



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 29, 1990

In reply refer to: A-90-160 through -163

Honorable James B. Busey
Administrator
Federal Aviation Administration
Washington, D. C. 20591

The National Transportation Safety Board has completed its investigation of a pilot deviation¹ incident in which a pilot flying a National Aeronautics and Space Administration (NASA), Northrup Talon, T-38A airplane descended below the altitude assigned by air traffic control (ATC). The incident resulted in a near-midair collision (NMAC)² between NASA T-38A, N920NS (NASA 920), and a Pan American World Airways Airbus A-310, N806PA (Clipper 140). It occurred about 2 miles northwest of the Washington/Dulles International Airport, Washington, D. C., on May 15, 1989, about 1841 local time. NASA 920 descended through its assigned altitude of 8,000 feet to an altitude of 7,000 feet mean sea level, which had been assigned to Clipper 140. Both airplanes were in level flight at approximately 7,000 feet when they passed. In addition to pilot performance, which the Safety Board has addressed in a recommendation letter to NASA, this incident also involved the performance of air traffic controllers and the ATC conflict alert system.³

¹Pilot deviation: The actions of a pilot that result in the violation of a Federal Aviation Regulation.

²An incident associated with the operation of an aircraft in which the possibility of collision existed as a result of proximity of less than 500 feet to another aircraft, or an official report is received from a flightcrew member stating that a collision hazard existed between two or more aircraft.

³Using beacon data from aircraft equipped with mode C transponders, conflict alert calculates the projected vertical and horizontal flight paths of controlled aircraft and alerts the controller by both a visual and audible alarm when two aircraft are or are predicted to be in a position requiring immediate attention/action.

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Details of the Incident

The captain of Clipper 140 stated that the T-38 passed about 250 to 500 feet directly in front of his airplane at the same altitude and that no time was available to take evasive action. The pilot of NASA 920 said that he did not see Clipper 140 but that he expedited a climb to 8,000 feet after receiving a traffic advisory from ATC. The flight crews of both airplanes stated that at the time of the incident they were flying between cloud layers. They described the weather as "very scuddy" with no clear horizon and a forward visibility of 1/2 mile. Recorded ATC radar data indicated that the minimum distance between the two airplanes was 100 feet vertical and 700 feet lateral separation.

Clipper 140 had departed from the Washington/Dulles Airport with 166 passengers and 10 crewmembers aboard en route to Paris, France. NASA 920, with only the pilot aboard, had departed from Ellington Field in Houston, Texas, and was en route to Andrews Air Force Base, Washington, D.C., after a refueling stop at Fort Campbell, Kentucky. Both airplanes were operated under instrument flight rules (IFR) clearances.

Before the incident, both airplanes were under the ATC jurisdiction of the Dulles Approach Control. NASA 920 was eastbound, controlled by the Dulles North High Controller. The Dulles North High Controller cleared NASA 920 to proceed "direct ARMEL,⁴ direct Andrews, descend to cross ARMEL at and maintain eight thousand." The pilot of NASA 920 replied, "Roger, direct ARMEL direct Andrews down to eight." Radio communication with NASA 920 was transferred to the Washington Approach Control Final One (F1) position following an automated handoff to that facility. About the same time, Clipper 140 departed from Dulles Airport, under the control of the Dulles North Departure Controller. The Dulles North Departure Controller cleared Clipper 140 to climb and maintain 7,000 feet and to turn right heading 360 degrees. As Clipper 140 was completing its turn and leveling at 7,000 feet, the NMAC occurred. NASA 920 had continued its descent to 7,000 feet.

The pilot of NASA 920 told Safety Board investigators that after radio communication with his airplane had been transferred to the Washington F1 controller, he reported to the controller that he was descending to 7,000 feet, and the controller did not question it. As NASA 920 was leveling at 7,000 feet, the conflict alert at both Washington and Dulles activated. Soon thereafter, the Washington F1 controller was informed by a controller sitting next to him that he, the F1 controller, had a conflict alert on his display. The F1 controller issued a traffic advisory to NASA 920 about the same time that the NMAC occurred. The pilot of NASA 920 initiated a rapid climb to 8,000 feet after the paths of the two airplanes had crossed. Computerized radar information showed that the conflict alert activated 26 seconds before the paths of the airplanes crossed.

