National Transportation Safety Board

Washington, D. C. 20594

Safety Recommendation Log 2113

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In reply refer to: A-88-153 through -155

Honorable T. Allan McArtor
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On February 19, 1988, an AVAir Inc. Fairchild Metro III, N622AV, operating as Air Virginia (AVAir) flight 3378, crashed in Cary, North Carolina, shortly after it departed runway 23R at Raleigh Durham International Airport (RDU), Morrisville, North Carolina, with 2 flightcrew members and 10 passengers on board. The airplane struck water within 100 feet of the shoreline of a reservoir, about 5,100 feet west of the midpoint of runway 23R. The airplane was destroyed and all 12 persons on board were killed.[1]

The Safety Board considered the likelihood that a stall avoidance system (SAS) malfunction, specifically an inadvertent stick pusher actuation, occurred in the short time that AVAir 3378 was airborne. The SAS clutch switch was found in the disengage position, and a filament in one of the annunciator panel's two SAS fault indicator light bulbs was found stretched at impact, indicating that the bulb most likely was illuminated at that time. The illuminated bulb also could be explained by the fact that disengaging the SAS clutch by itself will cause the SAS fault bulb to blink; thus, the flightcrew may have begun the flight with the switch in the "off" position. However, the Safety Board considers this unlikely since AVAir required crewmembers to test the SAS in the before-taxi checklist and determine that it was engaged. Because AVAir pilots who had flown with the crewmembers of AVAir 3378 reported that both crewmembers consistently followed the checklists, the crew would have been unlikely to either allow the SAS to be disengaged before flight or to disengage the SAS without an indication of a system fault. Since it is unlikely that the crew would have continued a takeoff beyond the V1 decision speed with a SAS fault indication, the Safety Board concludes that the crew disengaged the SAS in response to what they perceived to be a SAS fault which occurred after V1.

The crew also could have mistakenly perceived a runaway nose-down trim as a malfunctioning stick pusher. Had this occurred, they would likely have responded by disengaging the SAS. However, the frequency of reported instances of Metro III runaway nose-down trim actuations in the service difficulty reports is very low;

[1]For more detailed information, read Aircraft Accident Report--*AVAir Inc. Flight 3378, Fairchild Metro III, SA227 AC, N622AV, Cary, North Carolina, February 19, 1988* (NTSB/AAR-88/10).

therefore, the probability of its occurrence is low. In addition, the trim setting that was found on the airplane was appropriate for an approximate 157-knot climb with neutral control column elevator force.

In the limited visual conditions which existed at the time, the first officer would have been unlikely to visually confirm a trim setting during the climbout. Rather, she could have trimmed the airplane for a 157-knot climb speed shortly after rotation. However, if following entry into the turn, the first officer had not begun to trim nose-up to compensate for the reduction of vertical lift from a 40° to 45° bank angle, the trim could have remained in the nose-down setting that was found after the accident. However, the lack of evidence on the actual performance of the trim system prevents the Safety Board from conclusively determining how the trim setting was achieved.

The Safety Board examined the components of the SAS from N622AV that could be disassembled, but no manifestation of a SAS malfunction was evident. The evidence indicating that the SAS fault light was illuminated makes it highly unlikely that the stick pusher could have actuated. If the light was flashing, then either the servomotor had a fault which would have disabled it or the crew disabled the servomotor. Regardless, the resultant likelihood of the stick pusher inadvertently actuating would have been highly remote. If the SAS fault light had illuminated steadily, then the computer, which would have initiated the illumination of the light, would also have inhibited electrical power to the clutch, thereby preventing the stick pusher from actuating. Although an electrical short could have permitted current to flow to the clutch despite a computer command to the contrary, the evidence of an illuminated SAS fault light indicates that such a short would have occurred concurrently with the particular fault that the computer had initially sensed, a highly improbable occurrence of two simultaneous and unique faults. Thus, the likelihood of an inadvertent stick pusher, itself remote, is even more so in the presence of evidence indicating the occurrence of an illuminated SAS fault light. Further, there were no signs within the capstan of the wratcheting that occurs when a crew attempts to override a SAS stick pusher, which also indicates that there was no unwarranted and uncommanded stick pusher. However, despite this evidence, without a cockpit voice recorder, the Safety Board was unable to determine why the crew disengaged the SAS clutch.

