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National Transportation Safety Board

Washington D.C. 20594

Safety Recommendation

Date: DEC - 3 1996

In reply refer to: A-96-128 through -140

Honorable Linda Hall Daschle
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

On November 12, 1995, at 0055 eastern standard time a McDonnell Douglas MD-83, N566AA, owned by American Airlines (AAL) and operated as flight 1572, was substantially damaged when it impacted trees in East Granby, Connecticut, while on approach to runway 15 at Bradley International Airport (BDL), Windsor Locks, Connecticut. The airplane also impacted an instrument landing system antenna as it landed short of the runway on grassy, even terrain. Flight 1572 was being conducted under Title 14 Code of Federal Regulations, Part 121, as a scheduled passenger flight from Chicago, Illinois, to BDL.[1]

The National Transportation Safety Board has determined that the probable cause of this accident was the flightcrew's failure to maintain the

[1]For more detailed information, read Aircraft Accident Report—"Collision with Trees on Final Approach, American Airlines, Inc., McDonnell Douglas MD-83, N566AA, East Granby, Connecticut, November 12, 1995" (NTSB/AAR-96/05)

required minimum descent altitude (MDA) until the required visual references identifiable with the runway were in sight. Contributing factors were the failure of the BDL approach controller to furnish the flightcrew with a current altimeter setting, and the flightcrew's failure to ask for a more current setting.

As a result of the overall circumstances of this accident, the Safety Board has concluded that there is great value in flying non-precision approaches with a constant rate or angle of descent until the airport environment can be visually acquired, if the avionics aboard the airplane can safely support such a procedure. Therefore, the Safety Board believes that the Federal Aviation Administration (FAA) should evaluate terminal instrument procedures (TERPS) design criteria for non-precision approaches to consider the incorporation of a constant rate or constant angle of descent to MDA in lieu of step-down criteria.

On another issue, based on evidence found during the investigation, the Safety Board has concluded that FAA quality control was inadequate for accurately resolving the height of the ridge line trees involved in this accident. More specifically, the manner in which the procedures specialists in the FAA's Office of Aviation System Standards (AVN-100) evaluated the obstacles on the instrument approach was markedly different from that of the flight procedures inspectors in the Flight Inspection Area Office (FIAO). As a result, it was possible for a different conclusion to be reached concerning the height of obstacles along the flightpath.

As part of AVN-100, procedures specialists design an approach based on charting methodology rather than actual physical surveys to determine obstacle clearance surfaces. The specialists never directly measure obstacle heights, glidepath angles, and other variables when they design an approach; rather, they rely on graphs, charts, maps, and tables of information to do so. During the initial development of the BDL VOR [very high frequency omnidirectional radio range] runway 15 approach, the procedures specialist determined, based on charts, that a 55-foot obstruction existed within the required obstacle clearance plane of the visual approach slope indicator (VASI). Further, if a visual descent point (VDP) were to be established at the intersection of the VASI with the MDA, the same obstruction would penetrate the required obstacle clearance plane by 55

feet. This was inconsistent with the FIAO determination, both during the approach development and after the accident by means of flight inspection, that the obstacle clearance plane was not penetrated by the ridge line and trees.

Order 8260.19C, paragraph 430, states, in part:

> Establish a VDP on a non-precision approach, providing the [standard instrument approach procedure] SIAP meets the requirements of TERPS....

But, paragraph 432, further states, in part:

> If a VDP is not established, give the reason; e. g., obstacles....

An examination of FAA records revealed no reason for the absence of a VDP for the approach to runway 15 at BDL.

If the VASI geometry designed by the procedures specialist indicated an encroachment by obstacles of 55 feet, then FAA procedures should have required re-examination of the approach to determine the adequacy of clearance, and the VASI should have been moved or decommissioned until the required obstacles were removed. If, on the other hand, the VASI obstruction clearance plane was "clear," then in the Safety Board's opinion, an appropriately located VDP should have been placed on the approach plate to provide flightcrews with an appropriate DME [distance measuring equipment] fix from which a visual descent for landing could be made more safely. Based on TERPS criteria for VDP location, the DME fix for the VDP should be located on the flightpath past the ridge line and trees. This would provide flightcrews with adequate required obstacle clearance and a defined point from which a visual descent could be made past the ridge line. It would also tend to keep approaching airplanes at a safer altitude until after passing the ridge line where they would begin their descents to the MDA.

