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# National Transportation Safety Board

Washington, D.C. 20594

## Safety Recommendation

**Date:** May 13, 1987

**In reply refer to:** A-87-52 through -55

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

The National Transportation Safety Board's investigation of several recent incidents involving operational errors committed by air traffic controllers provide cause for concern about the level of safety of the U.S. air traffic control (ATC) system. The findings from these investigations show that the nation's ATC system is at times overburdened with traffic; lacks continuously effective terminal and en route traffic flow control programs; and, at some control facilities, lacks the number of qualified controllers necessary to fully staff control positions throughout the day. Also, the Safety Board is concerned that the number of ATC operational errors, one indicator of system safety, has risen during the past few months reversing the generally decreasing trends during the preceding year. The number of runway incursions, another safety indicator, has also risen during the last 2 years. Finally, the number of reports of near midair collisions and particularly the number which involve at least one *air carrier airplane* increased between 1985 and 1986. These indicators suggest an erosion of safety in the ATC system which may worsen as a result of the predictable increases in air traffic and the typical convective weather during the summer season ahead.

During the course of its current investigations of accidents and incidents, the Safety Board is continuing to examine the relevant aspects of the ATC system including facility staffing levels, training, quality assurance and controller procedures, as well as the effect of the steady increase in traffic level. Findings related to these broad issues will be addressed in detail in future accident reports and safety recommendations. However, because of its strong concern about the safety of the ATC system during the summer months ahead, the Safety Board is directing this letter to the immediate need for Federal Aviation Administration (FAA) action to reduce air traffic density when and where the ATC system is operating at near saturation levels until a flow control program is developed which can meet the dynamic requirements of the system.

### System Safety Indicators

The Safety Board believes that the frequency of operational errors which lead to compromises of the separation standards for aircraft in flight or on the runway is one effective indicator of ATC system safety. The total number of operational errors increased 18 percent during the first quarter of 1987 when compared to the first quarter of 1986. This recent increase contrasts sharply with a general reduction in operational errors during 1985 and 1986. Runway incursion incidents caused by controller performance deficiencies have increased nearly 50 percent from 77 during 1984 to 115 during 1986. Near midair collision reports have also increased during the past year. The

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total number of near midair collision reports may not be a direct indication of ATC system performance since they often involve visual flight rules (VFR) traffic. However, the Safety Board finds it most significant that 57 of the reported 1986 encounters involved critical hazards 1/ for air carrier aircraft, most of which were presumably operating with the protection afforded by the ATC system. This represented a 42 percent increase over 1985 occurrences.

Historically, the number of operational errors and near midair collisions has increased substantially during mid-year months. These increases are believed to be related, primarily, to increased traffic levels during the summer flying period. This year, however, the expected upturn is starting at a level already well above the comparable period in 1986. Thus, the Safety Board is concerned that the tendency for operational errors and the potential for a catastrophic accident will continue to increase during the 1987 summer months.

#### Safety Board Investigations

The Safety Board dispatched teams of investigators to examine the circumstances of several recent operational errors. These teams were staffed with an operational investigator-in-charge, two air traffic control specialists, and a human performance investigator.

On February 25, 1987, a runway incursion accident occurred at the Los Angeles International Airport, Los Angeles, California. The accident involved a collision between Continental Airlines flight 866, a Boeing 727, and N98834, a Cessna 310R. Flight 866 had been cleared to take off on runway 25R by the tower south local controller while the Cessna had been cleared to taxi across runway 25R by the south ground controller. The aircraft collided at the intersection of runway 25R and taxiway 47J when the right main landing gear of the Boeing 727, which had just lifted off, struck the vertical stabilizer of the Cessna 310R causing substantial damage to the Cessna airplane.

On March 31, 1987, an operational error incident occurred in the airspace controlled by the Cleveland Air Route Traffic Control Center (ARTCC) near the Dryer navigational fix. The error involved Northwest flight 427, a DC-9, en route from Allentown, Pennsylvania, to Detroit, Michigan, and N52DC, a Falcon DA50, en route from Saginaw, Michigan, to Washington, D.C. Flight 427 was given a heading of 360° and a descent from flight level (FL) 290 to FL 240. The Falcon was at FL 290 and was turned to a heading of 170°, then was turned further to 210° and cleared to climb to FL 310. The two airplanes passed each other with 1 1/2 miles horizontal and 800 feet vertical separation.

