

Log 1708

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: July 16, 1984

Forwarded to:

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

SAFETY RECOMMENDATION(S)

A-84-69 through -74

The National Transportation Safety Board has completed its investigation into the near midair collision 1/ of Pan American World Airways, Inc., (PA) Flights PA 099 and PA 8113, which occurred about 1554 2/ on January 1, 1984, about 200 nautical miles east of Miami, Florida. The airplanes nearly collided over the Atlantic Ocean while under the control of the Miami Air Route Traffic Control Center (ARTCC) in a nonradar environment. Both airplanes were at their assigned flight levels and were operating on routes which had been approved and issued by the Miami ARTCC.

Through analysis of digital flight data recorder (DFDR) and available recorded radar data, the Safety Board's laboratory staff was able to reconstruct the flightpaths of both airplanes. The reconstruction indicated that the airplanes came within 300 feet of each other after the pilot of PA 8113 initiated an evasive maneuver to avoid a collision with PA 099. Additionally, the data indicated that the airplanes approached each other at a combined speed of about 840 knots. A midair collision may have been averted only as a result of the evasive action taken by the pilot of PA 8113. The Safety Board's analysis of data obtained during the investigation has disclosed several safety problems which the Board believes warrant immediate corrective action by the Federal Aviation Administration (FAA).

PA 099, a Boeing 747, was operating on a regularly scheduled international passenger flight from London, England, to Miami, Florida, and PA 8113, a McDonnell Douglas DC-10, was operating as a charter flight from New York's John F. Kennedy International Airport to the island of St. Maarten in the Caribbean. PA 099 was following an air traffic control (ATC) approved route on established airways from Bermuda to Exter to the Bimini radio beacon, and then direct to Miami. PA 8113 also was following an ATC-approved clearance that took the flight from Ormond Beach, Florida, direct to the Grand Bahama radio beacon, then along established airways to Grand Turk Island radio beacon, and on to St. Maarten.

1/ Near midair collision: instances in which aircrew members inform air traffic control personnel that the hazard of a collision existed between two or more aircraft.

2/ All times are eastern standard time and are based on the 24-hour clock.

About 1355, the Miami oceanic nonradar controller responsible for the ARTCC sector which PA 099 would transit as it proceeded toward Exter approved the airplane's operation at flight level (FL) 370 ^{3/} after having coordinated this approval with the appropriate New York ARTCC oceanic controller. The assignment of FL 370 for a westbound flight was a "wrong altitude for direction of flight" and although at variance with normal altitude assignment criteria, ^{4/} is authorized, providing the responsible controller coordinates with the affected adjacent sector or facility prior to the airplane's entry into that sector or facility. Such altitude assignments are used commonly by control personnel to provide vertical/altitude separation or, in many cases, to allow the users of the ATC system to operate more efficiently. The controller who approved FL 370 for PA 099 was relieved from his position at the end of his normal workshift at 1431. He stated after the incident that he had briefed his relief that PA 099's operation at FL 370 had been entered into the computer but that the altitude had not been coordinated with the controller of the next sector which PA 099 would enter. The relieving controller stated that he had been told, "everything has been coordinated." Consequently, he took no further action to coordinate PA 099's operation at FL 370 with the controller of the adjacent western sector. Even though the flight progress strip for PA 099 posted at the position had not been annotated to indicate that FL 370 had been coordinated with other sector controllers, the computer-generated flight progress strip posted at the adjacent western sector controller positions showed PA 099 at FL 370.

After the controller had been relieved and before PA 099 had passed through the sector in which the initial approval for flight level 370 was given, the controller responsible for the adjacent (western) sector coordinated between the two sectors for approval of the same flight level--370--for PA 8113 which was southeast bound. The approval was obtained about 1533. Although both controllers had flight progress strips at their positions indicating that PA 099 was at FL 370, neither controller recognized that the flightpaths of the two flights were convergent or that there was a potential conflict with both flights at the same altitude.

In all, four controllers should have observed the potential conflict from the flight progress strips posted for PA 8113 and PA 099 showing both flights at FL 370. The Miami oceanic nonradar controller had the primary responsibility to assure the separation between the flights, and the conflict must be attributed to his failure to perceive and react to the information available to him. However, redundancy in the ATC system, particularly when airplanes are operating in nonradar environments, is dependent upon reaction by all other controllers who have the opportunity to observe an impending conflict. In this case, the nonradar controller for the sector adjacent to that in which the conflict occurred and who had coordinated for the approval of FL 370 for PA 8113, the radar controller who communicated that flight level clearance to PA 8113, and the oceanic radio controller for the sector in which the near collision occurred, all had sufficient information to alert them to the situation. Further, they were obligated to inform the Miami oceanic nonradar controller of the need for action. Therefore, the failure of these redundant safeguards was contributory to the near midair collision.

