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National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 6, 1995

In reply refer to: A-95-71 through -73

Honorable David R. Hinson
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On June 8, 1995, the No. 2 engine of Valujet flight 597, a McDonnell-Douglas DC-9-32, equipped with Pratt & Whitney JT8D-9A engines, experienced an uncontained failure during takeoff at the William B. Hartsfield International Airport, Atlanta, Georgia. Flight 597 was a regularly scheduled passenger flight from Atlanta, Georgia, to Miami, Florida, operating under the provisions of 14 Code of Federal Regulations (CFR) Part 121. On board the airplane were the 2 pilots, 3 flight attendants, and 57 passengers.

After the engine failure, the takeoff was aborted, and the airplane was stopped on the departure runway. Engine fragments penetrated the cabin, struck a fuel line, and initiated a fire that destroyed the airplane. The passengers and crew were evacuated, resulting in one serious and several minor injuries. The aft flight attendant suffered shrapnel injuries and second and third degree burns. There were no fatalities. The rapid progression of the fire leads the Safety Board to conclude that if the airplane had been airborne or if more passengers had been on board, there would most likely have been numerous fatalities because of the fire and the buildup of toxic fumes in the cabin.

The on-going investigation has determined that during the initial takeoff roll, the 7th stage high pressure compressor (HPC) disc on the No. 2 engine failed. Examination of the failed 7th stage disc, part number (P/N) 774407, serial number (S/N) G78851, revealed that the failure originated at one of the shielding holes in the disc. The shielding holes are aligned with the disc tie bolt holes and are designed to redistribute and reduce stress concentrations in the disc. The holes are

below the base of the compressor blades and cannot be inspected without disassembling the engine.

The metallurgical examination showed that the failure was caused by a fatigue crack that originated at a corrosion pit in a shielding hole. There was evidence that the corrosion pit had been plated over during an overhaul of the disc in 1991. Additionally, it appears that the size of the corrosion pit exceeded the allowable limits at the time of the overhaul. Examination of the fatigue crack revealed a minimum of 7,000 to 8,000 fatigue striations. Assuming that each striation represents one "flight cycle," based on the 4,433 flight cycles accumulated since the last inspection, the crack would probably have been detectable by non-destructive testing or by visual inspection at the time that the engine was last overhauled.

Metallurgical examination of the disc also revealed numerous cracks, out-of-limit pitting, and plated-over corrosion in the other shielding holes, in addition to the hole from which the failure originated. Teardown of the engine showed that with the exception of the failed 7th stage disc, the engine appeared to be well maintained and in good condition. Visual inspection of the other discs from the failed engine found no evidence of cracks or abnormal corrosion.

Valujet records showed that the engine was one of a total of 23 acquired from Turk Hava Yollari (THY). THY is a Turkish domestic and international airline and operates an airframe and engine overhaul facility, including JT8D engines, in Istanbul. Valujet purchased 9 DC-9 series airplanes and 5 spare engines for a total of 23 engines. Of these 23 engines, one was involved in the accident, 3 have been overhauled since being acquired, 2 are currently under repair, 2 are awaiting disassembly for overhaul, and 15 have not been overhauled and are in service. To date, no evidence of cracks, out-of-limit pitting, or improper assembly and maintenance have been found in the discs that have been available to the Safety Board for examination.

Follow-on testing for plated-over corrosion and plating thickness is pending. The Safety Board has been informed that at least one other U.S. airline has purchased two engines that were last overhauled by THY.

In 1976, THY was authorized by the Federal Aviation Administration (FAA) to overhaul JT8D series engines. This authorization was reapproved on a bi-annual basis until 1986. At that time, THY decided not to reapply for the FAA authorization because the company had few customers that required their engines

to be overhauled by an FAA-approved facility. In 1994, THY again requested and received FAA certification under 14 CFR Part 145 as a JT8D overhaul facility. Between 1986 and 1994, THY continued to overhaul JT8D engines presumably in accordance with Pratt & Whitney manuals and procedures; however, they received no FAA oversight of their JT8D overhaul capability. THY reports that since 1985, the company has conducted 500 engine overhauls.