On April 3, 1987, an operational error incident occurred in the Bridgeport, Connecticut, sector of the Boston ARTCC. The error involved Pan American flight 528, a B727, en route from LaGuardia, New York, to Boston, Massachusetts, and Continental Airlines flight 602, a DC-9 en route from Dulles, Virginia, to Bradley Airport at Windsor Locks, Connecticut. The radar controller issued a climb clearance to flight 528 to 14,000 feet and provided a traffic advisory concerning flight 602. Pan American flight 528 advised he had traffic in sight. The radar controller thought that he had issued a descent clearance to 15,000 feet to flight 602 and that vertical separation would exist when the

1/ Critical: A situation where collision avoidance was due to chance rather than an act on the part of the pilot. Less than 100 feet of aircraft separation would be considered critical.

aircraft flightpaths crossed. Actually, he had issued a descent clearance to 14,000 feet which had been acknowledged. The flightcrew of Pan American flight 528 adjusted their rate of climb to avoid a potential midair collision and separation was lost when the aircraft passed with 400 feet vertical separation and 0.69 mile lateral separation.

On April 9, 1987, an operational error led to a runway incursion incident at Logan International Airport, Boston, during night VFR weather conditions. The error involved Northwest flight 35, a DC-9, taxiing for takeoff on runway 9 and Precision Airlines flight 509, a BE-99 which had been cleared for a visual approach to land on runway 4L. There was training in progress on both the local and ground control positions. The local controller approved the request of flight 35 to cross on runway 4L and while it was exiting the runway, flight 509 reportedly overflew the vertical tail of the DC-9. The tower supervisor became concerned as he observed the incident developing. Although he vocalized his concern, the error still occurred.

On April 13, 1987, an operational error incident occurred at the Hampton sector of the Boston ARTCC. The error involved USAir flight 64, a B-737 en route from Philadelphia, Pennsylvania, to Boston, and Eastern Air Lines flight 695, a B-727 en route from Boston to Washington National Airport. The aircraft were on opposite direction and parallel courses, with flight 695 level at FL 280 and flight 64 level at FL 270. The radar controller issued a climb clearance to flight 64 to FL 290 as the aircraft were passing. The aircraft did not have standard separation when the conflict alert activated. The aircraft passed with 400 feet vertical separation and 2.88 miles lateral separation.

On April 16, 1987, an operational error incident occurred at the Manchester Terminal Radar Approach Control (TRACON) position which is a part of the Boston ARTCC. The error involved Bar Harbor Airlines flight 756, a BE-99 en route from Boston to Burlington, Vermont, at 8,000 feet and N456DA, a PA-31 en route from Bangor, Maine, to Teterboro, New Jersey, at 8,000 feet. Both aircraft were on instrument flight rules (IFR) flightplans, and the aircraft passed with 0 lateral and approximately 200 feet vertical separation as the BE-99 was nosed over to avoid an imminent midair collision. The radar controller was aware of the pending conflict, yet was busy issuing coordination instructions and holding aircraft in his airspace as a result of adjacent center sector saturation. The controller did issue a descent clearance to flight 756 when the aircraft were approximately 1 mile apart. Both aircraft filed a near midair collision report as a result of the near collision.

The Safety Board's recent and past investigations of operational errors (and runway incursions incidents) have disclosed that the factors and circumstances of the errors vary and that the errors cannot be attributed to one single cause. Most of the occurrences, particularly those which have involved tower personnel, were the result of a breakdown in controller procedures, poor coordination, and a general lack of supervision. In many of the cases described in a special investigation of runway incursions, <sup>2/</sup> Safety Board investigators found that supervisors were either working a control position or performing other duties which precluded their availability to provide oversight and resolution of developing conflicts. The Safety Board's findings generally support the FAA's analysis <sup>3/</sup> which shows that operational errors are committed by both experienced and inexperienced controllers and are just as apt to occur during periods when traffic is

<sup>2/</sup> For more detailed information, read, Special Investigation Report—"Runway Incursions at Controlled Airports in the United States" (NTSB/SIR-86/01).

