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National Transportation Safety Board

Washington, DC 20594

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JAN 11 2000

Office of the Chairman

U.S. Department of Transportation Dockets
Docket No. FAA-1999-6482 – 15
400 Seventh Street, S.W.
Room Plaza 401
Washington, DC. 20590

RE: Docket No. FAA-1999-6482, Notice No. 99-19

Dear Sir or Madam:

The National Transportation Safety Board has reviewed the Federal Aviation Administration's (FAA) Notice of Proposed Rulemaking (NPRM) entitled "Revisions to Digital Flight Data Recorder Regulations for Boeing 737 Airplanes and for Part 125 Operations," published in the *Federal Register,* Volume 64, Number 222, on November 18, 1999. The proposed rule changes are the result of Safety Board investigations of two accidents and one incident.[1] The Board determined that the probable cause of the USAir flight 427 accident was a loss of control of the airplane resulting from the movement of the rudder surface to its blowdown limit. The Board's investigation showed that the rudder surface most likely deflected in a direction opposite to that commanded by the pilots as a result of a jam of the main rudder power control unit (PCU) servo valve secondary slide and overtravel of the primary slide. Simulations of the PCU show that if the secondary slide were jammed to the servo valve housing while offset from its neutral position and the primary slide moved to an overtravel position as a result of pilot inputs to the rudder pedals, the rudder could move in the direction opposite from that commanded by the pilot. The Board made similar findings for United Airlines flight 585 and Eastwind Airlines flight 517.

Although Boeing and Safety Board staffs agreed that the rudders moved to the blowdown limit in the three cases, arguments were made, and continue to be made, that the pilots caused the rudders to move rather than malfunctions in the rudder systems. Many years of investigative

[1] (a) National Transportation Safety Board. 1992. *United Airlines Flight 585, Boeing 737-291, N999UA, Uncontrolled Collision With Terrain for Undertermined Reasons, 4 Miles South of Colorado Springs Municipal Airport, Colorado Springs, Colorado, March 3, 1991.* Aircraft Accident Report NTSB/AAR-92/06. Washington, DC. (b) National Transportation Safety Board. 1999. *USAir Flight 427, Boeing 737-3001, N513AU, Uncontrolled Descent and Collision With Terrain, near Aliquippa, Pennsylvania, September 8, 1994.* Aircraft Accident Report NTSB AAR-99/01. Washington, DC. (c) NTSB incident DCA96IA061, Eastwind Airlines flight 517, N221US, Richmond, Virginia, June 9, 1996. (This incident as well as more than 100 other 737 events are discussed in the aircraft accident report NTSB/AAR-99/01.)

efforts were required for the Board to conclude that the rudder system was the likely source of the large rudder deflections. The lengthy investigations, continuing occurrences of serious incidents similar in nature to the referenced accidents and incident, and the nondefinitive resolution of pilot involvement prompted the Safety Board to issue, on April 16, 1999, the following safety recommendations to the FAA:

> Require that all Boeing 737 airplanes operated under 14 Code of Federal Regulations Parts 12 1 or 125 that currently have a flight data acquisition unit be equipped, by July 3 1, 2000, with a flight data recorder system that records, at a minimum, the parameters required by Federal Aviation Administration Final Rules 12 1.344 and 125.226, dated July 17, 1997, applicable to that airplane plus the following parameters: pitch trim; trailing edge and leading edge flaps; thrust reverser position (each engine); yaw damper command; yaw damper on/off discrete; standby rudder on/off discrete; and control wheel, control column, and rudder pedal forces (with yaw damper command; yaw damper on/off discrete; and control wheel, control column, and rudder pedal forces sampled at a minimum rate of twice per second). (Safety Recommendation A-99-28)
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> Require that all Boeing 737 airplanes operated under 14 Code of Federal Regulations Parts 12 1 or 125 that are not equipped with a flight data acquisition unit be equipped, at the earliest time practicable but no later than August 1, 2001, with a flight data recorder system that records, at a minimum the parameters required by Federal Aviation Administration Final Rules 12 1.344 and 125.226, dated July 17, 1997, applicable to that airplane plus the following parameters: pitch trim; trailing edge and leading edge flaps; thrust reverser position (each engine); yaw damper command; yaw damper on/off discrete; standby rudder on/off discrete; and control wheel, control column, and rudder pedal forces (with yaw damper command; yaw damper on/off discrete; and control wheel, control column, and rudder pedal forces sampled at a minimum rate of twice per second). (Safety Recommendation A-99-29)

