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AIRCRAFT ACCIDENT REPORT

EASTERN AIR LINES, INC.
McDonnell Douglas DC-9-31
N8943E, and a Cessna Model 206, N2110F
Raleigh-Durham Airport
Raleigh, North Carolina
December 4, 1971



NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D. C. 20591

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Adopted: April 5, 1972

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6. Abstract On December 4, 1971, at 1346 e.s.t., Eastern Air Lines, Inc., Flight 898, a Douglas DC-9-31, N8943E, on a regularly scheduled flight from Miami, Florida, to Washington, D. C., with en route stops at Raleigh, North Carolina, and Norfolk, Virginia, and a Cessna 206, N2110F, collided in midair. The collision occurred between the outer marker and the threshold of Runway 5 of the Raleigh-Durham Airport at Raleigh, North Carolina. Both aircraft were in communication with and under the control of the Raleigh-Durham Tower local controller. The DC-9 overtook the Cessna and descended on top of that aircraft. The tower local controller had cleared the DC-9 to land. Previous to this clearance, he had advised the Cessna pilot that Runway 5 was the active runway and to report on a 3-mile final approach for possible straight-in landing. The National Transportation Safety Board determines that the probable cause of this accident was the inadequacy of air traffic control facilities and services in the Raleigh-Durham terminal area. The Board further determines that the relative flightpaths of the two aircraft and the configurations physically limited each flightcrew's ability to see and avoid the other aircraft. There were two recommendations made to the Federal Aviation Administration.		17. Key Words collision, see and avoid, approach controller, local controller, sequence, radar traffic advisory, outer marker, separation, coordinating, evasive, overtaking, meteorological conditions, visibility study		18. Distribution Statement Released to public Unlimited distribution	
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S P E C I A L N O T I C E

This report contains the essential items of information relevant to the probable cause(s) and safety messages to be derived from this accident/incident. However, for those having a need for more detailed information, the original factual report of the accident/incident is on file in the Washington office of the National Transportation Safety Board. Upon request, the report will be reproduced commercially at an average cost of 15¢ per page for printed matter and 75¢ per page for photographs, plus postage. (Minimum charge \$1.00.)

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D. C. 20591

AIRCRAFT ACCIDENT REPORT

Adopted: April 5, 1972

EASTERN AIR LINES, INCORPORATED
MCDONNELL DOUGLAS DC-9-31,
N8943E, AND A CESSNA MODEL 206, N2110F
RALEIGH-DURHAM AIRPORT
RALEIGH, NORTH CAROLINA
DECEMBER 4, 1971

SYNOPSIS

At approximately 1346 c.s.t., December 4, 1971, an Eastern Air Lines DC-9, N8943E, and a Cessna 206, N2110F, collided in flight on the final approach to Runway 5, Raleigh-Durham Airport, Raleigh, North Carolina. Both aircraft were in communication with the Tower Control. The DC-9 landed safely with no injuries to the 23 passengers and four crewmembers. The Cessna crashed and burned on the airport. The pilot and the only passenger in the Cessna were fatally injured.

As a result of the collision, the Cessna became affixed to the landing gear of the DC-9. Both aircraft were aligned along their longitudinal axis with the main landing gear of the DC-9 impaled in the trailing edges of the wings of the Cessna. The Cessna was transported in this manner for several miles before it fell free and impacted in a near vertical attitude on the airport.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the inadequacy of air traffic control facilities and services in the Raleigh-Durham

terminal area. The Board further determines that the relative flightpaths of the two aircraft and the configurations physically limited each flight crew's ability to see and avoid the other aircraft.

Recommendations

As a result of this investigation, the National Transportation Safety Board made the following recommendations to the Federal Aviation Administration (FAA):

1. Require an exchange of pertinent traffic information between the control tower and the associated radar approach control facility whenever a pilot, who is operating in accordance with VFR, has requested a service or stated his intended flight operations. Such exchanges of information should be accomplished on a lower priority basis than that accorded to the transmission of control clearances.
2. Require the pilots of all aircraft equipped with an operable transponder to have the transponder turned "on" and adjusted to reply on the appropriate Mode A13 code whenever VFR operations are conducted into, or in proximity to, an airport serviced by a radar approach control facility.

