

Adopted!

Log 2292



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 12, 1991

In reply refer to: A-91-27 through -31

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

On January 18, 1990, at 1904 eastern standard time, Eastern Airlines flight 111 (EA 111), N8867E, a Boeing 727-225A, collided with N44UE, an Epps Air Service Beechcraft King Air A100, while EA 111 was landing on runway 26 right at the William B. Hartsfield International Airport, Atlanta, Georgia, and as the King Air A100 was preparing to turn off the runway after having landed ahead of EA 111. Both airplanes were in radio communication with the Hartsfield Air Traffic Control (ATC) tower local controller at the time of the accident. As a result of the collision, the King Air A100 was destroyed and the B-727 received substantial damage. The pilot of the King Air was fatally injured, and the copilot was seriously injured. There were no passengers onboard the King Air and there were no reported injuries on the B-727.¹

The final controller was responsible for maintaining separation of succeeding airplanes on the approach to the outer marker of Hartsfield Airport's runway 26 right. The monitor controller was responsible for maintaining separation of succeeding airplanes on the approach from the outer marker to within 1 mile of the runway. It is evident, by the airspeed reductions that were issued by the monitor controller to the flightcrew of N44UE, that he was attempting to achieve additional separation between Continental Airlines flight 9687 (CO 9687), a DC-9, and N44UE prior to N44UE crossing the runway threshold of 26 right. The recorded radar data indicate that the separation between CO 9687 and N44UE never exceeded 3.5 miles. Therefore, the monitor controller's action failed to achieve the 4 mile minimum required separation standard. He also failed to compensate for the added closure rate that occurred between N44UE and the following airplane, EA 111, as a result of the airspeed reductions he issued to N44UE.

¹For more detailed information, read Aviation Accident Report--"Runway Collision of Eastern Airlines, Flight 111, Boeing 727 and Epps Air Service, Beechcraft King Air A100, William B. Hartsfield International Airport, Atlanta, Georgia, January 18, 1990" (NTSB/AAR-91/03)

EA 111 was about 4.0 miles behind N44UE at FREAL intersection. In order to accomplish the desired sequencing of EA 111 trailing N44UE, an early speed reduction for EA 111 was required. A timely and sufficient airspeed reduction adjustment was not issued by either the final controller or the monitor controller.

The required separation between EA 111 following N44UE was 2 1/2 miles inside the final approach fix. It appears that the monitor controller was late in recognizing the potential conflict of decreasing separation between N44UE and EA 111. About 6 miles from the runway, he assigned an airspeed change to EA 111, "reduce to your final approach speed." This speed assignment was not in conformance with the ATC Handbook, which states that a controller shall advise an aircraft to increase or decrease to a specified speed in knots. In addition, the monitor controller did not receive an acknowledgement from the flightcrew of EA 111 for the instruction to reduce to approach speed, and thus should not have assumed that the instruction had been received and complied with. Therefore, the monitor controller initiated a sequence of events that caused the final approach interval spacing to quickly approach the minimum of 2 1/2 miles. Although he was relieved of direct responsibility for the ensuing loss of separation when the north local controller transmitted "EA 111, you are in sight, cleared to land 26 right," the Safety Board believes that the monitor controller's action contributed to the speed differential and to the overtake that ultimately was a factor in the accident. At the time of the north local controller's transmission, EA 111 was almost 6 miles from the runway and the King Air was about 3 miles out. However, the distance between the two aircraft was decreasing at an unacceptable rate and was less than the required 2.5 miles separation as N44UE arrived at the runway threshold.

The Safety Board reviewed the pertinent FAA Air Traffic Control Handbook 7110.65F requirements and concluded that the instructions contained therein clearly define the controller's responsibilities for "same runway separation" and "anticipating separation." The Safety Board concluded that the physical evidence on the runway and on both airplanes indicated that the collision occurred on a runway that was the responsibility of the north local controller.

The Safety Board concludes that this accident was a result of lapses in the performance of the Atlanta tower north local controller and, to a lesser extent, the performance of the Atlanta approach control north final controller and the radar monitor controller. Specifically, the north local controller did not ensure the separation of the aircraft approaching and landing on runway 26 right. Further, he failed to follow the prescribed procedure of issuing appropriate traffic information to the crew of EA 111. This information would have improved the flightcrew's situational awareness and their motivation to search for the preceding King Air. The Atlanta approach north final controller and the radar monitor controller had opportunities to issue timely speed reductions to ensure that adequate separation was maintained between the successive aircraft on final approach but did not do so.