<sup>3/</sup> Profile of Operational Errors and Deviations in the U.S. Air Traffic System, Calendar Year 1985, dated May 1986.

moderate or light as when traffic is heavy. Nonetheless, the Safety Board believes that a continual increase in daily workload can be a factor which increases a controller's vulnerability for error, that longer periods between breaks and the cyclic nature of the workload can lead to an insidious loss of attentiveness during a period of reduced traffic with serious consequences.

When Safety Board investigators interviewed randomly selected controllers in TRACON, tower, and ARTCC facilities, nearly all of those interviewed in the ARTCC facilities expressed concern about the increasing levels of traffic they were required to control during some periods of their work shifts. They stated that certain sectors become extremely busy and present complex traffic situations during some periods as air carrier airplanes operate to and from their major hubs for flight connections.

The controllers' observations of a continually growing workload are substantiated by a recent FAA report which shows that at 22 airports, the average daily operations for February 1987 have increased 10.2 percent when compared to July 1981, just before the Professional Air Traffic Controllers Organization (PATCO) walkout. Individually, these data show that Atlanta has increased 25 percent, Los Angeles has increased 17 percent, Detroit has increased 46 percent, and Newark has increased 55 percent. This same report shows that the average daily operations at the 20 ARTCC's have increased 10.4 percent when compared to 1981. Individually, these data show the average at Atlanta ARTCC has increased 28 percent, Los Angeles has increased 35 percent, and Boston, Jacksonville, and Washington ARTCC's have all increased 21 percent.

While the controllers did not believe that the current situation should be categorized as "unsafe," many believed that an unsafe situation could develop if the traffic volume continues to increase. In fact, many controllers in the facilities expressed concern that the controller staff on board will not be sufficient in terms of numbers, qualifications, and experience to cope with the needs of their facility during the coming summer. In addition, the controllers believe that overtime needs and scheduled leave will exacerbate the problem, particularly where the flexibility to use some controllers in busy positions is limited by individual qualifications. They were concerned that many of the controllers who will be staffing busy positions this summer have not had experience handling the complex air traffic control situations that develop when the circumvention of thunderstorms is required, and to do so under increased levels of traffic could lead to an unsafe condition.

### Discussion

The function of the ATC is to promote and assure the safe, orderly, and expeditious flow of aircraft from their departure to their destinations. The system has evolved with the growth of air traffic into a complex array of ground-based radar systems, computers, navigational aids, and communication equipment. The Safety Board acknowledges that the continual advancements of this system since the early 1970's including the en route and terminal radar, conflict alert logic, and airspace segregation have had significant effects on both safety and system capacity. Although there are assorted automated features, the primary element in the system remains the air traffic controller. The controllers still must mentally perceive and project the flow of aircraft as they enter their assigned airspace, decide the direction and altitude that each aircraft must fly in order to pass through the airspace while maintaining a prescribed separation from all of the other aircraft, and communicate the proper commands to the pilot. A controller may have more than 20 aircraft to track and direct at a given time. The Safety Board recognizes that it is a demanding task that requires special aptitudes, training, experience, and mental discipline.

In August 1981, over 11,000 controllers of the total staff of about 17,000 were terminated after the PATCO walkout. In anticipation of the PATCO strike, the FAA had developed a contingency plan which was initiated after the walkout. The plan permitted continued operation of the ATC system at a restricted level by the remaining controller workforce augmented by FAA supervisory staff, military controllers, and the extensive use of overtime. The ATC restrictions imposed included the allocations of slots for scheduled traffic in and out of major airports and a reservation system to limit general aviation access to the ATC system. At the same time, the FAA undertook a massive program to hire and train a replacement workforce at an accelerated pace. The combined efforts of traffic restrictions and restaffing and the dedicated performance of the working controllers sustained the system from 1981 through 1984. The Safety Board believes that the FAA's performance during that period was commendable. By 1984, the restaffing efforts had progressed to the extent that the slot allocation and general aviation reservation programs were lifted except for four major airports <sup>4/</sup> defined as high-density traffic airports where specific limitations are still imposed on the number of IFR operations that can be scheduled or reserved during any given hour.