INVESTIGATION

Eastern Air Lines DC-9, N8943E, operating as Flight 898 (EA 898), originated at Miami, Florida, and was scheduled to terminate at Washington, D. C., with en route stops at Raleigh, North Carolina, and Norfolk, Virginia. It departed from Miami with 23 passengers and a crew of four at 1212¹ which was 2 minutes behind schedule. The first officer, seated on the right, was operating the controls. The flight from Miami to Raleigh was conducted under an IFR² flight plan.

The Cessna, N2110F, with a pilot and one passenger, departed the Raleigh Municipal Airport at approximately 1310 for a VFR³ local flight. Contact was established between the Cessna and the Raleigh-Durham Airport Tower at 1332:55. There were no radio communications between Raleigh Approach Control and the Cessna.

The Cessna requested approval from the tower to circle at 500 feet over Morrisville, North Carolina, for a few minutes before entering the traffic pattern. The request was acknowledged and the Cessna circled over the passenger's residence in Morrisville, approximately 3.5 nautical miles from the threshold of Runway 5 and near the extended centerline of the runway.

The Cessna reported southwest of the outer marker at 1342:40 and requested clearance to land. The tower advised that Runway 5 was the active runway and requested the Cessna to report 3 miles on final approach for possible straight-in landing.

At 1344:35, the following conversation was recorded between Raleigh Approach Control and the Raleigh-Durham Control Tower:

¹ All times used herein are eastern standard time, based on the 24-hour clock.

² Instrument Flight Rules

³ Visual Flight Rules

Approach Control: "Eastern 89H is just about a half mile inside the marker now, had to keep him a little late because of some traffic out there he was getting by."

Tower: "Yeah, ok, I got 'em both in sight and that was the Cessna, I believe, out there that was circling Morrisville for some reason. I got 'em in sight, you say he's in front of him now?"

Approach Control: "...yea. he's passing. Well, they're both right together now. I can't tell which one's in front."

The DC-9 contacted Raleigh Approach Control at 1340:55 and was cleared for a straight-in ILS⁴ approach. The DC-9 was given four traffic advisories by Approach Control. In response to the first two advisories (which proved later to be related to the Cessna), the DC-9 replied: "He must be below the overcast, we're gonna be dropping down (in) the overcast in another thousand feet or so." A third advisory was issued. "You're 5 southwest of the outer marker now, traffic is just at the 12:30 position, now at about 2½ miles, appears to be turning northeast bound." The fourth advisory was: "You're at the outer marker right now. That traffic is at your two o'clock position now approximately one mile."

The DC-9 asked Approach Control, "Who (do) you want us to talk to now?" Approach Control replied, "...the tower 119.3, I was just going to keep you until you got past that traffic to make sure you didn't run over him, he could be low, I don't know the altitude." At 1344:15, the DC-9 replied that they had the runway in sight and were instructed to contact the tower.

Fifteen seconds later (1344:30), it reported to the tower, "Just passed the marker we're a little high out here." The tower cleared the DC-9 to continue its approach and advised that traffic was a Cessna just reported the marker inbound. The DC-9 replied, "We just went over the top of

⁴ Instrument Landing System

him there." One minute later the DC-9 was cleared to land. Twenty-five seconds later (1346:15), the DC-9 reported to the tower that they had descended on top of another aircraft, and they did not want to land.

As a result of the collision, the Cessna became lodged in the DC-9 landing gear and remained there for approximately 1 minute and 15 seconds. The Cessna separated from the Eastern DC-9 aircraft after crossing the threshold of Runway 5. It fell and impacted in a near vertical attitude on the airport. The aircraft was demolished by impact and subsequent ground fire. The pilot and passenger received fatal injuries. The DC-9 landed 1 hour and 7 minutes after the collision. The aircraft received minor damage to the fuselage and landing gear. There were 23 passengers and four crewmembers on board, none of whom suffered any injuries.