Although these lapses of controller performance are cited as causal, the Safety Board also has chosen to recognize that the controllers' performance was a direct product of FAA air traffic management institutional decisions and practices that do not allow for human performance lapses in judgement or decision making. The air traffic control procedures permitted the local controller to assume full and complete responsibility for in-trail separation of aircraft on the final approach by invoking visual separation standards. As a result, two critical problems arose: (1) the separation distance between EA 111 and N44UE was reduced from the radar requirement of 2.5 miles minimum (inside the final approach fix) to some indeterminate distance necessary for N44UE to clear the runway prior to the arrival of EA 111 over the threshold; (2) an important redundant element, (the monitor controller) was removed from the loop. In addition, the air traffic procedures allow for the issuance of multiple landing clearances, which were issued in this case to CO 9687, N44UE and EA 111 in a period of 49 seconds while all three aircraft were still on final approach. An effect of this action was to remove another redundant element in the system: all aircraft had their landing clearances, and therefore no further communications with the local controller were necessary. When the simple but compelling distractions caused the local controller to divert his attention away from the landing aircraft, the stage was set for this accident.

It is well-documented that human performance is subject to simple lapses (errors of omission), particularly in the presence of distracting events. Thus, the designers and operators of complex systems, such as the Air Traffic Control system, who implement design features and operating procedures that allow one individual to assume the full burden for safety-critical operations must bear some of the responsibility for accidents attributed to the occasional lapse in the performance of a single individual.

Therefore, in addition to noting individual performance in the assessment of causal and contributing factors, the Safety Board cites the broader failure of the Federal Aviation Administration to provide air traffic control equipment and procedures that adequately take into consideration those occasional lapses in human performance that must be expected.

In examining the specific circumstances of this accident, the Safety Board became concerned that the current provisions in air traffic control procedures permit the controller to issue landing clearances to several aircraft in succession without assurance that the adequate separation will be maintained between those airplanes as they approach the landing threshold.

In the 1977 edition of the Air Traffic Control Handbook, 7110.65A, the issuance of multiple landing clearances was not allowed. Specifically, paragraph 1122, "Anticipating Separation," stated, "Landing clearance need not be withheld until prescribed separation exists if there is reasonable assurance it will exist when the aircraft crosses the landing threshold. However, do not clear a succeeding aircraft to land on the same runway before a preceding arriving aircraft crosses the landing threshold..." This is basically the same text that is contained in the current Handbook, 7110.65F; however, the earlier procedures went on to say, "...do not clear more than the first two aircraft to land at any one time and include traffic

information with the clearance." During March 1978, this paragraph was changed to delete the numerical limits for clearing aircraft to land. The Safety Board believes that current air traffic control procedures, as they pertain to the anticipated separation of arriving aircraft, require nearly flawless human performance that makes no allowance for an error of omission or lapse of attention due to any type of distractive event. Therefore, the Safety Board believes that the procedures contained in the Air Traffic Control Handbook, 7110.65F, paragraph 3-127, "Anticipating Separation," should be amended to preclude the issuance of multiple landing clearances to aircraft outside of the final approach fix. Also, a numerical limit should be established so that no more than two landing clearances may be issued to successive arrivals.

The Safety Board believes that this change will increase system effectiveness, while not creating an undue burden on the controller. Nevertheless, pilots also have a responsibility for separation assurance on the runway and vigilance during landing must be a shared. The Safety Board is aware that if the local controller had provided traffic information to the crew of EA 111, the accident might have been prevented. This procedure, had it been followed, would probably have prompted the crew to query the local controller as to the position of their traffic on the runway, since it was unlikely that visual observation would have occurred. As a system redundancy, the Safety Board believes that the importance of issuing traffic information to arriving aircraft should be stressed. Therefore, the Safety Board believes that a mandatory, formal briefing should be provided to all air traffic controllers on the importance of, and the need for, giving traffic information when issuing an anticipated separation landing clearance. The briefing should be contained in an Air Traffic Bulletin.