Access to the ATC system today is otherwise unrestricted except for the daily metering of traffic in the system provided by a limited flow control program which is managed from a Central Flow Control Facility in the FAA's Washington headquarters. The present flow control program is imposed to maintain a flow of aircraft into the major terminals which is consistent with the established acceptance rates for those airports with consideration for factors such as terminal area weather and runway configuration in use. The program is not capable of detecting or preventing a traffic overload in individual ARTCC sectors. During en route flight, the aircraft destined for the different major terminals intermix with each other and with aircraft bound for less busy airports for which there are no flow control limits. Consequently, the present flow control has no predictive capability for sector saturation and en route traffic is regulated at the ARTCC and TRACON facility level. This regulation is effected by traffic managers who are responsible for monitoring the overall situation and by individual controllers who meter the traffic by maintaining prescribed in-trail separation distances to ensure that traffic is passed from sector to sector and en route to terminal facilities in an orderly progression.

Although the level of traffic operating within the ATC system has been permitted to increase, the controller workforce has not yet reached its full strength. The total number of controller personnel on board is close to the stated objective of 15,225. However, many of these controllers still have to complete their training, and the FAA must redistribute controllers to understaffed facilities before complete stability of the workforce is achieved. Even then, it will take years to reacquire a workforce with an experience level comparable to that which existed before the 1981 PATCO walkout.

However, the strength and experience level of the controller workforce is only one of several factors which affect the ability of the ATC system to accommodate increasing levels of traffic safely. Even with a full staff of trained and experienced controllers, there is a limit to ATC system capacity imposed by the required spacing of airplanes that can be landed and departed from the airport runways available (airport acceptance rates) and the rate at which airplanes can be intermixed as they move with an orderly flow and prescribed separations through a given volume of en route airspace. Other factors affecting these rates include the complexity introduced by individual sector geographical size and characteristics, converging airways, the presence of hazardous weather, radio frequency congestion, and the wide variation of performance characteristics of different

<sup>4/</sup> The high-density traffic airports are John F. Kennedy, LaGuardia, O'Hare, and Washington National.

airplanes. The Safety Board believes that the peak traffic flow in some parts of the ATC system today is approaching the limits imposed by these considerations. In fact, the present staffing shortages of certain facilities notwithstanding, ATC facilities now are generally able to staff all control positions with qualified persons during the periods when peak traffic flow is anticipated. Thus, while the overall level of experience may be a factor, the staffing shortages per se are probably not a significant limitation to the maximum level of traffic that can be safely handled during the peak periods. The staffing shortages might become a factor in the total daily capacity of the ATC system if the need to handle peak traffic were extended throughout the day, thus requiring that all control positions remain staffed for prolonged periods. However, the Safety Board does not believe that arbitrary increases in the number of controllers, over the presently authorized full staffing level, would produce a corresponding increase in the number of aircraft that the ATC system could handle safely.

During the last several months airlines have experienced mounting delays for scheduled departure and arrival flights. Deregulation and airline hubbing concepts have been major factors in these delays, which have been increasing and will continue to rise with the increase in flights during the upcoming summer travel period unless corrective action is implemented. These delays occur because the airlines schedule more departure and arrival flights during a specific time period than the airports and ATC system can accommodate. The FAA has stated that it will continue to adhere to its policy to hold airplanes on the ground at their departure points until the ATC system capacity is capable of handling the airplanes for their entire flight routing, and the Safety Board strongly supports this policy. Theoretically, airplanes should not be required to fly holding patterns as a result of in-flight delays except for unforeseen circumstances such as weather, runway closings, or ground equipment discrepancies. However, during visits to the Boston and Cleveland ARTCC's, Safety Board investigators learned that some aircraft destined for Boston Logan Airport and Chicago O'Hare Airport are required to hold in flight because airborne traffic is exceeding the airport acceptance rates. The Safety Board believes that this situation indicates limitations in the ability of the present ATC flow control program to adjust system demand to match system capacity.

The Safety Board is particularly concerned that any FAA actions to succumb to industry and public pressure to reduce delays by relaxing restrictions on access to the ATC system will overtax airport and controller capabilities. In this regard, the FAA's recent actions to relax several flow control measures, including a reduction in in-trail restrictions to as little as 10 nautical miles in some airspace, could adversely affect controller workload and compromise system safety. The Safety Board is not aware of the extent to which the FAA evaluated the potential impact of these actions and believes that a thorough analysis must consider such factors as controller workforce experience and the complexities that can arise when thunderstorms develop suddenly.