The proposed requirements, as drafted, would satisfy Safety Recommendations A-99-28 and -29, except for the slight modification of the compliance dates and the number of flight control input force sensors. The Safety Board recognizes the rationale for the proposed modification of the compliance dates for retrofit of 737s with and without flight data acquisition units (FDAUs) to August 18, 2000, and August 20, 2001, respectively, to coincide with the 1997 regulation, Although the Safety Board would prefer a compliance date of August 20, 2001, for all 737s, we understand the FAA's decision to extend the compliance period to August 19, 2002, for those airplanes that installed a FDAU between July 16, 1996, and November 18, 1999, in order to meet the 1997 regulations. The proposal to allow one force sensor per airplane axis to measure flight control input forces, however, would hinder the ability of investigators to differentiate crew actions from anomalies in the flight control system. This ability to differentiate is central to the Safety Board's recommendations.

The actual rudder pedal force exerted by each crewmember is critical to understanding the loss of control problems experienced by the 737. The measurement of rudder pedal force for all four pedals will allow investigators to isolate the pedal force of each crewmember from inputs by airplane systems. A single sensor placed "midstream" in the rudder control system, as

proposed by Boeing, would not identify whether the crew inputs were in opposition to each other or whether the nose wheel steering or some other system anomaly forward of the sensor caused the inputs. In addition, any jams in the controls between the pedals and the sensor may go undetected because the force exerted by the crew would not be registered by the sensor. Therefore, if the upgrade requires only a single force sensor in the rudder system, the possibility will remain that the information recorded would not be sufficient to identify some future flight control problems even after the proposed retrofit.

The Safety Board appreciates that Boeing has made significant design changes in the 737 rudder system, both in the next-generation models and through retrofits to the 737-100 through -500 series airplanes. Even with these changes, however, the complexity of the 737 rudder system and its lack of redundancy provide the potential for multiple, unforeseen failure mechanisms that could be catastrophic.

Incidents involving flight control anomalies continue to occur. For example, on February 23, 1999, a Boeing 737-200, registration N282AU, operated as MetroJet (USAir) flight 2710, experienced a rudder deflection and made an emergency landing at Baltimore-Washington International (BWI) airport. The airplane was equipped with an 1 l-parameter flight data recorder; no control surface positions were recorded and the only cockpit flight control information was control column position. Although the investigation is continuing, the pilots reported an "out of control rudder" to air traffic control, and the Safety Board's flight simulation work indicates that there was a sustained; slow moving rudder to maximum blowdown deflection during the flight that has so far remained unexplained. Further, not knowing rudder pedal force has made it impossible to separate pilot actions from rudder system anomalies.

The Safety Board notes that, as it recommended, the FAA has proposed an increase in sampling rates for parameter 88, "All Cockpit Flight Control Input Forces," contained in Part 121, Appendix M, and Part 125, Appendix E, for Boeing 737 airplanes. The Board also notes that the FAA further proposes that the "remarks" section of parameter 88 should not apply to 737s. However, the "remarks" section covers more than sampling rate requirements; it also covers a requirement to record both control force inputs for those airplanes that have a flight control breakaway capability that allows either pilot to independently operate the control. This latter requirement should still apply to 737s. Although concerns had existed that current control force sensors would not meet the range and accuracy requirements of the proposed rule, suitable control force sensors are likely to be available by the compliance dates. Therefore, the Safety Board contends that separate sensors to measure the pilot and copilot flight control input forces must be used when breakaway features are employed.

In summary, the Safety Board agrees with the general parameter requirements and the modified compliance dates. However, given the long and contentious history associated with uncommanded rudder movements on Boeing 737 airplanes, another catastrophic crash of a 737 in which the actions of the crew or airplane systems cannot be differentiated as the source of the rudder movement would be intolerable. Therefore, the Safety Board urges the FAA to reconsider its position and require pilot and copilot input forces to be measured with separate sensors for each control wheel, each control column, and each rudder pedal.

We appreciate the opportunity to comment on this important rulemaking activity and urge the FAA to act on the Board's comments to the NPRM and to expedite the issuance of the final rule.

Sincerely,

Jim Hall
Chairman