The type of SAS malfunction that could occur can range in severity from the annoying to the potentially catastrophic, e.g., an uncommanded and unwarranted stick pusher. The SAS malfunctions that have been reported in the Metro II and Metro III suggest that the potentially serious malfunctions occur the least often. Most reported incidents were relatively inconsequential insofar as their potential impact on the safety of flight was concerned. These included such faults as a SAS ground test failure and a SAS vane heat failure. Of the potentially serious malfunctions, in particular an unwarranted and uncommanded stick pusher actuation, only one reported instance occurred on climbout in the Metro III type airplane. The Safety Board examined information related to this type of malfunction in a Metro III that was reported to have occurred on approach to Greater Cincinnati International Airport. However, that incident appears to have been a highly unique one in which water contamination in the fuselage of the airplane provided an electrical conduit which first actuated the stick pusher, then prevented the clutch from being disengaged.

N622AV was manufactured after Fairchild incorporated a Federal Aviation Administration (FAA) directed remedy to correct a problem which had produced such actuations, i.e., a tendency in the SAS computers of early Metro airplanes to become

uncalibrated and, as a result, actuate the stick pusher at inappropriate air speeds. This remedy appears to have reduced the frequency of unwarranted stick pusher actuations. Therefore, given the flight profile of AVAir 3378, the lack of marks on the capstan of the airplane, the very low incidence of reported unwarranted and uncommanded stick pushers on climbout in the Metro III, and the indications of an illuminated SAS fault light, the Safety Board believes that AVAir 3378 did not experience an unwarranted stick pusher on takeoff.

However, the point in the flight regime during which a SAS fault occurs also can affect the severity of an occurrence, which under other conditions may have been inconsequential. For example, a fault that occurs when the airplane is close to the ground can lead to potentially more adverse consequences than one that occurs when the airplane is at altitude. Despite the fact that the required response to a SAS fault indication is relatively simple, i.e., disengaging the SAS clutch by means of the toggle switch located on the center pedestal and pulling appropriate circuit breakers, merely disengaging the clutch requires several steps. These include perceiving a fault indication, localizing the fault, recalling the response, locating and then identifying the disengage switch, and finally, moving the switch itself. These actions, which require little time to perform, could distract a crewmember from flight monitoring and control duties, particularly in certain phases of flight. If at the same time the visibility was limited and the airplane was in a high traffic environment, the consequences of that fault could be potentially serious, rather than be merely distracting.

AVAir 3378 flew in what were perhaps the most adverse conditions in which a perceived SAS fault could occur. The airplane was close to the ground, in a busy terminal area, and in instrument meteorological conditions. As a result, the crew needed a high degree of concentration to fly the airplane solely by reference to the instruments and coordinate routine in-flight duties, such as responding to air traffic control clearances. At the same time, they would have been performing activities, such as retracting the gear, while attempting to respond to a perceived SAS fault.

Given these conditions, a SAS malfunction at any point in the flight of AVAir 3378, regardless of whether it actually occurred or was perceived to have occurred, could have distracted the crew when such a distraction could be least afforded. Yet, because of what the crew believed to be potential catastrophic consequences of an uncommanded and unwarranted stick pusher inherent in a perceived SAS fault, they had to take immediate action in response. The response, therefore, was required irrespective of the phase or circumstance of flight that they were in because the approved Fairchild and AVAir Metro flight manuals failed to mention that a SAS fault indicated by an illuminated warning on the annunciator panel does not require an immediate pilot response in all circumstances. Rather, because the same computer action that causes the fault light to illuminate also inhibits the SAS clutch or indicates the presence of an inhibited clutch, the likelihood of an inadvertent stick pusher actuating when a SAS fault is indicated is highly unlikely.

The Safety Board believes that an illuminated SAS fault light should properly be treated as a cautionary warning and not an emergency which requires an immediate response. Although the Safety Board agrees with the manufacturer, Fairchild, that a prudent response to a SAS fault is to disengage the system, the very probability of an inadvertent stick pusher actuation in the presence of an illuminated SAS fault light mitigates against an immediate universal response which could divert crew attention from more critical tasks. Therefore, the Safety Board believes that the Federal Aviation Administration (FAA) should review the approved flight manual of the

Fairchild Metro airplane with regard to flightcrew response to an illuminated SAS fault and, if necessary, revise it to reflect the cautionary, nonemergency nature of a SAS fault which requires a response after more immediate flight monitoring and control duties have been completed.

Since the crew of AVAir 3378 was, most likely, unaware of the cautionary nature of the SAS fault, they were required by the flight manual to immediately respond to the perceived fault. The Safety Board believes that, irrespective of the actual nature of the perceived SAS fault, due to the particular circumstances of this flight, a perceived SAS fault distracted the crew, compromised their ability to monitor the instruments and to control the airplane, and, as a result, contributed to the cause of the accident.

The Safety Board believes that the potential benefit the SAS provides to airplane stability in the early stages of a stall may be outweighed by the potentially adverse consequences of a system fault during critical phases of flight. Since the Metro III airplane with its larger wing span, more powerful engines, and more efficient propellers is inherently more stable than its Metro II predecessor, the need for such a system on the Metro III is questionable. Therefore, the Safety Board urges the FAA to conduct flight tests in the Metro III airplane to determine the extent to which the SAS stick pusher enhances the airplane's flight characteristics in the stall regime. If the tests fail to demonstrate the need for the stick pusher, then the stick pusher should be permanently disengaged on all Metro III airplanes.

