

Log 1910



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 3, 1986

In reply refer to: A-86-65 through -75

Honorable Donald D. Engen
Administrator
Federal Aviation Administration
Washington, D. C. 20591

On August 2, 1985, at 1805:52 central daylight time, Delta Air Lines (Delta) flight 191, a Lockheed L-1011-385-1, N726DA, crashed while approaching to land on runway 17L at the Dallas/Fort Worth International (DFW) Airport, Texas. While passing through the rain shaft beneath a thunderstorm, flight 191 entered a microburst which the pilot was unable to traverse successfully. The airplane struck the ground about 6,300 feet north of the approach end of runway 17L, hit a car on a highway north of the runway killing the driver, struck two water tanks on the airport, and broke apart. Except for a section of the airplane containing the aft fuselage and empennage, the remainder of the airplane disintegrated during the impact sequence, and a severe fire erupted during the impact sequence. Of the 163 persons aboard, 134 passengers and crewmembers were killed; 26 passengers and 3 cabin attendants survived. ^{1/}

Operations

The Safety Board has completed its investigations of three windshear-related accidents that occurred since 1984; most recently, the Delta L-1011 at DFW Airport on August 2, 1985, a United Airlines B-727 at Denver, Colorado, on May 31, 1984, and a USAir DC-9 at Detroit, Michigan, on June 13, 1984. During these investigations, Safety Board personnel examined training records to determine the crewmembers' instructions concerning the identification and avoidance of windshear, and the specific recovery procedures that were practiced during their simulator training. None of the records had documentation of windshear training, and airline training personnel could only speculate as to what specific windshear profiles the crewmembers had flown during their simulator training sessions. The Safety Board is aware that a formal standardized windshear training program is currently not required by the Federal Aviation Administration (FAA) for air carriers operating under 14 CFR Part 121. Consequently, documentation of specific training is presently not required to be placed in pilot training records.

^{1/} For more detailed information, read Aircraft Accident Report--"Delta Air Lines, Inc., Lockheed L-1011-385-1, N726DA, Dallas/Fort Worth International Airport, Texas, August 2, 1985" (NTSB/AAR-86/05).

The Safety Board does know, however, that most carriers voluntarily give their flightcrews windshear scenarios during simulator training. The Safety Board believes that efficiency and effectiveness of training would be improved if the type of windshear profile, and the date of such training, were recorded in the pilot's training record. Such records would allow airline training departments to ensure that all crewmembers receive the broad scope of simulator training during initial and recurrent training sessions that would include the variety of windshear conditions that can be encountered during approach and departure operations. The Safety Board believes that such recordkeeping would enhance airline training programs and would not be burdensome, and that the FAA should require air carriers to keep records of any windshear simulator training their flight crewmembers receive.

The Safety Board is also concerned that some air carrier operations manuals do not contain specific thunderstorm avoidance procedures for operations in the terminal operating environment. During the Safety Board's investigation into the operational and training procedures employed by Delta, Safety Board investigators studied the guidance given Delta flightcrews regarding thunderstorm avoidance. Delta's procedures state that flightcrews are to maintain a distance of at least 5 miles from a thunderstorm cell when below 10,000 feet.

Several other major air carriers' operational procedures were studied regarding thunderstorm avoidance policy. While all carriers had at least the same basic avoidance criteria as Delta, some carriers also stressed the added importance of remaining clear of thunderstorms while on final approach to, or initial departure from, an airport. While pleased that some carriers recognize the acute hazards of thunderstorms in the terminal environment, the Safety Board believes that more specific guidance needs to be provided to flightcrews regarding this issue.

The Safety Board believes that unless the final approach or initial departure path from an airport is clear of thunderstorm activity, flightcrews should not continue operations. In this regard, the Safety Board believes that the FAA should review the operations manuals of all air carriers to make certain that they contain specific guidance to flightcrews concerning thunderstorm avoidance during terminal operations, including a prohibition against terminal operations when a thunderstorm is over the airplane's projected flight path or the airport. The FAA should also examine airline training curricula to verify that the avoidance of thunderstorms in the terminal area is emphasized.