Valujet received all of the normal maintenance records upon purchase of the airplanes and engines. The examination of the maintenance records for the accident engine and a review of the importation process found nothing unusual. The records indicate that at the time of the accident, the engine had accumulated 36,601 hours and 32,200 cycles since new and 5,621 hours and 4,433 cycles since overhaul by THY in 1991. The 7th stage disc had originally been installed in another engine and has accumulated 24,101 hours and 16,340 cycles since new. Seventh stage discs installed in JT8D-9A engines have a life limit of 30,000 hours or 20,000 cycles, whichever comes first. The accident disc had a slightly reduced life limit of 30,000 hours and 18,932 cycles because it had originally been installed in a higher rated engine.

The maintenance records indicate that the disc was in storage for an extended period of time in 1991. Whether the disc was stored as spare parts or was installed on a stored spare engine is not known. However, while the records indicate that the part was visually inspected before being placed into service, the corrosion was not detected.

While the maintenance logs show when the engine was overhauled, the process logs or "fly sheets," which provide specific details on each component, were not provided to Valujet with the maintenance records. The process logs would include the dates when the disc was stripped, inspected and replated. The investigation has been unable to obtain copies of this information. However, the records do indicate that when the disc was visually inspected by THY on June 15, 1993, it had accumulated 21,583 hours and 14,360 cycles. The maintenance records do contain notations in the margin of the 7th stage HPC disc component card that indicate a "C" check was accomplished by THY on May 14, 1991. THY has stated that a "C" check involves overhaul and includes stripping, inspecting, and replating of the disc. At that time, it had accumulated 18,477 hours and 11,907 cycles.

Pratt & Whitney engine manuals provide overhaul facilities with inspection guidance, allowable limits for damage, and repair procedures. The Safety Board

believes that the inspection material is quite detailed but that it can be difficult to understand. For instance, it would appear that, per the engine manual, damage, such as a corrosion pit of less than 0.005 inch, can be blended out to a maximum of 0.005 inch and that the disc can be replated and returned to service. However, the Safety Board believes that the maintenance material could also be interpreted to mean that a 0.005-inch pit is allowable before blending. The instructions are also ambiguous in that they provide for inspection of the tie bolt holes and later provide that all holes are to be inspected; however, there is no specific reference to inspecting the shielding holes. Additionally, there can be some confusion as to whether it is necessary to remove the blades to inspect the disc. Such misunderstandings and interpretations can be magnified when translating the instructions from English into another language. The Safety Board believes that the language concerning inspection and damage limits provided in the maintenance manual should be changed to prevent any misunderstanding about the amounts of allowable and repairable damage, and the procedures required for inspecting and repairing the disc and returning it to service.

Thus far, the investigation has been unable to determine whether the accident disc was the only disc that was improperly processed and inspected, or whether a systemic process control problem exists at THY. Additionally, the Safety Board is aware that since this engine was overhauled, THY received an FAA Part 145 approval as an engine overhaul facility. Therefore, the current procedures and processes in effect at THY may not reflect the practices in effect when the engine was overhauled.

The accident involving Valujet flight 597 indicates that there is a potential for a major catastrophic accident because of a failure in the 7th stage HPC disc in certain JT8D engines. The Safety Board believes that safety-of-flight concerns are sufficiently great as to warrant examinations of 7th stage and other steel HPC discs overhauled by THY. Based upon the examination of the failed disc, the Safety Board believes that such an examination should be made before the engines have accumulated 3,000 cycles since the last THY overhaul.

The Safety Board is concerned over the process by which the THY engines were accepted for service in the United States. The investigation has determined that an FAA-designated airworthiness inspector (DAR) was responsible for determining the airworthiness of the airplanes purchased by Valujet. However, Valujet hired the services of a consultant to determine the serviceability of the spare engines, including the accident engine. The consultant examined the serviceability tags provided by THY, the engine records, compliance with

airworthiness directives, and had a borescope examination of the engines conducted after they came to the United States. As previously stated, it is not possible to examine the 7th stage disc in the area of the tie bolt and shielding holes even by the use of a borescope. Since all of the records for the engine were in the Turkish language, the previous 2 years of maintenance records were translated into English. However, since the engines were not overhauled by an FAA-approved facility, the consultant could not have been assured whether all practices and procedures used in the overhaul complied with FAA and Pratt & Whitney specifications. The THY serviceability tags for the accident engine are missing from the Valujet maintenance records and have not been examined by the Safety Board's maintenance records group.