3/ Flight Level—A level of constant atmospheric pressure related to a reference datum of 29.92 inches of mercury. Each is stated in three digits that represent hundreds of feet. For example, flight level 250 represents a barometric altimeter indication of 25,000 feet; flight level 255, an indication of 25,500 feet.

4/ FAA Handbook 7110.65C, Paragraph 230, requires that ATC personnel assign cardinal altitudes or flight levels based on the flight's magnetic course. Above FL 290 (29,000): Magnetic courses 000° through 179° - odd cardinal flight levels at intervals of 4,000 feet beginning with FL 290 (FL 290, FL 330, FL 370). Magnetic courses 180° through 359° - odd cardinal flight levels at intervals of 4,000 feet beginning with FL 310 (FL 310, FL 350, FL 390).

The four controllers involved in the incident stated in interviews that all positions within the sectors were adequately staffed, a supervisor was assigned and available, and traffic volume was "busy, but not excessive."

In reconstructing the events which led to the near midair collision, the Safety Board observed at least three factors which affected the controllers' ability to detect the impending conflict. First, because of the absence of coordination of the assignment of PA 099 to FL 370, contrary to normal cardinal altitude assignment practice, the controllers in the adjacent sector were not attentive to the increased potential of aircraft on converging flightpaths at the same altitudes.

Second, there was no designated (labeled) intersection where the airways being transited by the two flights crossed. Thus, the flight progress strips which were posted at the controller positions showed each flight's actual or projected progress relative to the time of passage at different geographic locations rather than their projected progress relative to a position at which their flightpaths would cross. Therefore, the controllers needed to project mentally the data shown for each of the flights to recognize that both would pass the same position about the same time. The potential conflict would have been very apparent to the controllers had routes crossed at a designated intersection since the flight progress strips for both flights would have projected the estimated time of arrival at a common geographic position. Both flights would have been projected to pass the intersection within 1 minute at the same flight level, a situation which the controllers probably would have noted.

Third, the intersection at which the conflict occurred was just beyond the limit of radar coverage for the Miami ARTCC. Since PA 099 had yet to come within the acquisition range of the radar tracking system, the conflict alert feature was not available as a backup to the controller. Had the radar coverage included the crossing intersection of the airways, the controllers would have been monitoring the convergent flightpaths and should have noted them in time to have taken appropriate action to provide separation. Had they failed to do so, the radar tracking system would have produced a conflict alert which would have drawn the controllers' attention to the impending conflict.

The Safety Board has expressed its concern repeatedly about the level of safety in the ATC system and has addressed its concern in two reports issued after special investigations of the ATC system. ^{5/} The special investigations were directed toward the poststrike rebuilding efforts and related safety issues. Two of the significant issues addressed by the Safety Board were the FAA's efforts in monitoring the effectiveness of the ATC Quality Assurance Program, specifically controller performance, and the ability of the FAA to detect the onset of controller stress or fatigue before these factors affected a controller's performance. As a result of the latter concerns, the Safety Board on May 19, 1983, issued Safety Recommendations A-83-35 and A-83-36.

During its investigation of the circumstances leading to the near midair collision between PA 099 and PA 8113, the Safety Board examined the quality assurance efforts and the working circumstances of personnel in the Miami ARTCC. Interviews conducted with management and controller staff indicated that quality assurance efforts in the center were generally "reactive," or "after the fact," rather than "active" or "preventive." The Safety Board believes that these must be preventive efforts. The facility assistant

^{5/} Special Investigation Report—"Air Traffic Control System," December 8, 1981, (NTSB-SIR-81-7), and Special Investigation Report—"Followup Study of the United States Air Traffic Control System," May 12, 1983, (NTSB-SIR-83-01).

manager for quality assurance stated that normally controller training and proficiency records were reviewed only as part of the investigation of operational errors rather than as a routine means of determining the need for training. This was exemplified by a review of the training records of the controller assigned as the oceanic nonradar controller on duty at the time of this incident. This controller, who was an area supervisor, had an unblemished record from 1976 until March 1983 when he was found to be deficient in the area of "flight data" during a routine over-the-shoulder (OTS) performance evaluation. Subsequently, he was graded deficient in the same area during an OTS evaluation in September 1983. There were no indications that these evaluations prompted any steps to correct the observed deficiencies. Moreover, the Safety Board's review of training and proficiency records selected at random indicated that the records were devoid of documentation of required proficiency training other than the OTS evaluation forms. Based on a review of informal records maintained by area supervisors (first line), Safety Board investigators determined that the required training was being completed, but not documented by the facility training department. A record of training received is considered necessary for an effective Preventive Quality Assurance Program.