⁴ARMEL: ARMEL VORTAC is a very high frequency omnidirectional range/tactical air navigation ground station that provides pilots with azimuth and distance-to-station information.

Investigation

The multi-channel voice communication recorder, which normally would have recorded the voice communications between NASA 920 and the Washington F1 controller, failed to record the information on the designated channel. However, other channels had not malfunctioned, and as a result of interviewing controllers and listening to conversations between supervisors recorded on other channels immediately following the incident, the Safety Board has concluded that the pilot of NASA 920 reported to the F1 controller on initial contact that he was descending to 7,000 feet.

The Washington F1 controller stated that after taking the handoff on NASA 920 he did not review the flight progress strip nor did he mark the strip to reflect the altitude to which he expected NASA 920 to descend. He stated that, when he accepted the handoff on NASA 920, he was busy with other duties and did not notice the type aircraft in the target's data block. In addition, he said that he did not know what a T-38 was. After the incident, the Washington F1 controller marked the flight progress strip of NASA 920 to indicate the flight was at 8,000 feet. He told Safety Board investigators that he had taken this action to indicate the altitude of the flight after the occurrence but not as a result of the pilot's initial contact. Other altitudes were later marked on the flight progress strip to indicate the airplane's assigned descent altitudes into Andrews Air Force Base.

The Dulles North Departure Controller stated that he recalled observing an eastbound target on his radar display with a limited data block that indicated the target was at 8,000 feet. The Safety Board has determined that this target was NASA 920. The Dulles North Departure Controller was aware that this target would cross the flight path of Clipper 140. However, he said that he did not provide a traffic advisory to the flightcrew of Clipper 140 because he knew that cloud cover existed and that the pilots of other aircraft had reported being in instrument meteorological conditions. He also expected that the target would remain at 8,000 feet as cleared.

Both the Dulles North High Controller and the Dulles North Departure Controller reported that they had no knowledge of a conflict alert until after the incident and computer data had been reviewed. Computer-recorded information revealed that 17 seconds after the conflict alert began flashing, the Dulles North Departure Controller placed his "slew-ball," which provides a type of electronic marker, on NASA 920 and depressed the "enter" button. This type of action would have, under certain conditions, caused the full data block for NASA 920 to cease to be displayed. However, because of this action and although this data block was now in a conflict alert status, the data block and conflict alert message didn't disappear. Shortly afterward, the paths of the two airplanes crossed, and the North Departure Controller again positioned his slew ball on NASA 920 and typed a Terminate Control (TC) message into the computer. If accepted by the computer, the TC would have "dropped the track" for NASA 920 in the Dulles radar system. Also, the

conflict alert message would have disappeared from the display, along with the data tag representing NASA 920. However, because the Washington F1 controller had accepted the electronic handoff on NASA 920, Washington Approach Control had track control of the aircraft and the TC message entered at Dulles was invalid. Thus, the data tag of NASA 920 appeared in the conflict alert status on the Dulles radar display.

While the Safety Board has concluded that the visual portion of the alarm was displayed to both the Dulles North High Controller and the Dulles North Departure Controller, the conflict alert aural alarm at Dulles airport had been inhibited for a 5-mile radius around the radar antenna from the surface to 50,000 feet. Because NASA 920 and Clipper 140 were within this radius when the conflict alert occurred, the Dulles controllers received no aural alarm. As a result of this investigation, the inhibition has been removed. Both aural and visual alarms are now functioning as originally designed, with no inhibitions.

Discussion

The decision by the Dulles North Departure Controller not to issue a traffic advisory to Clipper 140 was not in accordance with procedure. Because the airplanes were initially separated by the minimum requirement of 1,000 feet, he was required to issue an advisory regardless of weather conditions. The Air Traffic Control handbook, 7110.65E, subparagraph 5-8, "Merging Target Procedures," states that merging target procedures will be applied to all radar-identified turbojet aircraft regardless of altitude. These procedures instruct controllers to issue traffic information. Despite the weather conditions, the Safety Board believes that, had a radar traffic advisory been provided, the captain of Clipper 140 may have sighted the T-38 and taken evasive action.