Similarly, the Safety Board is concerned that, during inadvertent windshear encounters, flightcrews may be relying upon flight director systems that have not been modified to incorporate windshear logic. The Safety Board determined the pitch commands that the flight director system present on Delta flight 191 would have displayed to the flightcrew during its windshear encounter. The Safety Board was concerned that the flightcrew might have attempted to fly the airplane following the commands given by the flight director system. The Safety Board's analysis concluded that, after the flightcrew selected the take off/go-around (TOGA) mode during the missed approach, the flight director logic would provide command guidance to the go-around angle-of-attack. This command may not be compatible with the higher angles-of-attack necessary to escape a windshear encounter. While Delta procedures do not address the use of the flight director system during a windshear encounter, at least one major carrier does caution its flightcrews not to use the flight director if such a condition is encountered.

The Safety Board is aware that flight directors, with suitable windshear escape logic, are becoming available for use on air carrier aircraft. These flight directors will provide optimal guidance to a flightcrew should a windshear inadvertently be encountered. In the interim, the Safety Board believes that the FAA should direct airline flight operations departments to review their procedures so that flightcrews are cautioned not to rely on their flight director displays should a windshear condition be encountered, unless such systems have been modified to incorporate windshear guidance logic.

Air Traffic Control

On the day of the accident, several flightcrews either experienced windshear personally or observed weather conditions associated with windshear but did not report it to air traffic control (ATC). If those flightcrews had informed ATC of their encounters, ATC could have warned subsequent arrivals of the existence of shear conditions. If the captain of flight 191 had been made aware of windshear experienced by aircraft preceding him, his decision to continue the approach to the airport may have been altered, when added to his own observations and experiences.

Pilots are required to advise controllers of hazardous flight conditions upon becoming aware of them. In addition, the Safety Board believes that an early, general advisory concerning reported windshear would alert pilots that they are approaching an area of concern. Such a general advisory would be appropriate for an automatic terminal information service (ATIS) broadcast and would only need to be updated upon receipt of more significant shear reports. The advisory should be accompanied by a solicitation for pilot reports (PIREPs). In this way, the need for individual solicitations of PIREPs would be eliminated, thus reducing congestion on ATC frequencies.

Even if windshear PIREPs had been transmitted to the tower, the Safety Board notes that there is no established requirement for the length of time that such windshear reports are to be broadcast by controllers to pilots of subsequent flights. The transmission of this type of information is, for the most part, left up to the individual controller.

The Safety Board notes that it is not uncommon for a controller to receive a windshear report from an aircraft, pass that on to the next aircraft, and then, unless the second aircraft confirms the existence of a shear condition, discontinue further advisories to subsequent aircraft. The Safety Board believes controllers should transmit such PIREPs to arriving or departing aircraft until confirmation is received that the shear condition has dissipated. The PIREP should be relayed verbatim as received from the reporting flightcrew, along with the time of the encounter and type of aircraft involved.

On the day of the accident, the Fort Worth Air Route Traffic Control Center (ARTCC) was staffed by a weather coordinator. That individual, as part of the Traffic Management Unit, provided liaison between the Center Weather Service Unit (CWSU) and the controller work force. The DFW Tower, as a terminal facility, did not have a designated weather coordinator, and current FAA staffing does not provide for such a position in terminal facilities. During the time of the accident, the supervisor in the DFW terminal radar approach control (TRACON) was responsible for the dissemination of any information received from the CWSU, and these duties were to be performed in conjunction with normal supervisory duties. Although in this accident there were no

communications from the CWSU, it is quite conceivable that, on other occasions, significant weather information may not receive the necessary level of attention when it is handled by someone tasked with other duties of equal or higher priority.

The Safety Board believes that the FAA should establish a weather coordinator position at busy terminal facilities to coordinate the receipt and dissemination of weather information and advisories. This person could also be responsible for soliciting and disseminating PIREPs, and could provide an interface with traffic managers at the appropriate en route facility.