Both the DAR and the consultant might have assumed that THY possessed a valid FAA certificate to overhaul JT8D engines at the time that the accident engine was last overhauled. This would be a relatively easy assumption because the engines were provided with serviceability tags from an FAA-approved facility that by all appearances had held an overhaul certificate since 1974. However, during the time that this engine was overhauled, THY did not have FAA authorization to overhaul JT8D series engines. Thus, there would have been no FAA surveillance of the company's JT8D overhaul procedures or practices for several years before THY's recertification in 1994.

Furthermore, a detailed examination of the engine's history may have been complicated because most of the records were in Turkish. The Safety Board believes that the DAR and the consultant would have had a better understanding of the condition of the engines and the history of their maintenance if more of the records had been in English. The Safety Board believes that additional guidance should be provided to DARs and consultants to ascertain whether facilities that have repaired or overhauled aircraft, aircraft engines and aircraft equipment submitted for acceptance in the United States held the proper FAA certificates at the time the work was accomplished. In either event, the guidance should include the actions to be taken to ensure compliance with the Federal Aviation Regulations.

Therefore, as a result of its investigation of this accident, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Issue an Airworthiness Directive to require the inspection of Pratt & Whitney JT8D engine high pressure compressor steel discs that were last overhauled and maintained by Turk Hava

Yollari of Turkey prior to reaching 3,000 cycles since that last overhaul and inspection. Special attention should be given to the potential for corrosion pitting or cracks in the shielding holes in 7th stage high pressure compressor discs. (Class I, Urgent Action) (A-95-71)

Modify the wording of the inspection and damage limits provided in the Pratt & Whitney manuals and service bulletins for JT8D high pressure compressor steel discs to prevent any misunderstanding of the amount of damage allowed and the procedures required for the repair and return to service of the discs. (Class II, Priority Action) (A-95-72)

Provide additional guidance to designated airworthiness representatives and aviation maintenance personnel to ascertain whether facilities that have repaired or overhauled aircraft, aircraft engines and aircraft equipment submitted for acceptance in the United States held the proper Federal Aviation Administration certificates at the time the work was accomplished. In either event, the guidance should include the actions to be taken to ensure compliance with the Federal Aviation Regulations. (Class II, Priority Action) (A-95-73)

Chairman HALL, Vice Chairman FRANCIS, and Member HAMMERSCHMIDT concurred in these recommendations.

By: Jim Hall
Chairman

Log 2559

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 17, 1995

In reply refer to: A-95-77 and -78

Honorable David R. Hinson
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On July 2, 1994, about 1843 eastern daylight time, a Douglas DC-9-31, N954VJ, operated by USAir, Inc., as flight 1016, collided with trees and a private residence near the Charlotte/Douglas International Airport (CLT), Charlotte, North Carolina, shortly after the flightcrew executed a missed approach from the instrument landing system approach to runway 18R. The captain, first officer, one flight attendant, and one passenger received minor injuries. Two flight attendants and 14 passengers sustained serious injuries. The remaining 37 passengers received fatal injuries. The airplane was destroyed by impact forces and a postcrash fire. Instrument meteorological conditions prevailed at the time of the accident, and an instrument flight rules (IFR) flight plan had been filed. Flight 1016 was being conducted under 14 Code of Federal Regulations (CFR) Part 121 as a regularly scheduled passenger flight from Columbia, South Carolina, to Charlotte.[1]

The National Transportation Safety Board has determined that the probable causes of the accident were: 1) the flightcrew's decision to continue an approach into severe convective activity that was conducive to a microburst; 2) the flightcrew's failure to recognize a windshear situation in a timely manner; 3) the flightcrew's failure to establish and maintain the proper airplane attitude and thrust setting necessary to escape the windshear; and 4) the lack of real-time adverse weather and windshear hazard information dissemination from air traffic control

[1]For more detailed information, read Aircraft Accident Report -- "Flight Into Terrain During Missed Approach, USAir Flight 1016, DC-9-31, N954VJ, Charlotte/Douglas International Airport, Charlotte, North Carolina, July 2, 1994" (NTSB/AAR-95/03)

(ATC), all of which led to an encounter with and failure to escape from a microburst-induced windshear that was produced by a rapidly developing thunderstorm located at the approach end of runway 18R.