The Air Traffic Control Specialist at the local control position at the Raleigh-Durham Airport Tower stated in part:

"N2110F next reported over the outer marker and I advised the aircraft to continue approach. Shortly thereafter EAL 898, a DC-9, contacted me and reported passing the outer marker and being a little high. I immediately advised EAL 898 that a Cessna had just reported the outer marker inbound. Eastern 898 then reported passing the traffic and I observed two aircraft in the vicinity of the outer marker. The Eastern DC-9 appeared to be above, to the left and ahead of the other aircraft."

The captain of the DC-9 stated in part:

"Tower advised some traffic had been reported at the outer marker. I advised we must have flown over him. We did not have the traffic in sight."

Witnesses to the accident stated that the Eastern DC-9 overtook the Cessna and the two aircraft merged. They generally agreed that the Cessna was under the fuselage and nearly aligned longitudinally with the DC-9 with the landing gear of the DC-9 behind the wings of the Cessna.

They further stated that the two aircraft remained in this position from the point of collision to a position near the approach end of Runway 5. Witnesses at the airport observed pieces of the Cessna fall off as the aircraft came over the airport and the Cessna break away from the DC-9 and fall nosedown to the ground, and explode on impact.

The foil recorder medium from the flight data recorder was analyzed. A graph was prepared starting when the aircraft departed 7,700 feet and covered the subsequent 6 minutes of flight. The "g" trace was relatively stable with a peak excursion of +1.3 g at approximately 1,150 feet mean sea level with the aircraft on a heading of 48° magnetic at an indicated airspeed of 145 knots. Five seconds after this excursion, the aircraft leveled off at an altitude of approximately 1,050 feet and remained at this altitude for approximately 1%minutes.

The DC-9 was equipped with a cockpit voice recorder. Examination revealed that the cockpit area microphone channel was not recording properly and no data relative to the collision was on the recording.

The National Transportation Safety Board made a visibility study, based on facts obtained from witness statements, the flight data recorder graph, local weather reports, local transcriptions of Raleigh Approach Control and tower communications recordings.

The weather observation made at the Raleigh-Durham Airport by the National Weather Service at 1350 showed an estimated ceiling of 4,500 feet overcast with visibility more than 12 miles with breaks in the overcast. The wind was from 20° at 11 knots.

Raleigh (RDU) Approach Control is located in the city of Raleigh, North Carolina, and is equipped with long range radar. The tower is located at the Raleigh-Durham Airport and is not radar equipped.

The FAA issued Order 7110.22, dated September 19, 1970, Subject: Arrival and

Departure Handling of High Performance Airplanes. Paragraph 5c of this document contains the following directive:

...all terminal radar facilities shall implement either Stage II⁵ or Stage III⁶ of the National Terminal Radar Program by July 1, 1971."

The volume of traffic at Raleigh-Durham Airport would require implementation of Stage II, radar advisory service. The purpose of Stage II service is to adjust the flow of arrival VFR and IFR aircraft into the traffic pattern in a safe and orderly manner. Although pilot participation in this service is not mandatory, pilots of arriving VFR aircraft are encouraged to initiate radio contact with approach control when reaching the perimeter of the area in which Stage II services are provided⁷

The RDU approach control facility was granted an exemption from the requirement to provide Stage II radar advisory service. The type of radar being utilized (long range radar), the location of the antenna (25 miles southeast of the RDU Airport), antiquated telephone key equipment, and personnel shortages were cited in the request for exemption as factors which precluded the provision of expanded radar service at RDU.⁸

The FAA conducted a postaccident flight check of the Raleigh-Durham ILS. It was found to be operating within prescribed tolerances.

No preimpact malfunction or mechanical failure was found during the examination of either aircraft.

⁵Stage II - Radar advisory and sequencing service for VFR aircraft.

⁶Stage III - Radar sequencing and reparation service for VFR aircraft.

⁷Reference, Airman's Information Manual, Part 1, Chapter 4, Terminal Radar Programs for VFR Aircraft.