During its investigation of the accident, the Safety Board noted that the presence of towering cumulus and cumulonimbus clouds, although included in the remarks section of the 1700 EDT weather sequence provided to the tower, was not placed on the ATIS since the FAA does not require this information to be included on ATIS broadcasts. In this instance, towering cumulus clouds were visible to inbound flights; however, the Safety Board believes there are other conditions that could inhibit a flightcrew's ability to observe these types of clouds, such as darkness during night operations and instrument meteorological conditions.

In addition, the Safety Board has learned that there is no specific requirement to include references to lightning on ATIS broadcasts, even though it may be included on official weather observations. The existence of lightning is in itself a direct confirmation of thunderstorm activity and therefore should be reported on the ATIS. This is particularly important at locations where individual air carriers have no independent source for weather information and thus rely on the ATIS for such information. The Safety Board believes that the FAA should require the observation of lightning, cumulonimbus clouds, and towering cumulus clouds to be included on ATIS broadcasts when that information has been included in the remarks section of official weather reports.

At no time before, during, or after the accident did the DFW controllers describe radar-depicted precipitation areas as prescribed in FAA Handbook 7110.65D (i.e. weather area, band of weather, etc.). The Feeder East Controller's use of phrases such as "little bitty thunderstorm" and "little rain shower" did not comply with the phraseology required of controllers. In addition, controllers are not to classify weather areas, such as thunderstorms or rain showers, without confirmation from official sources. The Safety Board believes that all air traffic controllers should be briefed on the importance of using proper phraseology without classifying the areas when describing weather areas depicted on their radarscopes.

Similarly, the Safety Board is concerned that some controllers on duty at the time of the accident did not have a clear understanding of what constitutes a thunderstorm and, as a result, may not have fully appreciated the hazards associated with them. At the time of the accident, controllers were required to review a brochure which described thunderstorms and to certify that they had reviewed the item. The Safety Board believes that simply having controllers read and initial a circulated brochure does not provide them with an adequate knowledge of thunderstorms. The Safety Board believes that the FAA should develop a comprehensive weather refresher course, including a section on thunderstorms and their hazards to flight safety, and should require all controllers to complete this course during refresher training.

Also during the investigation, the Safety Board became aware that a weather coordinator course is offered at the FAA Academy in Oklahoma City, Oklahoma. Although this course is not mandatory, the person serving as weather coordinator during the time of the accident had attended the weather coordinator course. Interviews conducted by Safety Board investigators revealed a consensus among Fort Worth ARTCC weather coordinators that the course was useful. The Safety Board believes that the benefit gained by those attending the course is significant in heightening the attendees' appreciation for the flight hazards associated with certain weather elements. Also, the enhanced knowledge gained during the course would allow traffic managers to be more conversant in meteorological matters with the CWSU meteorologist. In addition, some interpretation training in the observation of Remote Radar Weather Depiction System (RRWDS) or similar equipment would be helpful in providing a proficiency in the detection and dissemination of information regarding significant precipitation areas.

Weather

After the crash of a Pan American Boeing 727 in a microburst-induced windshear at Kenner, Louisiana, on July 9, 1982, the Safety Board issued several Safety Recommendations to the FAA designed to mitigate the low-altitude windshear hazard. Safety Recommendation A-83-23 stated:

Expedite the development, testing, and installation of advanced Doppler weather radar to detect hazardous windshears in airport terminal areas and expedite the installation of more immediately available equipment such as add-on Doppler to provide detection and quantification of windshear in high risk terminal areas.

The Safety Board believes that deployment of advanced Doppler radar in terminal areas currently represents the best means for detection and warning of hazardous windshears in the airport terminal area. The Safety Board is pleased to note that the FAA has developed a plan to accelerate the implementation of advanced Doppler radars to cover 17 selected airports. However, delivery of these modified Next Generation Radars (NEXRAD) will not begin until late in 1989. The delivery of Terminal Doppler Radars will not commence until 1991.

According to data supplied to the Safety Board by the National Oceanic and Atmospheric Administration, there is about an 83-percent probability of having a microburst-related incident each convective season and that there is a 25-percent probability each period of it being a disaster. Clearly, the probabilities show that another microburst-related aviation accident will occur before the first advanced Doppler radar is deployed at an airport.