The Safety Board believes that a safer way to reduce airline delays and to alleviate the peaks in ATC system demand is to impose realistic flight scheduling by all the air carriers. Some departure and arrival times for scheduled flights must be rescheduled to times when the airports and ATC system are underused. The Safety Board understands that the recent efforts of the Office of the Secretary of Transportation (OST) and the FAA to elicit cooperation with the airlines to resolve scheduling peaks has been partially successful. The Safety Board believes that the OST and FAA should continue to encourage and coordinate voluntary actions by the air carriers to achieve schedules compatible with ATC system capacity. If voluntary measures are not successful, the FAA should review the need for other actions such as an extension in the application of the high-density traffic airport limitations.

The Safety Board believes that the key to achieving maximum ATC system capacity involves the implementation of effective and efficient traffic management programs. These traffic management or flow control programs should be automated and should include predictive capabilities based on the dynamic analysis of traffic conditions. The traffic management programs should be adequate to ensure that the workload of individual controllers does not exceed safe levels.

The Safety Board's staff has been briefed on the FAA's new aircraft situation display (ASD) which has been developed for use in its Central Flow Control Facility. The Safety Board understands that this new program will provide the capability for flow control technicians to analyze real-time traffic conditions in all 20 domestic ARTCC's. The Safety Board hopes that the program will be used to conduct comprehensive analysis of individual ARTCC sectors which have been identified as reaching traffic saturation at certain times in the day. Such an analysis should enable the FAA to examine current departures and arrivals at major airports and the routes of flight in between so that traffic management solutions can be developed to alleviate the peak traffic period. The Safety Board believes this new flow control tool should significantly enhance the FAA's ability to reduce peak traffic periods in specific ATC system sectors and airspace.

As a result of its investigation, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Take immediate action to reduce the maximum acceptance rates at those airports now monitored by the Central Flow Control Facility, and place limits on en route flightplan approval to the extent necessary:

- to ensure that the peak traffic in Air Route Traffic Control Center sectors resulting from the intermixing of aircraft destined for different airports remains at or below present levels; and
- to ensure that in-flight holding is limited to unpredictable circumstances

until these factors are included in an automated predictive air traffic control system flow control program based on dynamic situation analysis. (Class I, Urgent Action) (A-87-52)

Initiate a program to solicit controller views and to analyze pertinent data such as traffic count reports from the offline analysis management program (OAMP), extracted radar data, air-to-ground communication tapes, etc., and use tools such as the aircraft situation display:

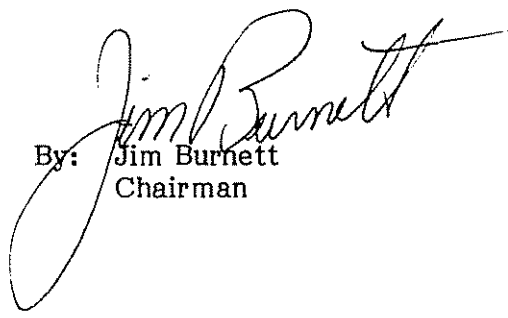
- to identify critical Air Route Traffic Control Center and Terminal Radar Approach Control sectors;
- to establish criteria for the sector maximum safe traffic density in critical sectors;
- to develop a means for predicting periods when traffic levels might approach or exceed safe limits; and

- to develop procedures or actions to prevent sector overload by alternative flight routing, revised sector design, or establishing more effective flow control measures. (Class II, Priority Action) (A-87-53)

Permit no further relaxation in flow control measures including the en route miles in-trail separation restrictions prescribing the flow of traffic in those Air Route Traffic Control Center sectors and Terminal Radar Approach Control airspace that feed the major terminal facilities, and continue to analyze and monitor the effect of previously reduced in-trail separation restrictions to determine the effect on controller workload, considering controller experience and the potential impact of summer thunderstorms. (Class II, Priority Action) (A-87-54)

Publish in Notices to Airmen or in a widely circulated Advisory Circular the locations and time periods where traffic density is approaching critical limits, and encourage nonscheduled flights to select departure and arrival times and appropriate alternate routing to avoid critical areas. (Class II, Priority Action) (A-87-55)

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

  
By: Jim Burnett  
Chairman