⁸FAA has programmed the implementation of the Stage II radar advisory service at Raleigh-Durham Airport during November 1972.

Federal Aviation Regulation (FAR) section 91.67, prescribes in part:

"When weather conditions permit, regardless of whether an operation is conducted under Instrument Flight Rules or Visual Flight Rules, vigilance shall be maintained by each person operating an aircraft so as to see and avoid other aircraft ..."

Section 91.67 further prescribes:

"Each aircraft that is being overtaken has the right of way and each pilot of an overtaking aircraft shall alter course to the right to pass well clear."

FAA Terminal Air Traffic Control Handbook, 7110.8B, Chapter 3, Section 10, paragraph 520 states:

"Establish the sequence of arriving and departing aircraft by requiring them to adjust flight or ground operations as necessary to achieve proper spacing."

ANALYSIS

Examination of both aircraft showed no preimpact failure or malfunction of any system or component. Both aircraft had been maintained in accordance with approved maintenance schedules. The crew of the DC-9 and the pilot of the Cessna were properly certificated and qualified to pilot their respective aircraft. (For detailed information see Appendix B.)

The Cessna was being operated in accordance with visual flight rules. The DC-9 was being operated in accordance with instrument flight rules. Since both aircraft were below the overcast and visibility was unrestricted when the accident occurred it was incumbent upon the pilots of both aircraft to maintain vigilance so as to see and avoid other aircraft.

A study of the two flightpaths in relation to time, position, and altitude show the DC-9 to have been above or in the overcast until approximately 3344:14. All four radar traffic advisories were issued prior to this time. The DC-9 crew's ability to observe the Cessna was negated by

clouds during the time the traffic advisories were given.

The study disclosed that the Cessna was not visible to the flightcrew of the DC-9. During the period of time that the DC-9 was in visual meteorological conditions below the clouds, the Cessna was below the DC-9's normal visual horizon.

The Cessna was a high-winged aircraft with restricted overhead visibility. The DC-9 remained behind and in the Cessna's blind spot until just prior to impact.

The approach controller issued four radar traffic advisories to the DC-9, each of which pertained to the only radar target which he observed to be in proximity as both flights proceeded toward the outer marker. Since communication was not established or required with the Cessna, the approach controller had no way of knowing the altitude of the unidentified target or the pilot's intended flightpath. The approach controller indicated his concern regarding the unidentified target by continuing to provide advisories until the DC-9 pilot stated that he was in visual contact with the runway, at which time the aircraft still had not been sighted by the DC-9 crew.

Once the flight had entered visual meteorological conditions, it became incumbent upon the crew of EA 898 to maintain vigilance so as to see and avoid other aircraft, as prescribed by FAR 91.67. However, since the Cessna was below the DC-9's normal visual horizon, the Board concludes that there was insufficient opportunity for either flightcrew to see and avoid the other aircraft. This indicates an inadequacy in the see-and-avoid concept of collision avoidance for the conditions present in this accident.

The tower controller is responsible for the proper sequencing of arrival and departure traffic. At approximately 1341:50, the tower controller was provided with the required control information pertaining to the DC-9, which was then 16 miles southwest of the airport. At 1342:45, the Cessna repeated for the second time, a request to land at the Raleigh-Durham

Airport, describing his position as southwest of the outer marker. At no time did the Cessna pilot refer to his distance from the outer marker or to any change from his previous altitude of 500 feet. The local controller did not attempt to obtain this information but requested a report from the pilot 3 miles out final for a possible straight-in approach.

At the time of the Cessna pilot's initial request for landing, he could have been advised of the DC-9 which was inbound on the localizer course. By not providing this advisory information to the Cessna, the local controller failed to avail himself of a timely opportunity to effect an orderly flow of arrival traffic.

