National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: May 16, 2003

In reply refer to: A-03-15 and A-03-16

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

Recent investigations in the United States and the United Kingdom have revealed problems with the quality of digital flight data recorder (DFDR) data recorded by the following regional jet airplanes: the Embraer 135 and 145, the Canadair CL-600, and the Fairchild Dornier 328. Although the DFDR systems installed on these airplanes appear on the surface to meet the requirements of 14 *Code of Federal Regulations* (CFR) 121.344, Appendix M, a close examination of the recorded data reveals that the output from units supplying data to the DFDR systems in those airplanes is not being updated at a rate sufficient to meet DFDR sampling rate requirements. That is, the DFDRs are recording data at a higher rate than the data source is being updated. As a result, repeated values are found in consecutive DFDR samples.

This problem first came to light during the United Kingdom's Air Accidents Investigation Branch (AAIB) investigation of a September 6, 2001, accident involving an Embraer 145 regional jet. As a result of this investigation, the AAIB issued Safety Recommendations 2002-01 through -04 to the Centro Tecnico Aeroespacial (CTA) of Brazil and to the Civil Aviation Authority (CAA) of the United Kingdom. The recommendations, stated below, focused on the repetition of recorded values for mandatory parameters that are sampled and recorded more than once per second:

> As a matter of urgency, the Centro Tecnico Aeroespacial (CTA) of Brazil should require Embraer and the manufacturers of the flight data recording installation to investigate the nature and extent of the recording anomalies associated with the EMB 145 DFDR installation, to correct them on existing and future aircraft, and subsequently demonstrate that the DFDR faithfully records the time histories of the data transducer outputs. The CAA as part of its JAA [Joint Aviation Authorities] activities should monitor this process. (Recommendation 2002-01)

The CAA should liase with Embraer to ensure that the DFDR installations on all UK registered Embraer aircraft meet applicable UK regulatory requirements. (Recommendation 2002-02)

The CTA of Brazil should bring the EMB 145 DFDR anomalies to the attention of other national regulatory authorities**.** (Recommendation 2002-03)

The CAA should ensure that other aircraft types operating on the UK register and fitted with similar flight data recording installations meet UK regulatory requirements. (Recommendation 2002-04)

The National Transportation Safety Board has read out DFDRs from seven other Embraer 145 aircraft and found the same problems detailed in the AAIB recommendations. We have also reviewed data from several Embraer 135 aircraft and found the same repetition of recorded values for parameters sampled more than once per second. This is clearly not in compliance with 14 CFR Part 121.344, Appendix M. The Safety Board is concerned that this problem has the potential of severely hindering future Safety Board investigations.

As stated earlier, this DFDR problem is not unique to Embraer regional jets. On November 17, 2002, about 1800 eastern standard time, a Canadair CL-600-2B19 (CRJ-2), N868CA, operated by Comair as Delta Connection flight 5109, encountered turbulence while in a descent near Rockville, Virginia. The flight was enroute from The William B. Hartsfield Atlanta International Airport, Atlanta, Georgia, and was destined for Ronald Reagan Washington National Airport, Washington, D.C. During their examination of the DFDR after the incident, Safety Board investigators noticed that several key mandatory parameters had not been updated as often as the Federal Aviation Regulations (FAR) require. Specifically, the vertical acceleration values, which are required to be accurately recorded 8 times per second, had been supplied by a data source that was updated only 5 times per second. As a result, approximately every other vertical acceleration value was the same as the previous value. Investigators also noticed that the data source for the pitch attitude parameter, which is required to be sampled 4 times per second, had been updated only twice per second. Several other parameters that are required to be sampled more than once per second were also suspected of having data sources that had not been updated at the rates stipulated by the FAR.

In this instance, the recording of repeating or stale values significantly hampered the investigation by failing to provide data sufficient to determine the severity of in-flight turbulence. The good values that were recorded indicated that the aircraft had experienced wing loading that approached structural limit, but because the turbulence event was very short and the sampling of vertical acceleration values was inadequate, investigators were uncertain if the DFDR captured the peak acceleration. Due to this uncertainty, the FAA required the carrier to conduct an extensive inspection of the aircraft prior to returning it to scheduled service.