Another indication that quality assurance efforts were deficient was the apparent lack of action to correct previously identified procedural shortcomings brought to facility management's attention by employee suggestions. These suggestions concerned flight progress strip markings and the coordination of altitude assignments where the assigned flight level was not the normal cardinal altitude assignment. Documents examined after the incident showed that related problems were defined and suggestions for improvement were submitted by controllers to the Facility Advisory Board in April 1983. The Safety Board is aware that improved procedures for marking flight progress strips were implemented in January 1984 after the near midair collision between PA 099 and PA 8113.

Its investigation of this incident has reinforced the Safety Board's concern that evaluation of controllers' physiological or psychological state, particularly with regard to the effects of stress and fatigue, is not being sufficiently emphasized. The controllers in the Miami ARTCC had been working an average of 46 hours per week for 6 months prior to this incident. Before the 1981 ATC strike, controller personnel were normally scheduled and worked a 40-hour workweek. The present staffing will not permit a reduction in the amount of scheduled overtime, and additional staffing is not currently in sight. The 64-year-old nonradar oceanic controller involved in the handling of the two aircraft during this incident had worked 6 days a week during 7 of the 9 weeks preceding the incident. He also had worked two consecutive midshifts (2300-0700) during the 2 weeks before the incident. Research studies 6/ have indicated that single midshift assignments are preferable to consecutive midshift assignments because the former does not significantly disturb circadian rhythms. These studies recommend that workers be given at least a full day off to recover following a midshift assignment. Another study 7/ suggests that tolerance and adaptability to shift work decrease with age. The majority of controllers who were interviewed stated that they believed that shift work was a form of stress for them. Furthermore, all of the controllers expressed a desire to end or cut down on the amount of overtime they are currently working.

6/ Rutenfranz, Joseph, Peter Knauth, and Dieter Angersbach, "Shift Work Research Issues," p. 251; and Akerstedt, T., Shift Work and Health. Interdisciplinary Aspects," in R.G. Rentos and R.D. Shepard (Eds.), Shift Work and Health. (NIOSH No. 76-203), Washington, D.C., HEW publication, 1976, pages 179-197.

7/ Johnson, L., et. al., The Twenty-four Hour Workday: Proceedings of a symposium on variance in work-sleep schedules, NIOSH Publication No. 81-127, July 1981.

Although it is impossible to evaluate objectively the effects of stress and fatigue as factors in the performance of the controllers who were on duty at the time of this incident, the Safety Board is concerned that the effects of shift work and prolonged overtime on controller performance are not sufficiently recognized. In its response to Safety Recommendation A-83-35 dated August 24, 1983, the FAA stated that it agreed with the need for the recommended actions and was disseminating a discussion paper on stress and fatigue to all controllers and supervisors, to be followed by a 1-hour video presentation on stress and stress management. Safety Board investigators learned during their on-scene investigation that the subject video tape had been available at the facility for about 1 month but only the facility's assistant air traffic manager had viewed the tape. None of the controllers, supervisors, and staff specialists interviewed had viewed the tape, nor had management developed a schedule to achieve this objective. Additionally, the assigned flight surgeon at the Miami ARTCC stated that he was not aware of the video presentation. The discussion paper referred to in the FAA's August 24, 1983, letter was issued by the Federal Air Surgeon on February 29, 1984, as an information memorandum entitled "Warning Signs of Employee Distress." Regional Flight Surgeons were directed to send this memorandum to all ATC facility managers.

During an interview, the assigned flight surgeon stated that although he usually walks through the control room on a daily basis, he has received no formal direction from the Regional Flight Surgeon or from the FAA's Office of Aviation Medicine regarding the monitoring of controller stress and fatigue. He stated that he would respond to observe specific individuals if performance difficulties were brought to his attention by control personnel, first-line supervisors, or other facility management. The Air Traffic Manager (ATM) stated that he did consult routinely with the assigned flight surgeon before returning individual controllers to ATC duties following an operational error. The assigned flight surgeon stated that he did not interview or examine the four controllers involved in the incident cited before they were returned to normal duties. The ATM indicated that there is no procedure for the Regional Flight Surgeon to monitor stress and fatigue within the facility. The assigned flight surgeon's primary role as the facility flight surgeon is performing annual physical examinations for assigned ATC personnel and handling walk-in "sick call" items. Additionally, in his capacity as an assistant regional flight surgeon, he performs annual physical examinations for other air traffic control and FAA personnel within the local commuting area and monitors aviation medical examiner's and airman's physical examinations in the south Florida area. These collateral duties might dilute the assigned flight surgeon's attention to a facility program to detect controller stress and fatigue.