In spite of procedures that required the FIAO to coordinate with the flight procedures specialists in the event of data or charting errors, such coordination apparently was never effectively accomplished. Therefore, the

Safety Board believes that the FAA should examine and make more effective the coordinating efforts of the flight inspection program and the procedures development program, with emphasis placed on ensuring quality control during the development, amendment, and flight inspection process for instrument approaches.

On a related matter, Safety Board investigators found that the TERPS Handbook states that consideration should be given to induced altimeter errors and pilot control problems in precipitous terrain that may result when winds are 20 knots or more over such terrain. No changes to the instrument approach procedure for runway 15 at BDL were made to account for precipitous terrain. Moreover, precipitous terrain is not defined in the TERPS Handbook. However, the BDL runway 15 approach is used primarily when the speed and direction of winds preclude the use of the primary runway 06/24. These conditions are likely to result in wind velocities in excess of 20 knots over the ridge line, which occurred the night of the accident. Such winds can adversely affect airplane altimetry. Although it does not appear to have been a factor in this accident, the Safety Board concludes that the FAA should have, but did not, consider the issue of precipitous terrain when developing and modifying the approach to runway 15. Therefore, the Safety Board believes that the FAA should incorporate precipitous terrain adjustments in the runway 15 approach.

In addition, the Safety Board believes that the FAA should include a more comprehensive set of guidelines concerning precipitous terrain adjustments in the TERPS (FAA Order 8260.3B) Handbook, clarifying the definition of precipitous terrain, and establishing defined criteria for addressing the potential effects of such terrain.

The investigation revealed that FAA flight inspections of instrument approaches are not normally flown during adverse wind and turbulence conditions, such as those on the night of the accident, because the flight inspection pilots must fly under visual flight rules (VFR) to observe man-made obstacles and high terrain. Therefore, the flight inspectors may not be fully aware of how such adverse conditions affect the safety of a particular instrument approach. Because the Safety Board is concerned that non-precision approaches at airports other than BDL may be adversely affected by wind and turbulence associated with precipitous terrain, the Safety Board

believes that the FAA should review and evaluate the appropriateness of the let-down altitudes for all non-precision approaches that have significant terrain features along the approach course between the initial approach fix and the runway. Airline safety departments and pilot labor organizations, such as the Allied Pilots Association and the Air Line Pilots Association, should be consulted as part of this review. In addition, the Safety Board believes that the FAA should solicit and record user comments about difficulties encountered in flying a particular approach to evaluate approach design more accurately.

On another issue, investigators found that the approach controller is required to issue the QNH (above sea level) altimeter setting on initial contact with an arriving flight, in accordance with the Air Traffic Control Handbook, FAA Order 7110.65. AAL flight 1572 first contacted the approach controller at 0043:41. The controller should have issued the current altimeter setting of 29.38 inches Hg. at that time. The controller said that the omission was inadvertent. If the controller had issued the current altimeter setting on initial contact, the aircraft would most likely have been 40 feet higher than it actually was when it struck the trees.[2] The survey of tree heights that was performed shortly after the accident indicated that the trees in the area of initial impact were approximately 60 feet tall. Therefore, an additional 40 feet might have given the aircraft enough clearance to miss the trees on the downslope of the ridge.

This investigation highlights the fact that there is no requirement for an approach controller to issue an altimeter change to an aircraft after the initial contact. However, considering the fact that the pressure changes were described by the weather observer as "pressure falling rapidly," and especially in light of the controller's failure to issue the current altimeter setting (29.38 inches Hg.) upon initial radio contact and his 0044:34 entry of 29.34 inches Hg. in the ARTS system while the accident aircraft was on his frequency,[3] the Safety Board concludes that it would have been prudent

[2]The altimeter setting of 29.42 inches Hg. (the QNH equivalent of the 29.23 inches Hg. QFE setting the flightcrew was using on final approach) minus 29.38 inches Hg. equals .04, or 40 feet of indicated altitude.

[3]When he entered 29.34 inches Hg., the controller should have recognized that this was a substantially lower barometer reading than existed when the accident airplane

for the approach controller to have issued the altimeter setting changes as the airplane neared the airport. The latest altimeter setting available to the approach controller while the accident flight was on his frequency was 29.36 inches of Hg. If the flightcrew had received and correctly entered this setting, it would have resulted in the airplane being approximately 60 feet higher and most likely enabling it to clear the trees on the ridge line.

