



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: December 15, 1999

In reply refer to: A-99-104 through -106

Honorable Jane F. Garvey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On November 11, 1998, about 2100 eastern standard time, a fire erupted in the forward cargo compartment of a Delta Air Lines McDonnell Douglas MD-11, N811DE, while the airplane was parked at a gate at Hartsfield International Airport, Atlanta, Georgia. No passengers or crewmembers were aboard the airplane at the time, and the airplane sustained minor damage. It was destined for Boston, Massachusetts, as a scheduled passenger flight under the provisions of 14 Code of Federal Regulations Part 121.

The National Transportation Safety Board's investigation of the incident revealed that the fire propagated from the forward cargo control unit (CCU)¹ to an insulation blanket located directly behind it. The CCU is mounted to fuselage structure outboard of the left-hand cargo sidewall liner, across from the cargo door. Examination of the CCU, which is manufactured by Lucas Aerospace Cargo Systems (Lucas), revealed that wiring damage to an external electrical connector² led to an excessive electrical current when power was applied to the unit. As a result, several electrical pins inside the CCU were vaporized, which created hot gases that escaped through the CCU's back cover and ignited the adjacent Mylar-covered insulation blanket. The pins are designed to distribute electrical power from the airplane's 115-volt AC ground power bus to the CCU's printed circuit "motherboard" assembly but were incapable of adequately conducting the excessive current spike.

According to Lucas, the original CCU motherboard electrical pins have undersized diameters and use a copper alloy that has higher resistance than desired. Lucas identified this

¹ The CCU is part of the electric cargo loading system. It receives 115-volt, 3-phase alternating current via a ground power bus, distributes the power throughout the system, and provides the switching logic that commands electrically powered rollers that are mounted throughout the cargo floor. The CCU is protected by ten 10-ampere (amp) circuit breakers.

² The connector had been disconnected for maintenance from a floor-mounted powered roller unit located several feet from the CCU, and its connector plug wires were severed during a subsequent cargo loading operation.

problem before the Atlanta incident and began installing upgraded connector pins on newly assembled CCUs. The upgraded pin is larger in diameter and has greater electrical conductivity, which, according to Lucas, enables it to consistently sustain at least 600-ampere (amp) current spikes until the 10-amp aircraft circuit breaker trips. Lucas also released Service Bulletin (SB) 462650-25-01 on April 17, 1998, which recommended “replacing the motherboard...at the next aircraft layover where the maintenance action can be accomplished...to reduce the chances of secondary damage...as a result of an external short to ground.” However, the CCU involved in the Atlanta incident had not yet been modified in accordance with the SB.

According to data provided by Lucas, 48 CCU failures involving pin failures and other internal electrical faults have been reported since 1993. All but one of the pin failures involved the original pin design, and two of these failures were associated with hot gases escaping the CCU.

In addition to the Atlanta incident, the Safety Board is investigating two other MD-11 incidents involving failures of the Lucas cargo control system and subsequent external thermal damage. The most recent incident was reported on March 29, 1999, when maintenance personnel in San Bernardino, California, discovered evidence of a fire while removing several floorboards on a World Airways MD-11, N274WA. The Safety Board’s investigation revealed that the insulation blanket between fuselage stations 1661 and 1681 was burned. A detailed inspection of the area revealed that a wiring harness was routed onto frame 1681 without the required support bracket/clamp, which allowed a wire bundle to chafe against the frame.³ Evidence of arcing was also present on the wire bundle and the frame. The inspection also revealed failure of the CCU’s electrical pins, which had not yet been modified in accordance with the Lucas SB.

Although the investigation of the San Bernardino incident revealed that the fire did not originate in the CCU, the Safety Board is nonetheless concerned that CCUs not yet modified in compliance with SB 462650-25-01 could experience connector pin failures and external thermal damage, which could lead to the ignition of the adjacent Mylar-covered insulation blanket.⁴ The Safety Board is also concerned about the risks of a CCU-related fire during passenger loading and unloading and that a ground fire could propagate without detection until an airplane is airborne. Therefore, the Safety Board believes that the FAA should issue an airworthiness directive (AD) requiring MD-11 operators to modify their CCUs in accordance with Lucas SB 462650-25-01.