At 1344:15, the Cessna pilot reported over the outer marker. This provided a second opportunity for the local controller to advise the Cessna pilot of the incoming DC-9, which he did not do. Fifteen seconds later the DC-9 pilot reported the outer marker. The local controller transmitted, "ok Eastern 898, continue your approach, traffic is a Cessna just reported the marker inbound." The captain of the DC-9 replied, "We just went over the top of him there." Realizing the limited forward visibility of his aircraft and the proximity of the Cessna, the captain could have requested the tower controller to keep him advised and clear of the traffic. Also, a clearing maneuver might have made the small airplane visible to one or both crewmembers of EA 898.

The tower controller accepted the captain's statement as a report that the DC-9 had passed the Cessna. He did not query the flight as to whether they had the Cessna in visual contact.

In view of the DC-9 captain's report over the outer marker 15 seconds after the Cessna, the local controller should have instructed him to hold over the outer marker or execute a 360° turn to assure proper traffic separation. The instructions issued to the DC-9 to continue the approach 15 seconds behind a Cessna were, in the Board's opinion, not compatible with good operating practices.

The collision may have been avoided if the discussion between the approach controller and the tower controller had occurred prior to the time that both airplanes passed the outer marker. The approach controller said that he “. . . had to keep him (DC-9) a little late because of some traffic out there he was getting by.” The tower controller’s response was: “Yeah, okay, I got him in sight. You say he’s in front of him now?” After deliberation the approach controller replied, “I can’t tell which one’s in front.” This discussion started 5 seconds after the DC-9 reported passing the outer marker and continued for 20 seconds, and ended 20 seconds before the DC-9 reported the collision. During this discussion, the DC-9 transmitted, “We just went over the top of him.” This transmission complicated the situation.

The coordination between the controllers occurred much too late in the sequence of events to permit a proper evaluation of the relative position of the two aircraft. At this time it may have been too late to instruct one of the aircraft to take evasive action to avoid the impending collision.

From the time the Cessna reported over the outer marker until the time of collision, there were no transmissions directed to or received from that aircraft. Although the Cessna was on the same frequency as the DC-9, the Cessna pilot probably did not monitor the transmissions between the tower and the DC-9. It is reasonable to assume that if the Cessna pilot had been aware of the overtaking DC-9, he would have taken some measure of evasive action.

If Stage II radar advisory service, as described earlier in this report, had been available at RDU, this accident might have been prevented. The Cessna pilot probably would have been in communication with RDU approach control and

if so, he would have been provided with timely sequencing service.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of this accident was the inadequacy of air traffic control facilities and services in the Raleigh-Durham terminal area. The Board further determines that the relative flightpaths of the two aircraft and the configurations physically limited each flightcrew’s ability to see and avoid the other aircraft.

RECOMMENDATIONS

As a result of this investigation, the National Transportation Safety Board made the following recommendations to the Federal Aviation Administration (FAA):

1. Require an exchange of pertinent traffic information between the control tower and the associated radar approach control facility whenever a pilot, who is operating in accordance with VFR, has requested a service or stated his intended flight operations. Such exchanges of information should be accomplished on a lower priority basis than that accorded to the transmission of control clearances.
2. Require the pilots of all aircraft equipped with an operable transponder to have the transponder turned “on” and adjusted to reply on the appropriate Mode A/3 code whenever VFR operations are conducted into, or in proximity to, an airport serviced by a radar approach control facility.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/JOHN H. REED

Chairman

/s/OSCAR M. LAUREL

Member

/s/FRANCIS H. McADAMS

Member

/s/LOUIS M. THAYER

Member

/s/ISABEL A. BURGESS

Member

April 5, 1972

1. Investigation:

The Board received notification of the accident at 1415 e.s.t., on December 4, 1971. The investigator in Charge and another investigator were dispatched immediately to the scene from the New York City Field Office with technical assistance from Washington, D.C. Working groups were established for the Cessna, DC-9, Air Traffic Control, Flight Recorder and Cockpit Voice Recorder. Parties to the investigation were Eastern Air Lines, Inc., Federal Aviation Administration, Air Line Pilots Association, Airplane Owners and Pilots Association and the Air Transport Association. The on-scene investigation was completed on December 8, 1971.

2. Hearing:

There was no public hearing.

