National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: March 29, 2002

In reply refer to: A-02-05

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

On March 2, 2002, American Airlines flight 334, a Fokker F.28 Mark 100,[1] experienced an uncontained rupture of the turbine wheel in the AlliedSignal model GTCP36-150RR auxiliary power unit (APU) after deicing fluid entered the APU while the airplane was being deiced at the Dallas-Ft. Worth International Airport, Texas. The interior of the airplane's tailcone sustained damage from the liberated turbine wheel fragments. One fragment of the turbine wheel penetrated the aft pressure bulkhead and became embedded in the first aid kit that is stored directly beneath the flight attendant's aft jump seat in the rear of the airplane's cabin. The event occurred as the airplane was preparing to depart Dallas-Ft. Worth as a scheduled domestic flight to Nashville, Tennessee, in accordance with 14 *Code of Federal Regulations* Part 121. There were no injuries to the passengers and crewmembers.

Generically, APUs are small jet engines equipped with generators and bleed air ports to provide electricity and air to the airplane while it is on the ground. The APU normally operates at 100 percent rpm, but under some circumstances it can quickly accelerate beyond this value, resulting in a hazardous situation. The GTCP36-150RR APU is equipped with an electronic control unit (ECU) that will, among other things, shut down the APU by closing off its supply of fuel if it senses that the speed of the APU rotors is greater than 107 percent rpm. In the F.28 Mark 100, the APU is mounted in the tailcone transversely across the fuselage and directly behind the aft pressure bulkhead. Air for the APU is supplied through an inlet duct on the upper right side of the fuselage just forward of the vertical fin's leading edge.

Examination of the APU by the National Transportation Safety Board at the American Airlines facility in Tulsa, Oklahoma, revealed that the compressor case was ruptured in the plane

[1] The airplane is certificated as the "F.28 Mark 100," but it is commonly called the "F.100."

of the turbine wheel.[2] The turbine wheel was broken into numerous small fragments. The fragments are to undergo a metallurgical examination to determine if fatigue was a factor; however, no evidence of fatigue has been found at this time. Interrogation of the ECU's nonvolatile memory showed that an overspeed had occurred.

On March 6, 2001, an event that was similar to the Dallas-Ft. Worth event occurred on American Airlines flight 581, an F.28 Mark 100, at Dorval International Airport, Montreal, Canada. As in the Dallas-Ft. Worth event, the airplane was being deiced while the APU was operating. The ECU nonvolatile memory showed that the ECU sensed an overspeed and cut off fuel to the APU. However, the rotor continued to accelerate until the turbine wheel burst.

The Type I deicing fluid being used to deice American Airlines flight 334 is an ethylene glycol solution that is combustible when compressed. If deicing fluid enters the APU inlet, it will augment the combustion process. If the APU ingests enough deicing fluid, it will sustain combustion even if the ECU senses an overspeed and cuts off the fuel to the APU. Because the ECU no longer has command of the rotor speed, the APU will continue to accelerate unabated until the turbine wheel bursts.

In February 2001, American Airlines issued a "Winterization Bulletin" for the F.28 Mark 100 airplane, advising that deicing fluid should not be allowed to enter into the APU inlet. Additionally, the F.28 Mark 100 Maintenance Manual, Section 12-31-00, page 301, states, "Do not let de-icing and/or anti-icing fluid/water mixture go into the APU inlet. Injury to persons and/or damage to equipment can occur."

Although its investigation into the event at Dallas-Ft. Worth event is ongoing, the Safety Board is concerned that deicing fluid could inadvertently enter the APU inlet of another F.28 Mark 100, resulting in an uncommanded acceleration of the APU rotors and another turbine wheel rupture. The Board is further concerned that turbine wheel fragments liberated by such an event could penetrate the cabin of the F.28 Mark 100 and injure passengers and crew. The Federal Aviation Administration has advised the Safety Board that the Fokker F.28 Mark 4000 has the same APU and air-inlet configuration as the F.28 Mark 100.

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

> Immediately issue an airworthiness directive for the Fokker F.28 Mark 100 and F.28 Mark 4000 airplanes that prohibits auxiliary power unit operation during deicing operations. (A-02-05) (URGENT)

[2] The turbine wheel and compressor impeller are mounted back-to-back within the compressor case.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT and BLACK concurred in this recommendation. Member GOGLIA disapproved this recommendation and filed the enclosed dissent.

Original Signed

By: Marion Blakey
Chairman

Enclosure

DISSENTING STATEMENT

Notation 7453

Member Goglia, Dissenting;

The safety recommendation to the FAA that an airworthiness directive be issued to prohibit APU operation "during deicing operations" misses the mark. First, it does not address the importance of effective training in deicing and anti-icing applications. We know the critical importance of deicing and anti-icing because there have been numerous accidents related to this activity, the lack of it, or its improper application. Safety would be far better served by a directive that addresses the issue from a broader perspective that holds the prospect of an ongoing higher standard of training for all deicing crews across all fleet types, rather than the correction of a specific shortcoming for a particular aircraft type.

Second, prohibiting the use of the APU during "deicing operations" may have significant unintended consequences.

Again, safety would be better served by having a well-trained deicing crews that are fully trained and comprehend all aspects of this important activity and the consequences of any deviation from approved procedures.

John Goglia, Board Member