Contributing to the accident were: 1) the lack of ATC procedures that would have required the controller to display and issue airport surveillance radar (ASR-9) weather information to the pilots of flight 1016; 2) the Charlotte tower supervisor's failure to properly advise and ensure that all controllers were aware of and reporting the reduction in visibility and the runway visual range value information, and the low level windshear alerts that had occurred in multiple quadrants; 3) the inadequate remedial actions by USAir to ensure adherence to standard operating procedures; and 4) the inadequate software logic in the airplane's windshear warning system that did not provide an alert upon entry into the windshear.

About 1845, the CLT ATC tower activated the "crash phone" linked to the airport fire station (Station 17) and indicated that "we lost a plane on radar - 5 - 5 SOB [Souls on Board]." Eight fire fighters responded with three aircraft rescue and fire fighting (ARFF) trucks (Blaze 1, 2, and 7), and one quick response and command truck (Blaze 5) from the fire station located near the base of the ATC tower. Several fire fighters stated that at the time the equipment was dispatched "it was raining very hard."

The initial notification to the fire station by the ATC tower did not identify any particular location of the downed aircraft because of the restricted visibility; thus, the fire equipment traversed the airport, via taxiway A, searching for evidence of an accident. At 1846:09, the ATC ground controller notified the crew in Blaze 5 "we have a large area of smoke visible from the tower, now it appears to be approximately a quarter mile north of the old hangar that CCAir is using...."

Simultaneous to the ground controller's transmission, the crew of Blaze 5 heard a transmission from the City alarm room indicating that there was a "possible plane crash in the vicinity of Wallace Neel and Old Dowd." The ATC ground controller contacted the crew of Blaze 5 and stated that there were "five zero souls, plus five crew on board." The fire equipment vehicles crossed the airport, and two of the vehicles exited the airport property through a security gate (gate 36) operated by a magnetic key card. The two remaining vehicles were delayed because of difficulties opening gate 36; in fact, they "crashed" through the gate and proceeded to the accident site.

About 4 minutes after the Charlotte ARFF units arrived on scene, the Charlotte Fire Department units arrived at the accident site. The fire fighting efforts proceeded for approximately 5 minutes, using water and aqueous film-forming foam as the extinguishing agents.

The Safety Board is concerned that the response of the ARFF units was delayed because of difficulties experienced in opening airport security gate 36. The Airport Authority later determined that the gate had been functioning properly but had failed to open because the ARFF personnel had passed their magnetic cards through the card readers too quickly.

While the solution to this problem would be for emergency response personnel to pass the gate cards through the card reader more slowly, the ARFF Incident Commander testified at the Safety Board's public hearing that when the gate did open, it did so very slowly. The Safety Board believes that passing a gate card through a card reader too quickly by emergency response personnel, who would normally be anxious and hurried while responding to a disaster, is understandable. However, response time is critical in fighting fires, especially aircraft fires. The time lost in repeatedly trying to open a gate, and then waiting for the gate to retract to the open position, could jeopardize lives.

The Safety Board acknowledges that fences and restricted gate access are required for security at airports; however, devices used to provide this security should not interfere with an expeditious response by emergency personnel. Therefore, the Safety Board believes that the Federal Aviation Administration (FAA) should require that all airports certificated under 14 CFR Part 139 identify gates that ARFF personnel and their equipment might need to access while responding to emergencies. Further, the FAA should require the necessary changes to ensure that ARFF personnel and their equipment can pass through these gates without hesitation or delay. Additionally, the gates that are identified and the procedures required to access them should be included in the Airport Emergency Plan.