This accident illustrates the safety hazards that may result when flightcrews of landing aircraft are not informed of current altimeter settings in circumstances of rapidly falling atmospheric pressure. Therefore, the Safety Board believes that for arriving aircraft executing instrument approaches at all airports, during periods in which the weather observer has included in the weather report the remark, "pressure falling rapidly," controllers should be required to issue, as frequently as practical, altimeter setting changes to flightcrews in addition to the altimeter setting issued on initial contact.

On a related issue, automatic terminal information service (ATIS) information Victor, based on 2251 eastern standard time weather, from a weather observation taken almost 2 hours before the accident, was broadcast continually throughout the time of the accident. Because of the age of the observation, ATIS Victor was of little use to flights in the area of BDL. The Safety Board concludes that the tower controller being relieved should have advised the relieving controller that the ATIS needed to be updated, even if it meant that they had to use the airport police to tell the weather observer to call the tower with more current weather. Although the failure to update the ATIS was not a factor in this accident, this failure raises concerns because of the potential hazards of not having current weather information available for flights inbound to BDL. Therefore, the Safety Board believes that the FAA should revise Facility Operation and Administration handbook 7210.3, or other appropriate orders, to require that when a tower shuts down for any reason, and if the tower controllers have time to record a new ATIS indicating that the tower is closed, they should do so.

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initially reported on the frequency (29.38), and it should have reminded him that he had not provided the flightcrew with a current altimeter setting.

The investigation found that the northwest low level windshear alert system (LLWAS) sensor bordering the airport was physically out of alignment by 38 degrees. The FAA has stated that procedures are in place to check and correct the alignment of sensors based on the site performance evaluation system (SPES) analysis, which is run on a regular basis. However, the FAA has also said that because of manpower shortages, it can take 3 to 6 months after discrepancies are noted for the alignment of the sensors to be examined and adjusted by airport personnel. The Safety Board concludes that 3 to 6 months after discrepancies are noted is an unacceptable amount of time to verify the accuracy of sensor alignment, since wind direction can have a direct bearing on the windshear detection capability of the system. Therefore, the Safety Board believes that the FAA should develop a plan to physically check and correct wind sensor alignment in a more timely manner.

The Safety Board is also concerned that the FAA's process of "recertifying" the LLWAS does not include checking to ensure that the sensors are properly aligned--despite the implication that "recertification" signifies that the system complies with all original certification requirements. Although the FAA has stated that the misalignment did not appear to degrade the system during the analyzed period, this result is relevant only to the wind conditions experienced during that period. A misalignment of 38 degrees could clearly compromise the effectiveness of the system under some wind conditions. Accordingly, the Safety Board believes that the FAA should evaluate its LLWAS recertification process and ensure that the process addresses the total functional capability of the system.

With regard to the airplane's escape slide, the Safety Board found that the instructions for rigging the inflation cable, which are contained in the Douglas DC-9/MD-80 maintenance manual, were ambiguous. At the time of the accident, they stated: "Check that loop on firing lanyard is secured to girt tab with retaining ring on manual inflation handle; then, secure lanyard cover flap over firing lanyard." The instructions did not specifically call for the inflation cable to pass through a grommet on a tab near the girt bar before the cable is connected to the retaining ring on the manual inflation handle. In addition, the diagram in the rigging instructions did not display the grommet or the tab, or the inflation cable passing through the grommet

on the tab near the girt bar before the cable is connected to the manual inflation handle. This is required for the slide to inflate properly. The Safety Board concludes that because of the ambiguous instructions that appeared in the Douglas maintenance manual, operators of MD-80 and DC-9 series airplanes could be misrigging emergency evacuation slides. Therefore, the Safety Board believes that the FAA should require all operators to inspect immediately all MD-80 and DC-9 floor level exits to ensure that evacuation slides have been properly rigged.

As a result of this accident, American Airlines took immediate action to clarify instructions in its maintenance manual and is conducting a fleet-wide inspection of all emergency evacuation slides on its MD-80 airplanes. Douglas also took action and revised its maintenance manual instructions for installation of evacuation slides to include improved diagrams showing proper routing of the inflation cable through the grommet tab, and to include instructions to "[p]ass [the] inflation cable loop through [the]grommet tab." (The "inflation cable" had previously been referred to in the manual as the "firing lanyard.") Although these revisions clearly and accurately depict the proper routing of the inflation cable, the Safety Board is concerned that the change in terminology from "firing lanyard" to "inflation cable" was not reflected in all the maintenance manual diagrams and instructions dealing with the installation and removal of evacuation slides. In several places the cable is still referred to as a "firing lanyard." The Safety Board concludes that because Douglas uses two different terms ("firing lanyard" and "inflation cable") for the same part in its MD-80 and DC-9 maintenance manuals, the manual remains potentially confusing. Therefore, the Safety Board believes that the FAA should require Douglas Aircraft Company to review and amend its MD-80 and DC-9 maintenance manuals so that terminology used in graphics and instructions pertaining to the installation and removal of evacuation slides are clear and consistent.