As part of its investigation of the Delta Connection flight 5109 incident, the Safety Board also reviewed DFDR data from several other Canadair CL-600 accidents. The DFDR data recovered from these aircraft exhibited the same data-sampling problem that was identified in the flight 5109 accident. The Board discovered that this under-sampling problem also existed on a

derivative of the CL-600 regional jet, the Canadair Challenger 600-2B16 aircraft, which is marketed as a corporate business aircraft.

On May 2, 2002, at 0830 eastern daylight time, the crew of a Fairchild Dornier 328-300, N429FJ, operated by Atlantic Coast Airlines, doing business as Delta Connection flight 6110, reported a strong odor of smoke in the cockpit. The captain declared an emergency and landed without incident at Atlantic City International Airport, Atlantic City, New Jersey. During the investigation of this incident, the Safety Board examined the DFDR from this aircraft and several other Dornier 328 aircraft. They discovered that this series of aircraft exhibits DFDR abnormalities identical to the ones found on the Embraer 145/135 and the Canadair CL600 series of aircraft.

All of the aforementioned airplanes are fitted with state-of-the-art glass cockpits that use cathode ray tubes (CRT) or equivalent cockpit display units (CDU) to display primary flight instruments, engine indicators, and crew alerts. To drive these CDUs, the manufacturers have installed a display concentrator unit that assembles all of the sensor data prior to sending it to the displays in the cockpit. These data concentrators are also used to assemble the data for the DFDRs, replacing some functions performed by the more traditional digital flight data acquisition unit (DFDAU). The Safety Board has determined that the display concentrators on these regional jets are programmed so that the data stream output to the DFDR is not updated at a rate sufficient to meet FAR data sampling requirements.

Regional jets comprise the fastest-growing segment of aircraft in commercial aviation. The Safety Board believes that the problem of output data being updated at a rate insufficient to meet DFDR sampling rate requirements warrants the FAA's immediate attention. Over the past 3 years, the Safety Board has investigated 21 regional jet accidents and incidents. In all of these investigations, the Safety Board relied heavily on the information provided by the DFDR in determining the probable cause. DFDR data must be conclusive and accurate for the Board to accurately recommend steps to improve the reliability and the safety of this category of aircraft. The Board therefore believes that the FAA should require that all Embraer 145, Embraer 135, Canadair CL-600 RJ, Canadair Challenger CL-600, and Fairchild Dornier 328-300 airplanes be modified with a DFDR system that meets the sampling rate, range, and accuracy requirements specified in 14 CFR Part 121.344, Appendix M.

Finally, to ensure that DFDR parameters are properly recorded so that future accident investigations will not be hindered by inadequate or repeating data, immediate corrective action is necessary to bring these regional jet airplanes into compliance with existing regulations. Therefore, the Safety Board believes that the FAA should survey all aircraft required by Federal regulation to have a flight data recorder to ensure that the data recorded meets the rate, range, and accuracy requirements specified in 14 CFR 121.344, Appendix M.

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

Require that all Embraer 145, Embraer 135, Canadair CL-600 RJ, Canadair Challenger CL-600, and Fairchild Dornier 328-300 airplanes be modified with a digital flight data recorder system that meets the sampling rate, range, and accuracy requirements specified in 14 *Code of Federal Regulations* Part 121.344, Appendix M. (A-03-15)

Survey all aircraft required by Federal regulation to have a flight data recorder to ensure that the data recorded meets the rate, range, and accuracy requirements specified in 14 *Code of Federal Regulations* 121.344, Appendix M. (A-03-16)

Vice Chairman ROSENKER, and Members CARMODY, GOGLIA, and HEALING concurred with these recommendations.

Original Signed

By: Ellen G. Engleman
Chairman

Safety Recommendation Reiteration List

SR Number	Reiteration Number	Report Number	Report Date	Accident Description	Accident City	Accident State	Accident Date
A-03-015	1	AAR-07-02	1/23/2007	Crash During Approach to Landing, Circuit City Stores, Inc., Cessna Citation 560, N500AT	Pueblo	CO	2/16/2005

Safety Recommendation Reiteration List

SR Number	Reiteration Number	Report Number	Report Date	Accident Description	Accident City	Accident State	Accident Date
A-03-016	1	AAR-05-01	5/17/2005	Hard Landing, Gear Collapse Federal Express Flight 647, Boeing MD-10-10F, N364FE	Memphis	TN	12/18/2003