³ As a result of the Safety Board’s investigation of this incident, the Federal Aviation Administration (FAA) issued Airworthiness Directive (AD) 99-08-51, on April 29, 1999, effective May 3, 1999, which requires visual inspections of certain MD-11 airplanes to verify that a bracket and an open face nylon clamp are installed to support a specific wire bundle, to inspect and repair any damage to the wire bundle, and to install a protective wrap around the wire bundle.

⁴ The FAA published two notices of proposed rulemaking in 64 Federal Register 43963 on August 12, 1999, proposing the adoption of two ADs that are applicable to certain airplanes, including the MD-11, to require that it be determined whether and at what locations Mylar-covered insulation blankets are installed and that they be replaced with new ones. According to the FAA, the proposed ADs are intended to ensure that Mylar-covered insulation blankets are removed from the fuselage to prevent the propagation of fire that could result from an otherwise uneventful electrical arc. The Safety Board has responded to the notices with its full support.

Another incident involving a CCU failure occurred in September 1998, when the CCU of a Varig Airlines MD-11 was damaged while the airplane was parked.⁵ According to information provided by Lucas, evidence of partial melting of the upgraded pins, which Lucas had installed during a prior modification, was found along with evidence that a hole was burned through the CCU's back cover.⁶ Varig reported that no short circuits were found in the system, and Lucas could not determine the primary cause of the damage. Although some of the upgraded connector pins were damaged, Lucas reported that arcing was found on the motherboard and the pin damage was probably secondary.

During its investigations of the Atlanta, San Bernardino, and Varig incidents, the Boeing Commercial Airplane Group's⁷ Product Support Division advised the Safety Board that it is preparing to issue an SB to recommend the installation of a nonflammable material between the CCU and the adjacent Mylar-covered insulation blanket. The Safety Board anticipates that a nonflammable thermal barrier between the CCU and the blanket will significantly decrease the potential for fire if external CCU damage results from shorted wires or internal electrical faults. Moreover, the Board considers the installation of a CCU thermal barrier desirable because aircraft insulation blankets are not designed to provide thermal protection from overheated electrical components. Therefore, the Safety Board believes that the FAA should issue an AD requiring MD-11 operators to install a protective thermal barrier behind the CCU in accordance with Boeing's SB immediately upon its release.

The Safety Board is also concerned that in the Atlanta, San Bernardino, and Varig incidents, the 10-amp circuit breakers did not trip, which may indicate that the CCU's circuit protection is inadequate in MD-11 airplanes. Analysis conducted by Lucas revealed that replacing the 10-amp circuit breakers with 5-amp breakers would provide increased circuit protection in the event of certain electrical faults. Therefore, the Safety Board believes that the FAA should require that Boeing implement improvements to the MD-11 cargo control system circuit protection that would decrease the likelihood of an electrical fire.

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

Issue an airworthiness directive requiring MD-11 operators to modify their cargo control units in accordance with Lucas Service Bulletin 462650-25-01. (A-99-104)

⁵ The Safety Board was not notified about this incident when it occurred but was subsequently informed of it by Lucas in connection with the investigation of the November 11, 1998, Delta Air Lines incident. According to Lucas, Varig submitted the CCU for repair but was not aware of the location and date of the malfunction. The Board reviewed all available information on the Varig incident to determine the consequences of the CCU malfunction but did not issue a report or a brief of the incident.

⁶ This is the only known failure of an upgraded pin.

⁷ Boeing acquired the McDonnell Douglas Corporation in 1997.

Issue an airworthiness directive requiring MD-11 operators to install a protective thermal barrier behind the cargo control unit in accordance with Boeing's service bulletin immediately upon its release. (A-99-105)

Require that Boeing implement improvements to the MD-11 cargo control system circuit protection that would decrease the likelihood of an electrical fire. (A-99-106)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred with these recommendations.

By: Jim Hall
Chairman