During the evacuation, the evidence showed that the aisle and areas in front of the escape route doors were partially blocked by passenger shoes. These obstacles could have caused injuries or loss of life if there had been an interior fire or other critical situation. The practice of commanding all passengers to remove shoes during evacuations was originally targeted primarily at high heeled shoes, and was intended to prevent slide punctures. But modern slide design and strengthened fabric now used in slide

manufacturing make the policy outdated. In addition, (with the exception of high heeled shoes) safety is served by passengers wearing shoes because they can exit an airplane and move away from an evacuated airplane more readily.

It may still be appropriate for crewmembers to instruct female passengers to remove high-heeled shoes that could cause injuries during an evacuation. Experience has shown that ankle and leg injuries are more likely to result from passengers wearing high heels. In addition, other injuries could also occur to rescue personnel and passengers as a passenger wearing high heels slides down to waiting individuals at the bottom of the slide. However, the Safety Board concludes that directing all passengers to remove shoes during evacuations may not be in the best interests of safety. There is no FAA policy regarding issuing commands for shoe removal during an evacuation. Although American Airlines is the only major carrier the Safety Board is aware of that instructs passengers to remove shoes during an evacuation, the Safety Board is concerned that there is no uniform policy or standard to which all operators (large and small) must adhere. The Safety Board therefore believes that the FAA should develop a uniform policy on shoe removal during evacuations, and require that all operators train their flight attendants to issue commands during an emergency evacuation consistent with that policy.

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

> Evaluate Terminal Instrument Procedures (TERPS) design criteria for non-precision approaches to consider the incorporation of a constant rate or constant angle of descent to minimum descent altitude in lieu of step-down criteria. (A-96-128)
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> Examine and make more effective the coordinating efforts of the flight inspection program and the procedures development program, with emphasis on ensuring quality control during the development, amendment, and flight inspection process for instrument approaches. (A-96-129)

Incorporate precipitous terrain adjustments in the BDL runway 15 approach. (A-96-130)

Include a more comprehensive set of guidelines concerning precipitous terrain adjustments in the Terminal Instrument Procedures (TERPS) (FAA Order 8260.3B) Handbook, clarifying the definition of precipitous terrain, and establishing defined criteria for addressing the potential effects of such terrain. (A-96-131)

Review and evaluate the appropriateness of the let-down altitudes for all non-precision approaches that have significant terrain features along the approach course between the initial approach fix and the runway. Airline safety departments and pilot labor organizations, such as the Allied Pilots Association and the Air Line Pilots Association, should be consulted as part of this review. (A-96-132)

Solicit and record user comments about difficulties encountered in flying a particular approach to evaluate approach design more accurately. (A-96-133)

For arriving aircraft executing non-precision instrument approaches at all airports, during periods in which the official weather report includes the remarks, "pressure falling rapidly," controllers should be required to issue as frequently as practical altimeter setting changes to flightcrews in addition to the altimeter setting issued on initial contact. (A-96-134)

Revise Facility Operation and Administration handbook 7210.3, or other appropriate orders, to require that when a tower shuts down for any reason, and if the tower controllers have time to record a new automatic terminal information service (ATIS) indicating that the tower is closed, they should do so. (A-96-135)

Develop a plan to physically check and correct low level windshear alert system (LLWAS) wind sensor alignment in a timely manner. (A-96-136)

Evaluate the low level windshear alert system (LLWAS) recertification process, and ensure that the process addresses the total functional capability of the system. (A-96-137)

Require all operators to inspect immediately all MD-80 and DC-9 floor level exits to ensure that evacuation slides have been properly rigged. (A-96-138)

Require Douglas Aircraft Company to review and amend its MD-80 and DC-9 maintenance manuals so that terminology used in graphics and instructions pertaining to the installation and removal of evacuation slides are clear and consistent. (A-96-139)

Develop a uniform policy on shoe removal during evacuations, and require that all operators train their flight attendants to issue commands during an emergency evacuation consistent with that policy. (A-96-140)

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

By: Jim Hall
Chairman