NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: October 3, 1974

Forwarded to:

Honorable Alexander P. Butterfield
Administrator
Federal Aviation Administration
Washington, D. C. 20591

SAFETY RECOMMENDATION(S)

A-74-77 through 83

On December 17, 1973, Iberia Air Lines Flight 933, a DC-10-30, was involved in an accident at Logan International Airport in Boston, Massachusetts. The captain was conducting an ILS approach to runway 33L when the aircraft struck an approach light stanchion and crashed on the airport. The sky was obscured and visibility was restricted by moderate rain and fog.

The aircraft was equipped with a digital flight data recorder (DFDR) which recorded measurements or status for 96 parameters. These data provided a means for accurately determining the aircraft's flight profile and the winds which acted upon the flight during its final approach. The evidence indicated that the aircraft descended through a significant low altitude wind shear. The wind changed from southerly at 29 knots, to westerly at 5 knots; this change occurred between 500 feet and 200 feet altitudes.

The effect of such a wind shear on the performance of both the aircraft and the flightcrew was examined further in a McDonnell Douglas Co. DC-10-30 simulator. Wind and visibility conditions were reproduced. More than 50 approaches were flown by five pilots who were qualified in the DC-10 aircraft. Tests indicated that the wind shear condition combined with other circumstances to produce a situation conducive to an accident.

The approach of Flight 933 was flown using the autopilot/autothrottle system to the published decision height. An unusable glide slope below DH made it mandatory for the pilot to disengage the autopilot upon descent through 200 feet. DFDR data showed that the wind shear caused the autopilot/autothrottle system to establish a lower-than-normal pitch attitude and thrust setting during the descent. The aircraft was stabilized on the glide slope and slightly left of the runway centerline when the pilot disengaged the autopilot

approach was not published in official U. S. instrument approach procedures and was unknown to the captain of Flight 933.

The Safety Board further believes that even with a 40-foot TCH, the clearance afforded to the wide-bodied aircraft is too low. The theoretical effect of a wind shear was considered in the AIA study, but only as it effected the aircraft flight profile during automatic landing operation. The study did not consider the glidepath deviation which can occur because of the pilot's response to wind shear effects, particularly during the critical transition from automatic to manual flight and visual reference, as required on Category I and Category II approaches. Research data for such an analysis is limited.

The Safety Board is concerned that the circumstances of this accident are not unusual and believes that positive action must be taken to minimize the possibility of future accidents. These actions must be directed toward ensuring adequate wheel clearance on all Category I approaches considering all adverse tolerances including flightpath disturbances caused by wind shear, and minimizing the effect of such disturbances by improving pilot performance through better training and hazard-alerting procedures. Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

1. Relocate as soon as possible ILS glide slope transmitter sites in accordance with FAA Order 8260.24 to provide a larger margin of safety for wide-bodied aircraft during Category I approaches.

2. As an interim measure, increase DH and visibility minimums for those approaches where the combination of the glide slope transmitter antenna installation and the aircraft glide slope receiver antenna installation provide a nominal wheel clearance of less than 20 feet at the runway threshold.

3. Pending the relocation of the glide slope facility to comply with FAA Order 8260.24, expedite the modifications to official U. S. instrument approach procedures so that they display glide slope runway threshold crossing height for all approaches having a TCH of less than 47 feet.

4. Issue an Advisory Circular which describes the wind shear phenomenon, highlights the necessity for prompt pilot recognition and proper piloting techniques to prevent short or long landings, and emphasizes the need to be constantly aware of the aircraft's rate of descent, attitude and thrust during approaches using autopilot/autothrottle systems.

and transitioned from instrument to visual reference. Simultaneous with this action, the aircraft descended below the altitude band of the wind shear. The pitch attitude and thrust which had been established by the autopilot to compensate for the changing wind caused the aircraft to descend more rapidly when the longitudinal wind component stabilized.

When the situation was reproduced in the simulator, immediate recognition of the wind shear's effect and positive pilot action was required to prevent an impact short of the runway threshold. The pilots who participated in the tests agreed that the restricted visual cues hindered prompt recognition of the developing descent rate and accurate assessment of the pitch attitude change required to arrest the descent. Invariably, descent below glide slope occurred during the simulated approaches.

A deviation below the glide slope, whether induced by the pilot or by unusual environmental factors, is potentially dangerous during any approach; however, it is particularly hazardous on those approaches which have glide slope installations that provide threshold crossing heights (TCH) of less than the 47-foot minimum specified in FAA Order 8260.24 dated February 24, 1972.

The TCH for the Logan International Airport runway 33L extended glide slope is only 34.3 feet. Had Flight 933 been able to remain on the glide slope, the main landing gear wheels would have passed only 24.6 feet above the approach light stanchion and 7.8 feet above the runway threshold.

The Aerospace Industries Association of America, Inc. (AIA) conducted a study in 1970 to evaluate minimum wheel clearance when accounting for worse-case tolerances considering improved glidepath receiving and tracking equipment. The study assessed the compatibility of glide slope receiver antenna installations on the wide bodied aircraft with existing glide slope transmitter installation criteria. The study concluded that an antenna installation such as that on the DC-10 would result in TCH of at least 10 feet when a reasonable probable combination of adverse tolerances was applied to a glide slope having a TCH of 40 feet.

The Douglas Aircraft Company recognized the potential hazard for those Category I approaches that have glide slope heights over the threshold that are below 40 feet. They recommended to all operators of DC-10's that the pilot change his flight profile near DH and actually fly above the glide slope to the point of flare in order to assure adequate clearance over the runway threshold. The Safety Board believes that such a recommendation is in conflict with the well-known merits of a stabilized approach. Furthermore, the TCH for the Logan 33L

Recommendation No. 3.

Pending the relocation of the glide facility to comply with FAA Order 8260.24, expedite the modifications to official U. S. instrument approach procedures so that they display glide slope runway threshold crossing height for all approaches having a threshold crossing height of less than 47 feet.

Comment.

Action has been initiated to include ILS glide path threshold crossing heights on the instrument approach procedure charts. These are presently being revised coincident with other routine procedure changes. We will expedite action to complete the revisions to all ILS approach procedure charts.

Recommendation No. 4.

Issue an Advisory Circular which describes the wind shear phenomenon, highlights the necessity for prompt pilot recognition and proper piloting techniques to prevent short or long landings, and emphasizes the need to be constantly aware of the aircraft's rate of descent, attitude and thrust during approaches using autopilot/autothrottle systems.

Comment.

We have already initiated steps to emphasize the need for more understanding of the low level wind shear phenomenon. On September 26, we began a series of briefings at all major FAA Air Carrier and Flight Standards District Offices to emphasize the need for supplemental weather data relating to turbulence and low level wind shear. This effort should help in reducing the number of accidents and incidents attributed to these weather phenomenon. These briefings will be given to all Air Carrier Operations Inspectors, who, in turn, will evaluate each air carrier program and report the results. They will stress the importance of using the weather information provided, especially severe weather and low level wind shear.

Recommendation No. 5.

Modify initial and recurrent pilot training programs and tests to include a demonstration of the applicant's knowledge of wind shear and its effect on an aircraft's flight profile, and of proper piloting techniques necessary to counter such effects.