The Safety Board cannot accept the FAA's actions to date as being responsive to Safety Recommendations A-83-35 and -36, and continues to urge that the FAA take further actions to:

Standardize and disseminate immediately as an interim measure basic guidelines and methodology for controller stress and fatigue detection and management, similar to those currently in use by some flight surgeons and facility supervisors and those developed by the Federal Aviation Administration's Office of Aviation Medicine personnel, to the air traffic control supervisors to assist them to detect and alleviate stress and fatigue among controllers. (Class II, Priority Action)
(A-83-35)

Expedite the development and implementation of the Air Traffic Controller Performance Assessment Program currently being developed by the Federal Aviation Administration's Office of Aviation Medicine to assist air traffic control facility supervisors and managers to objectively and subjectively evaluate controller performance and to detect and alleviate stress and fatigue among controllers. (Class II, Priority Action) (A-83-36)

Additionally, the Safety Board concludes that the specific circumstances leading to this incident indicate the need for remedial action to insure coordination between controllers of a sector and controllers of adjacent sectors and to insure that flight progress strip marking procedures are both standardized and adhered to in order to provide for timely and complete transfer of relevant information for traffic separation in a nonradar environment.

The Safety Board is aware that the FAA plans to expand radar coverage over the ocean in the Miami ARTCC by activating radar installations with a 200-nautical-mile range at Nassau, Bahamas, and Grand Turk Island. We understand that these installations are scheduled to be commissioned by January 1985. Miami ARTCC personnel and regional office personnel have informed the Safety Board that data from these remote radar installations will be transmitted via submarine cable. The cable will be the sole means of transmitting the radar data until a satellite channel is obtained by the FAA from a satellite common carrier. ^{8/} The FAA's Southern Regional Office personnel stated to Safety Board investigators that it would take about 12 months to obtain a satellite channel once a formal request was filed and that as of May 30, 1984, the FAA had not yet requested a satellite channel. During the on-scene portion of the investigation, investigators monitored very high frequency (VHF) radio communications from the Miami ARTCC's remote air/ground radio site located on Grand Turk Island that utilizes the existing submarine cable and found the relayed radio transmissions were distorted and somewhat garbled. Additionally, investigators were informed that the existing cable occasionally is out of service. The Safety Board is concerned that data from the new radar sites at Nassau and Grand Turk may not be reliable when transmitted via submarine cable, and therefore, not useable on a continuous basis. If so, air traffic controllers would not be provided an uninterrupted radar coverage and the means of alerting the controller to potential conflicts. Therefore, the Safety Board urges that the FAA expedite the necessary actions to enhance the overwater radar coverage and communications capabilities of the Miami ARTCC.

Accordingly, as a result of its investigation of the near midair collision between PA 8113 and PA 099 on January 1, 1984, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Institute recurrent training for all air traffic control personnel which emphasizes the need for strict adherence to existing position relief briefing procedures to assure a timely and complete transfer of essential information. (Class II, Priority Action) (A-84-69).

Modify flight progress strip marking procedures pertaining to "wrong altitude for direction of flight" assignments to uniformly require inclusion of a notation regarding the status of the transfer of relevant information to other controllers. (Class II, Priority Action) (A-84-70).

^{8/} Satellite common carrier: The term used within the satellite communications industry to denote a company or corporation who owns or operates by leasing, existing or planned communications satellites and associated ground stations.

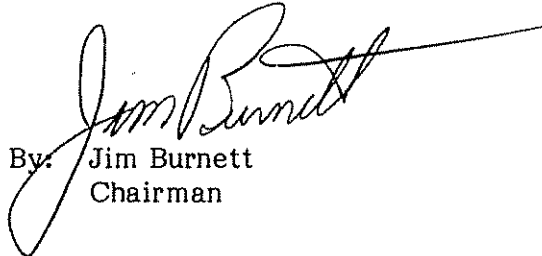
Require as part of each facility's Quality Assurance Program that the Regional Flight Surgeon or his designee examine air traffic control personnel who have been involved in an operational error or similar incident before they are allowed to return to operational duties. (Class II, Priority Action) (A-84-71).

Expedite the acquisition of sufficient satellite channels to provide the Miami ARTCC with uninterrupted radar service in the area of proposed expanded radar coverage. (Class II, Priority Action) (A-84-72).

Acquire sufficient satellite channels for the Miami ARTCC to improve the quality and reliability of radio communications transmitted to/from remote island facilities. (Class II, Priority Action) (A-84-73).

Review the route intersections currently used for computer-generated flight progress strip postings in the Miami ARTCC oceanic area and designate additional intersections as necessary to assist controllers to detect more reliably potential crossing traffic/route conflicts within the nonradar environment. (Class II, Priority Action) (A-84-74).

BURNETT, Chairman, GOLDMAN, Vice Chairman, BURSLEY and GROSE, Members, concurred in these recommendations.


By: Jim Burnett
Chairman