The Safety Board's concern about the hazard of runway incursions dates back to 1972 following an accident at the Chicago O'Hare International Airport.² As a result of that accident, four Safety Recommendations were issued to the FAA addressing air traffic control procedures and pilot-controller communications.³ The Board's concerns were further reiterated in 1979 following two more runway incursions incidents and one accident.⁴ These occurrences prompted the Board to recommend that the FAA conduct a directed safety study to examine the runway incursion problem and to formulate recommended remedial action to reduce the likelihood of such hazardous conflicts. That recommendation was issued in June 1979.

²North Central Airlines, Inc., McDonnell Douglas DC-9-31, N954N and Delta Air Lines, Inc. Convair CV-880-N8807E, O'Hare International Airport, Chicago, Illinois, December 20, 1972. NTSB/AAR-73-15.

³Since 1972, the Safety Board has issued 42 safety recommendations to the FAA addressing the problem of runway incursions. A summary of these recommendations and their current status is contained in appendix F.

⁴Midair Collision Involving a Falcon Jet, N121GW, and Cessna 150M, N6423K, Memphis, Tennessee, May 18, 1978. NTSB/AAR-78-14.

In response, the FAA commissioned the Transportation Systems Center in Cambridge, Massachusetts, to conduct a study. The study was completed in April 1981 with a report entitled "An Analysis of Runway-Taxiway Transgressions at Controlled Airports." The study concluded that "there does not appear to be any pattern to the causes . . . other than human errors on the part of both air traffic controllers and pilots." The study also concluded that "more uniform communication and verification of messages between pilots and controllers could serve to reduce the chance of ambiguous or erroneous commands/actions." The report raised the question as to whether system reliability might be improved by increasing the reliability of the human element or by adding redundant elements. The study did not evaluate controller training or human performance issues. The study did suggest that incident reporting might be part of the problem since there were indications that not all incidents are reported, which caused a situation that precluded appropriate corrective measures. Furthermore, the report did not propose any specific corrective measures.

Although the FAA did conduct the study on the runway incursion problem, the study did not result in the development of remedial action to reduce or alleviate the problem.

The Safety Board's concern about the problem was heightened again after it investigated a near collision between two DC-10's at the Minneapolis-St. Paul International Airport on March 31, 1985. That occurrence prompted the Board to undertake a special investigation study of runway incursion incidents. Since that time, additional incidents and accidents have continued to occur,⁵ which suggests the need for other measures to resolve this problem.

During 1985 and early 1986, the Safety Board investigated 25 more runway incursion incidents that were summarized in a special investigation report adopted on May 6, 1986.⁶ The Safety Board found that the incursions were the result of both controller errors and pilot deviations.

The report indicated that controller operational errors generally resulted from a coordination breakdown between local and ground controllers or distractions that diverted a controller's attention from a developing or established conflict situation. Pilot deviations accounted for about 30 percent of the incursions investigated by Safety Board staff and involved misinterpretations of clearances and unauthorized runway crossings. Many of

⁵Collision in Detroit, Michigan, December 3, 1990, between Northwest flights 299 and 1482, and collision in Los Angeles, California, February 1, 1991, between USAir 1493 and SkyWest 5569 are under NTSB investigation.

⁶Additional information on the general subject of runway incursions can be found in the National Transportation Safety Board, Special Investigation Reports, "Runway Incursions at Controlled Airports in the United States," NTSB/SIR-86/01, May 1986, and an FAA publication "Reducing Runway Incursions: An FAA Report" dated April 1990.

the incursions could have been avoided, if the pilots had looked for traffic before proceeding onto an active runway.

Fourteen recommendations were sent to the FAA addressing issues, such as procedures, training, pilot and controller communications and airport signing. The FAA took several actions in response to the Board's recommendations. These actions included establishing a runway incursion data base, distributing training material, including a video tape to bring controller and pilot attention to the problem, changes to controller and pilot phraseology, and placing more emphasis on airport taxiway guidance signs.

The MITRE Corporation also conducted an analysis of runway incursions summarized in a report in April 1989. This report⁷ defined controller-related factors as follows:

- o Erroneous scanning, or failure to scan the runway or approach path (local controller [LC] and ground controller [GC]).
- o Forgetfulness about the traffic situation (LC and GC).
- o Misjudgment of traffic separation (LC).
- o Lack of coordination or inadequate coordination with the LC on runway crossings (GC).
- o Errors in sending or receiving clearances and instructions (LC and GC).

