMB-120 Flight Data Recorder Test," which directed operators to conduct FDR potentiometer calibration testing every 6 months. As a result, the Safety Board classified Safety Recommendation A-96-34 "Closed—Acceptable Action" in May 1998. However, in an August 2003 letter commenting on a supplemental notice of proposed rulemaking in which the FAA proposed a 12-month FDR

[5] For more information about this accident, see National Transportation Safety Board, *In-Flight Loss of Propeller Blade, Forced Landing, and Collision with Terrain, Atlantic Southeast Airlines, Inc., Flight 529, Embraer EMB-120RT, N256AS, Carrollton, Georgia, August 21, 1995*, Aircraft Accident Report NTSB/AAR-96/06 (Washington, DC: NTSB, 1996).

potentiometer inspection interval, the Board reiterated its position on the inspection interval recommended in Safety Recommendation A-96-34.

The potentiometer sensors installed on Executive Airlines ATRs were similar to the potentiometer sensors used on the EMB-120; therefore, they were susceptible to the same problems that previously prevented accurate data from being recorded on the EMB-120. However, at the time of the accident, Executive Airlines only performed functional checks of the FDR system every 3,000 flight cycles. As evidenced by company maintenance data, it is possible that FDR functional checks performed every 3,000 flight cycles will only occur once every 1.5 years. After the accident, Executive Airlines began conducting FDR functional checks every 1,000 flight cycles.

The Safety Board concludes that the aileron flight control surface position sensors installed on airplanes in accordance with STC No. ST01310NY are unreliable and that FDR functional checks every 6 months could ensure the timely identification and correction of potentiometer malfunctions and ensure that accurate flight control data are available for accident and incident investigations. Therefore, the Safety Board believes that the FAA should require the replacement of aileron surface position sensors installed in accordance with STC No. ST01310NY with more reliable aileron surface position sensors within 1 year or at the next heavy maintenance check, whichever comes first, after the issuance of an approved STC. Until reliable aileron surface position sensors have been installed, require FDR functional checks every 6 months and replacement of faulty sensors, as necessary. Additionally, the Safety Board believes that the FAA should conduct a review of all FDR systems that have been modified by an STC to determine the reliability of all sensors used as flight control surface position sensors. If the review determines that a sensor does not provide reliable flight control surface position data, require that the sensor be replaced with a more reliable sensor.

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

> Require all 14 *Code of Federal Regulations* Part 121 and 135 air carriers to incorporate bounced landing recovery techniques in their flight manuals and to teach these techniques during initial and recurrent training. (A-05-30)
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> Require the replacement of aileron surface position sensors installed in accordance with Supplemental Type Certificate (STC) No. ST01310NY with more reliable aileron surface position sensors within 1 year or at the next heavy maintenance check, whichever comes first, after the issuance of an approved STC. Until reliable aileron surface position sensors have been installed, require flight data recorder functional checks every 6 months and replacement of faulty sensors, as necessary. (A-05-31)
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> Conduct a review of all flight data recorder systems that have been modified by a supplemental type certificate to determine the reliability of all sensors used as flight control surface position sensors. If the review determines that a sensor does not provide reliable flight control surface position data, require that the sensor be replaced with a more reliable sensor. (A-05-32)

Acting Chairman ROSENKER and Members ENGLEMAN CONNERS and HERSMAN concurred with these recommendations.

Original Signed

By: Mark V. Rosenker
Acting Chairman