The Safety Board is aware of the FAA's efforts to improve the existing Low-Level Wind Shear Alert System (LLWAS) as an interim system until the deployment of advanced Doppler radar at airports. The Safety Board certainly supports these efforts. However, there exist today systems capable of providing real-time weather information such as weather echo intensities and Doppler-derived turbulence data that also could be placed in terminal area facilities. Although these systems do not provide the same level of information or products as the FAA's planned advanced Doppler radar, information derived from these systems would be valuable to pilots.

These systems would provide information that could supplement information derived from the LLWAS. The Safety Board is also aware that manufacturers of such weather radar systems are willing to begin immediate tests of their equipment at selected airport control towers.

The Safety Board believes that as a minimum the FAA should, during the current convective season, conduct an operational evaluation of these systems at selected airports and, based on the results of the evaluation, consider deploying these systems as an interim measure until deployment of advanced Doppler radar in terminal areas and to supplement data derived from the LLWAS. The Safety Board notes that when the FAA's advanced Doppler radar becomes available at major airports, these less sophisticated systems could be placed at smaller airports.

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

Issue an Air Carrier Operations Bulletin to direct Principal Operations Inspectors to require air carriers operating under 14 CFR Part 121 to record in pilot training records the specific windshear simulator training administered to pilots during initial and recurrent training sessions. (Class II, Priority Action) (A-86-65)

Issue an Air Carrier Operations Bulletin to direct Principal Operations Inspectors to review those sections of company operations manuals and training curricula pertaining to thunderstorm avoidance procedures to verify that flightcrews clearly understand the policy that no aircraft should attempt to land or take off if its flight path is through, under, or near (within a minimum specified distance) a thunderstorm. (Class II, Priority Action) (A-86-66)

Issue an Air Carrier Operations Bulletin to direct Principal Operations Inspectors to require that company operations manuals and training curricula caution pilots not to use flight director systems during an inadvertent windshear encounter unless such systems incorporate windshear logic. (Class II, Priority Action) (A-86-67)

Include a message on the Automatic Terminal Information Service broadcast whenever weather conditions conducive to thunderstorm or microburst development exist in the terminal area or when such actual conditions have been observed or reported. (Class II, Priority Action) (A-86-68)

Amend Federal Aviation Administration Handbook 7210.3G, Facility Operation and Administration, to require the observation of lightning or existence of cumulonimbus and towering cumulus clouds as items to be included on Automatic Terminal Information Service broadcasts when that information has been included in the remarks section of official weather reports. (Class II, Priority Action) (A-86-69)

Require tower controllers to issue thunderstorm, microburst, and windshear reports when conditions differ from Automatic Terminal Information Service broadcast information and when actual pilot reports (PIREPS) have been received, and to solicit further PIREPS until such time that confirmation is received that the condition no longer exists. (Class II, Priority Action) (A-86-70)

Develop a position in major terminal facilities, to be staffed with National Weather Service meteorologists or Federal Aviation Administration personnel trained for meteorological observations, to be the focal point for weather information coordination during periods of convective weather activity that adversely affects aircraft and air traffic control system operations. (Class II, Priority Action) (A-86-71)

Require that all personnel engaged in weather coordinator duties attend the formal Weather Coordinator Training Course offered by the Federal Aviation Administration Academy, and expand that course to include training in the interpretation of weather echo intensity levels as depicted on remote weather radar displays. (Class II, Priority Action) (A-86-72)

Develop a thorough convective weather refresher course as part of recurring training for all personnel actively engaged in the control of air traffic. (Class II, Priority Action) (A-86-73)

Issue a General Notice to all en route and terminal facilities emphasizing the phraseology requirements for describing weather areas as stated in Federal Aviation Administration Handbook 7110.65D. (Class II, Priority Action) (A-86-74)

Conduct, during the current convective season, an operational test of currently available weather radar systems at selected airports and, based on the results of the evaluation, consider deployment of a system or systems to supplement data derived from the Low Level Wind Shear Alert System as an interim measure until deployment of advanced Doppler radar in terminal areas. (Class II, Priority Action) (A-86-75)

BURNETT, Chairman, GOLDMAN, Vice Chairman, and LAUBER and NALL, Members, concurred in these recommendations.

By: 
Chairman