The Safety Board believes that AVAir management created extraordinary conditions for the company, from early 1987 to the time of the accident, which limited its ability to adequately oversee its operations. During that time, AVAir moved its operations base several hundred miles, experienced considerable turnover in the management of its pilot operations as well as in its pilot ranks, acquired and then phased out a new and considerably more complex aircraft type, dramatically increased its number of pilots, intensively trained pilots, furloughed pilots, significantly expanded its route structure, significantly reduced its route structure, sustained a major accident, and finally, filed for bankruptcy.

During the time that AVAir experienced a high degree of turnover within its management, the FAA also experienced a high turnover rate among personnel from its Richmond, Virginia (RIC) and RDU offices who were assigned to oversee AVAir. The FAA turnover was due primarily to a variety of circumstances that were largely outside the control of any individual, such as the illness of the principal operations inspector (POI) who had been assigned to oversee AVAir since its inception. With the subsequent relocation of the company's operations base to RDU, the FAA transferred the responsibility for surveilling AVAir from RIC to RDU. Although this move was consistent with the FAA's policy of locating the surveilling office physically close to the operator under surveillance, the move caused further turnover in surveillance personnel. As a result, in a relatively brief period, several FAA inspectors needed time to familiarize themselves with AVAir and its operations. Unfortunately, this inconsistency in FAA's surveillance of AVAir occurred at a time when consistency was most required due to the turnover within the company's management.

Nevertheless, given the inherent limitations to the quality of the FAA's surveillance of AVAir caused by the turnover in personnel, the Safety Board believes that the efforts of the POI at the RIC flight standards district office to achieve a high level of surveillance were commendable, particularly since it occurred at a time when AVAir was undergoing rapid expansion and implementing intensive pilot training. The POI not only performed the routine, necessary surveillance of an expanding operator, but he also oversaw the operator's acquisition of the SD3-30 airplane and its operation under 14 CFR Part 121 rules.

On the other hand, the Safety Board believes that following the transfer of AVAir's certificate to RDU, the surveillance performance by the FAA achieved a low level in its quality and frequency. Considering the events that occurred to AVAir in just the 2 months before the accident, including a near fatal accident, bankruptcy, cessation of operations, and resumption of operations, the Safety Board is at a loss to explain why there is no record that the POI performed an en route inspection of an AVAir flight, observed a flight training session or a check ride, met the chief pilot or the manager of training, or even visited the company headquarters. If the POI was unwilling or unable to perform the necessary surveillance, then his supervisor should have taken the necessary action to ensure that AVAir was receiving the level of surveillance warranted by a major 14 CFR Part 135 carrier that was undergoing significant management and operational changes.

The Safety Board believes that, at a minimum, FAA surveillance should have been increased as a result of the rapid expansion of AVAir, as well as the subsequent financial distress of the company. The FAA provides POIs of 14 CFR Part 121 operations with manifestations of financial distress that indicate when additional surveillance may be warranted. Unfortunately, no such indicators are distributed to POIs of 14 CFR Part 135 operators. Additionally, indicators of rapid growth are not distributed to any POIs. AVAir displayed several indices of rapid growth and financial difficulty that should have been manifest to its POI. It began to furlough pilots, it phased out airplanes shortly after it had acquired them, and it contracted its route structure having just completed a major route expansion. The Safety Board believes that aviation safety would be enhanced if the FAA provided POIs of operators under 14 CFR Parts 135 and 121 with similar indicators of financial and rapid growth which suggest when increased surveillance of those operators is warranted.

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

> Review the approved flight manual of the Fairchild Metro airplane with regard to flightcrew response to an illuminated stall avoidance system fault, and revise it, as appropriate, to reflect its cautionary nature. (Class II, Priority Action) (A-88-153)
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> Conduct a special airworthiness review of the Metro III airplane, and determine the necessity of the stall avoidance system stick pusher. If the tests fail to demonstrate the need for the stick pusher, then the stick pusher should be permanently disengaged on all Metro III airplanes. (Class II, Priority Action) (A-88-154)

Provide principal operations inspectors of operators under 14 CFR Parts 135 and 121 with similar indicators of financial distress and rapid growth which suggest when increased surveillance of those operators is warranted. (Class II, Priority Action) (A-88-155)

KOLSTAD, Acting Chairman, and BURNETT, LAUBER, NALL, and DICKINSON, Members, concurred in these recommendations.

By: James L. Kolstad
Acting Chairman