3. Preliminary Report

No interim report was issued.

CREW INFORMATION

A, DC-9, N8943E

The pilot-in-command, Captain Neal G. Boswell, aged 44, held an FAA Airline Transport Pilot Certificate, No. 1227879, as well as a current first-class medical certificate without restrictions, dated November 11, 1971. Captain Boswell held a type rating in the DC-9 type aircraft. He was employed by Eastern Air Lines on January 3, 1955, and was subsequently qualified as a second and first officer on the Boeing 720. He completed his training on the Douglas DC-9 type aircraft and his DC-9 type rating on June 8, 1969. His last proficiency check was on June 19, 1971, and he completed his last recurrent training on May 5, 1971. Company records showed his total flying time to have been 6446:26 hours, of which 1379:34 hours were accumulated in the DC-9 aircraft. His flight time in the last 24 hours was 5:19, last 7 days 12:59 hours, last 30 days 47:26 hours and the last year 610:17 hours.

First Officer B. E. Dragland, aged 33, held FAA Commercial Pilot Certificate No. 1505606 and Flight Engineer Certificate No. 1710823 as well as a current first-class medical certificate without restrictions, dated May 10, 1971. He was employed by Eastern Air Lines on June 20, 1966. He was qualified as first officer on the DC-9 and CV-440 and second officer on the L-188. First Officer Dragland completed his initial training on the DC-9 on September 8, 1968, with a proficiency check in the aircraft. His last proficiency check was in the flight simulator on October 10, 1971. His last line check was on December 4, 1970, and he completed his last recurrent training on August 26, 1971. Company records showed his total flying time to have been 2242:28 hours, 1893:28 hours of which were accumulated in the DC-9 aircraft. His flight time in the last 24 hours was 5:19, last 7 days 6:22 hours, last 30 days 45:34 hours and the last year 607:44 hours.

Stewardess Charlotte Avchen, was employed by Eastern Air Lines in May of 1967. She completed her DC-9 training and qualification on May 24, 1967. Her most recent DC-9 training was completed in August 1971.

Stewardess Shannon Henry was employed by Eastern Air Lines in June 1968. She completed her DC-9 training and qualification on June 14, 1968. Her most recent DC-9 training was completed on July 13, 1971.

B. Cessna, N2110F

Pilot Willis Smith, Jr., held Commercial Pilot Certificate No. 353169, issued May 9, 1970, with ratings in airplane, single and multi-engine land, instrument and private pilot privileges in gliders. His secondclass medical certificate was dated September 30, 1971, with the limitation that he must wear glasses for near vision.

The pilot's logbook was not located, therefore, an accurate account of the pilot's flying time was not obtained. On an application for an Airman's Medical Certificate, dated October 3, 1969, the pilot claimed 800 hours of civil time, 1200 hours of military time, and 100 hours flown in the past 6 months. On a more recent application for a medical certificate dated September 30, 1971, the pilot claimed 1000 hours of civil time, 1500 hours of military time and 100 hours flown in the past 6 months.

AIRCRAFT INFORMATION

N8943E, a Douglas DC-9 model 31 aircraft. SIN 47166, was delivered on February 29, 1968. It was powered by two Pratt & Whitney JT8D engines.

The total time on the aircraft was 10,304:47 hours. Time since the last major inspection was 235 hours and 32 hours since the last line maintenance.

The No. 1 engine, S/N P656832D, had flown 9,986:47 hours since manufacture. The No. 2 engine, SIN P649544D, had a total of 14,651:47 hours flying time; 4,293:47 hours of this time had been flown since the last overhaul.

N211OF was a Cessna model 206 aircraft, serial number U206-0310. Its airworthiness certificate (normal) was issued on November 21, 1964. It was powered by a Continental I0-520 engine, serial No. 10663-4-A, and a McCauley DC-A 34C-58 type propeller.

Total time on the aircraft log was 1,498 hours. The last annual inspection was performed on November 19, 1971, with the aircraft time at inspection 1,498 hours. The engine had also accumulated 1,498 hours with 107 hours since overhaul.