The Safety Board is also concerned that CLT remained open and that air carrier operations continued for about 30 minutes after ARFF personnel and equipment were involved in fire fighting and rescue activities at the accident site. Although ARFF units were in close proximity to the airport and could have responded immediately to another emergency, the Safety Board found that all the available ARFF units and personnel were involved in the fire fighting and extrication efforts of USAir flight 1016. As a result, fire extinguishing materials were significantly diminished. The Safety Board believes that if another aircraft

emergency had occurred at the airport, it would have been extremely difficult for ARFF units to respond in a timely and effective manner.

About 2203, on November 22, 1994, Trans World Airlines flight 427, providing scheduled 14 CFR Part 121 service between St. Louis, Missouri, and Denver, Colorado, collided with a Cessna 441, N441KM, at the intersection of runway 30R and taxiway R, at the Lambert-St. Louis International Airport, Bridgeton, Missouri. Flight 427, a McDonnell Douglas DC-9-82, N954U, sustained substantial damage during the collision. The 2 flight crewmembers, an additional crewmember in the cockpit jumpseat, 5 flight attendants, and 124 of the 132 passengers on board evacuated the airplane without injury. The Cessna 441, operated by Superior Aviation Inc., was destroyed, and the commercial pilot and the passenger, who was a rated private pilot, received fatal injuries. The accident occurred during the hours of darkness, and visual meteorological conditions prevailed. Both flights were operating on IFR flight plans. The Cessna was holding in position awaiting takeoff clearance for an intended 14 CFR Part 91 positioning flight to Iron Mountain, Michigan.

Although the accident is still under investigation, the Safety Board found that Lambert-St. Louis International Airport remained open after the accident, and that aircraft movement continued near the accident site. Several radio transmissions to the ATC ground controller from pilots of taxiing airplanes revealed that they were concerned about the possibility of passengers from the accident flight wandering into the paths of taxiing airplanes. After receiving these transmissions, the ground controller stopped aircraft movement in the area. Shortly thereafter, all ground movement on the airport was halted.

The Safety Board believes that because the airport was not closed immediately following the accident, the potential for injury to the evacuated passengers by taxiing airplanes was high. Closing the airport would have allowed controllers to assess the situation and to redirect both airborne and taxiing traffic to areas of the airport that were remote from the accident site. The assessment period could have been brief, and the airport could have been reopened after safe conditions were confirmed by the airport operator.

Therefore, the Safety Board believes that the FAA should provide guidance to all airports certificated under 14 CFR Part 139 that in the event of an accident or significant incident, the airport be closed immediately by either the airport operator and/or the appropriate FAA air traffic facilities through letters of agreement with airport operators. In addition, airports, or portions thereof, should not be reopened until the airport

operator has ensured that: (1) aircraft operating areas are secure; (2) aircraft movement areas that are to be reopened have been properly inspected; and (3) adequate ARFF protection is available for aircraft operations.

Therefore, as a result of its investigation of these accidents, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Require that all 14 CFR 139 certificated airports identify gates that aircraft rescue and fire fighting personnel and their equipment might need to access while responding to emergencies, and make the necessary changes to ensure that emergency personnel and their equipment can pass through these gates without hesitation or delay. Additionally, the gates that are identified and the procedures required to access them should be included in the Airport Emergency Plan. (Class II, Priority Action) (A-95-77)
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> Provide guidance to all 14 CFR 139 certificated airports that in the event of an accident or significant incident, the airport be closed immediately by either the airport operator and/or the appropriate FAA air traffic facilities through letters of agreement with airport operators. Also, specify that the airport, or portions thereof, should not be reopened until the airport operator has ensured that: (1) aircraft operating areas are secure; (2) aircraft movement areas that are to be reopened have been properly inspected; and (3) adequate aircraft rescue and fire fighting protection is available for aircraft operations. (Class II, Priority Action) (A-95-78)

Chairman HALL, Vice Chairman FRANCIS, and Member HAMMERSCHMIDT concurred in these recommendations.

By: Jim Hall
Chairman