Also, the handbook required the Dulles North Departure Controller to issue an alert to Clipper 140 after he became aware of the conflict alert on his display. He should have issued a safety alert in the form of a traffic advisory and instructions to descend immediately. Such action would not have achieved the required separation between the two aircraft but would have increased the vertical distance between the two airplanes.

The Dulles North High Controller did not attempt any computer actions on either of the flights other than the routine handoff of NASA 920 to Washington Approach. Because he took no computer actions based on the recognition of the conflict alert, the Board finds no basis to believe that he had any knowledge of the conflict alert.

The letter of agreement between Washington National and Dulles ATC facilities specifies that turbojet aircraft destined for Washington National or Andrews Air Force Base (on the same route that NASA 920 used) will cross the airspace boundary at 8,000 feet. For propeller aircraft, the altitude is 7,000 feet. When the Washington F1 controller took the automated handoff and accepted NASA 920 from the Dulles controller, he should have noted the type of aircraft and its destination. When NASA 920 told the controller that it was out of 11,000 feet descending to 7,000 feet, the controller should have

detected the pilot's error, realizing that NASA 920 was a turbojet and should have been descending to 8,000 feet. The Washington F1 controller should not have accepted responsibility for NASA 920 when he was busy with other duties. These other duties probably created a "tunneled focus," precluding proper scanning and correlation of flight strip information. When the Washington F1 controller accepted the handoff, NASA 920 was about 25 miles from entering airspace assigned to Washington Approach. Therefore, the Washington F1 controller had sufficient time to have delayed the acceptance of the handoff until his other priorities had lessened. He could then have marked the strip properly and inquired about the type of aircraft he was accepting.⁵

Recommendations

The Safety Board's investigation determined that controller performance was not in accordance with either the Air Traffic Control handbook, 7110.65E, or the Operational Position Standards handbook, 7220.2A. The Safety Board believes that the FAA should require that all radar controllers and trainees receive a briefing concerning the performance deficiencies that occurred during this incident, along with the proper operating procedures, to prevent similar incidents. The briefing should include the following: (1) the effect of a controller accepting a handoff without determining from either the flight strip or data tag, the type of aircraft involved; (2) the effect of a controller responding improperly to a conflict alert warning by attempting to cancel the alert rather than solving the problem; and (3) the effect of a controller failing to call traffic to pilots of aircraft whose radar targets are merging when flying in known instrument meteorological conditions.

The Safety Board believes that continued exposure to repetitive alerts was at least partially responsible for the delayed action to the conflict alert by the Washington F1 controller. When the conflict alert in a terminal facility activates, all personnel in the facility can hear the aural portion of the alert that comes from one source in the radar room. In addition, this aural alarm is the same one used for the low altitude alert⁶, exposing all controllers to the sound. Of all low altitude and conflict alerts received in a typical facility, very few actually require intervention

⁵The FAA's Operational Position Standards Handbook, 7220.2A, provides detailed guidance on the conduct of operations at the different positions in each type of air traffic control facility. It outlines the "prerequisite knowledge" required to perform the job at each position of operation. Included as a part of basic prerequisite knowledge are strip marking and aircraft characteristics and recognition. Chapter 30, "Radar Team," Paragraph 30-26, "Review or Prepare Strip or Data Block," contains two subparagraphs particularly relevant to this incident: (1) review the strip or data block for complete and correct information, and (2) verify and/or correct questionable data.

⁶Low altitude alert/minimum safe altitude warning: a computer function that alerts the controller when certain aircraft are predicted by the computer to fly below a predetermined safe altitude.

by any one controller. As a result, controllers become conditioned by repetitive aural alarms, many of which are not critical.

The Safety Board also believes that the design of the visual portion of the conflict alert contributed to the lack of recognition by both the Dulles North High Controller and the Washington F1 controller. This alert flashes at the same rate and intensity as the data block information, which flashes during handoff status. Handoffs occur twice, throughout the entire system, for each airplane that a radar controller works through his airspace. A controller thus becomes accustomed to seeing information depicted in a flashing format. Because NASA 920 was in an area of the display and on a route in which many handoffs normally occur, the additional flashing of the letters "CA" (Conflict Alert) may have been less conspicuous.