The runway collision of EA 111 and King Air N44UE involved these same controller-related factors identified by both Safety Board and the MITRE corporation studies.

These factors are related to human performance and are being addressed in a number of different actions, including FAA and industry efforts to increase awareness of the magnitude and nature of the human performance problem, improved training and technological solutions that may reduce the workload, and a fail-safe redundancy for the human performance of air traffic controllers.

The Safety Board is aware of several advanced concepts in airport surface traffic detection and automation that, when perfected with the correct match of hardware and location-specific software, could provide warnings to preclude accidents of a nature similar to the collision of EA 111 and N44UE. For example, the FAA is currently testing an Airport Movement Area Safety System (AMASS). The AMASS system will use the data available in Airport Surface Detection Equipment (ASDE-3) and the Automated Radar Terminal System (ARTS) to identify potential incursions and will alert the controller

⁷The MITRE Corporation, "An Analysis of ATC-Related Runway Incursions, with Some Potential Technological Solutions," MTR-89W0021, April 1989.

so that timely corrective actions can be taken. The Safety Board fully supports the early development and installation of such systems at airports where the volume and complexity of traffic flow dictates its use.

On a broader scale, the Safety Board encourages the FAA to continue the research effort in Airport Surface Traffic Automation (ASTA), which is intended to develop automation tools and more complete automation for controlling the flow of aircraft on the airport surface. In addition to reducing the frequency of runway incursions, design goals of the program should include a reduction in taxiway incursions and improvements in ATC operational efficiency. This automation is intended to support interactions among the various aircraft on the airport surface and on the approach path, and their interaction with automation elements such as Departure Flow Management (DFM) and Terminal Air Traffic Control Automation (TATCA).

Although the Safety Board fully supports and encourages these efforts, it realizes that these programs are long term and are intended for a limited number of high-density air carrier airports. Therefore, the operational benefits will not be available until the late 1990's, or later. The Safety Board believes that although the efforts of the FAA are commendable, the FAA should expedite its efforts to fund, support, and implement an operational system analogous to the airborne conflict alert system to prevent runway incursion incidents at all U.S. certificated airports that are served by air carriers. The progress of preventive measures will be more fully examined and updated in future Safety Board reports.

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

Develop an Air Traffic Bulletin and provide a mandatory formal briefing to all air traffic controllers on the importance of, and the need for giving traffic information when issuing an anticipated separation landing clearance. (Class II, Priority Action) (A-91-27)

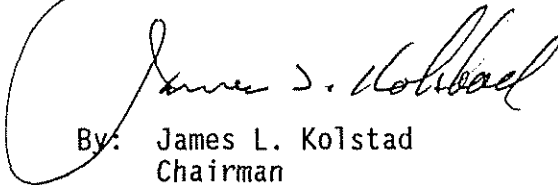
Amend the Air Traffic Control Handbook, 7110.65F, paragraph 3-127, to preclude the issuance of multiple landing clearances to aircraft outside of the final approach fix. Also, establish a numerical limit so that no more than two landing clearances may be issued to successive arrivals. (Class II, Priority Action) (A-91-28)

Expedite efforts to fund the development and implementation of an operational system analogous to the airborne conflict alert system to alert controllers to pending runway incursions at all terminal facilities that are scheduled to receive Airport Surface Detection Equipment (ASDE III). (Class II, Priority Action) (A-91-29)

Conduct research and development efforts to provide airports that are not scheduled to receive Airport Surface Detection Equipment with an alternate, cost effective, system to bring controller and pilot attention to pending runway incursions in time to prevent ground collisions. (Class II, Priority Action) (A-91-30)

Incorporate into the training syllabus at the Federal Aviation Administration's Academy at Oklahoma City, Oklahoma, materials which stress the importance of and the need for giving traffic information when issuing an anticipated separation landing clearance. Stress that this information will enhance pilot awareness and visual acquisition of preceding traffic, thereby providing a redundancy in separation assurance for controllers and pilots. (Class II, Priority Action) (A-91-31)

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



By: James L. Kolstad
Chairman