On October 6, 1981, as a result of its investigation of aircraft separation incidents at the Hartsfield-Atlanta International Airport, the Safety Board recommended⁷ that the FAA "Redesign the low altitude/conflict alert system at ARTS III facilities so that the visual alert is unique, easily detected, and adequately contrasted when the data tag is in the handoff status" (A-81-135) and to "Redesign the low altitude/conflict alert at ARTS III facilities so that the audio signal associated with the low altitude alert is readily distinguishable from that associated with the conflict alert and heard only by controllers immediately concerned with the involved aircraft." (A-81-134) The FAA stated that it did not concur with the recommendations but did concur that each controller should have a separate audio signal. No further action was taken by the FAA and the Safety Board closed both of the recommendations on March 8, 1983, classifying them as "Closed--Unacceptable Action."

On August 16, 1984, the Board issued recommendation A-84-83 (a reiteration of A-81-134) as a result of its investigation of aircraft flying too close to tall buildings while on approach to Washington National Airport⁸. Again, the FAA did not concur with the recommendation and stated that the aural alarm represented a general warning or "attention-getter;" that the blinking alphanumeric represent the specific warning by identifying the aircraft involved and the nature of the problem, either low-altitude alert or conflict alert; that either situation would require the controller's immediate attention; and that a separate alarm would not be beneficial. No further action was forthcoming, and on January 24, 1986, the Board classified this recommendation as "Closed--Unacceptable Action."

The Safety Board continues to believe that design improvements are needed in both the audio and visual presentations of the conflict alert system in order to effectively notify the controller of an alert. The conspicuity of the visual conflict alert warnings could be increased by having the symbology alternate between two different intensity levels at a

⁷Safety Recommendation Letter A-81-132 through -138 dated October 6, 1981.

⁸Safety Recommendation Letter A-84-82 through -84 dated August 13, 1984.

frequency rate higher than that used to denote a handoff. The audio signal should be routed via headsets only to those positions having immediate control of the aircraft. The audio signals for the low-altitude alert and the conflict alert should be different so that controllers can distinguish one from the other. This distinction, in turn, would reduce the number of repeated exposures to a single sound.

The National Transportation Safety Board therefore recommends that the Federal Aviation Administration:

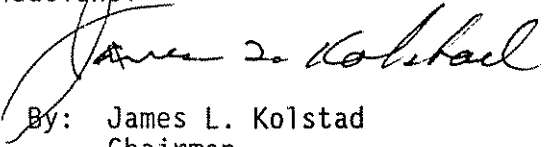
Brief all radar controllers and trainees on the controller performance deficiencies that occurred during the near midair collision between NASA 920 and Pan American 140, followed by a discussion of proper operating procedures. The briefing should include (1) the potential effects of a controller accepting a handoff without determining from either the flight strip or data tag the type of aircraft involved; (2) the potential effects of a controller responding improperly to a conflict alert warning by attempting to cancel the alert rather than solving the problem; and (3) the potential effects of a controller failing to issue traffic to merging flights that are flying in known instrument meteorological conditions. (Class II, Priority Action) (A-90-160)

Modify the low altitude/conflict alert at ARTS III, IIIA, and IIIA(e) facilities so that the audio signal associated with the low-altitude alert is readily distinguishable from that associated with the conflict alert. (Class II, Priority Action) (A-90-161)

Modify the low altitude/conflict alert at ARTS III, IIIA, and IIIA(e) facilities so that the audio signal associated with the low altitude alert and conflict alert is directed only to those positions having immediate control of the aircraft. (Class II, Priority Action) (A-90-162)

Modify the low altitude/conflict alert system at ARTS III, IIIA, and IIIA(e) facilities to increase the conspicuity of the visual alerts by having the symbology alternate between two different intensity levels at a frequency rate higher than that used to denote a handoff. (Class II, Priority Action) (A-90-163)

KOLSTAD, Chairman, COUGHLIN, Vice Chairman, and LAUBER, BURNETT and HART, Members, concurred in these recommendations.



By: James L. Kolstad
Chairman